

INDEX - ARCHERY

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ARCHERY FIRST SHOT FUNDAMENTALS

HAVE RANGE SET-UP BEFORE STUDENTS ARRIVE, POST RANGE RULES, HAVE EQUIPMENT READY, BLANK TARGET

1) Safety Orientation Class

- A. Eye Dominance
- B. Jewelry, Long Hair, etc.
- C. Enter Range: Range Officer (**Easily identifiable so people know who to contact**)
- D. Hand out Equipment (Except for Bows)
 - 1) Arm Guard, Finger Tab or Glove
 - 2) Quiver
 - 3) Measure Archers for Arrows (**3 Arrows** in Quiver)
- E. Explain **Safety Rules, Whistle Commands, Range Procedures & Pulling Arrows** as a Group on Waiting Line
- F. Demonstration (Group on Waiting Line) – During the demonstration, instructor names & points out bow and arrow parts necessary for youth to understand essential terms for those first shots. This would include the Eleven Steps to The Ten Ring.
 - 1. Shooting
 - Stance & Posture
 - Nock Arrow
 - Set Hook
 - Set Bow-Hand Grip
 - Raise & Extend Bow
 - Draw
 - Anchor
 - Aim
 - Release
 - Follow Through
 - Relax & Evaluate
 - 2. Dropping Arrow
 - 3. Retrieving Arrow
 - 4. Pulling Arrow
 - 5. Lost Arrow (Arrow Top of Target Butt)
 - 6. Carrying Arrows
- G. **Safety** Reminders
 - 1. Always Keep Arrows Pointed Down Range
 - 2. Only Shoot Target in Front of You
- H. Select Bow (Safety: **NO DRY FIRING**)
 - 1. Flight 1 – Select Bows
 - Archers Shoot First End of 3 Arrows (1st Arrow with Instructor)
 - Pull Arrows (Range Officer Last to Walk Back)
 - 2. Flight 2 – Select Bows, Shoot Pull Arrows
 - 3. ETC.

THE ELEVEN STEPS TO THE TEN RING

1) Stance & Posture

- a) Place one foot on each side of shooting line.
- b) Find a comfortable balanced stance with feet shoulder width apart.
- c) Stand straight, keeping ribs and chest down, and bottom tucked under. Keep shoulders down and relaxed.

2) Nock Arrow

- a) Place arrow on arrow rest, holding arrow close to nock.
- b) Keep index fletching pointing away from bow.
- c) Snap nock of arrow onto bowstring under nock locator.

3) Set Hook

- a) Set first groove of first three fingers around the bowstring under the arrow nock creating a hook.
- b) Keep back of drawing hand flat and relaxed.
- c) The thumb and pinky should be tucked away.

4) Set Bow-Hand Grip

- a) Position the bow-hand on the bow grip by making a Y with the fingers and thumb.
- b) The knuckles of the fingers should be positioned at a 45-degree angle and the thumb pointed towards the target.

5) Raise & Extend Bow

- a) Raise bow arm and string hand together towards the target, while keeping shoulder down and aligning chest perpendicular to target.
- b) Drawing arm should be near level of nose.
- c) Bow arm should be rotated so it is straight up and down.

6) Draw

- a) Draw the string back in a straight line from raising and extending bow (step 5) to the side of the face anchor point.
- b) Set drawing arm shoulder back and down until elbow is directly behind or a bit higher than arrow.

7) Anchor

- a) Draw string to side of face placing tip of first finger on corner of mouth.
- b) Keep hand snug against face folding thumb down and little finger towards palm.

8) Aim

- a) Look at target or through sight, keeping focus on form.
- b) Focus on the point of aim if not using sight.
- c) If using sight, then focus on the point you want to hit.
- d) Keep string lined up with center of bow.

9) Release

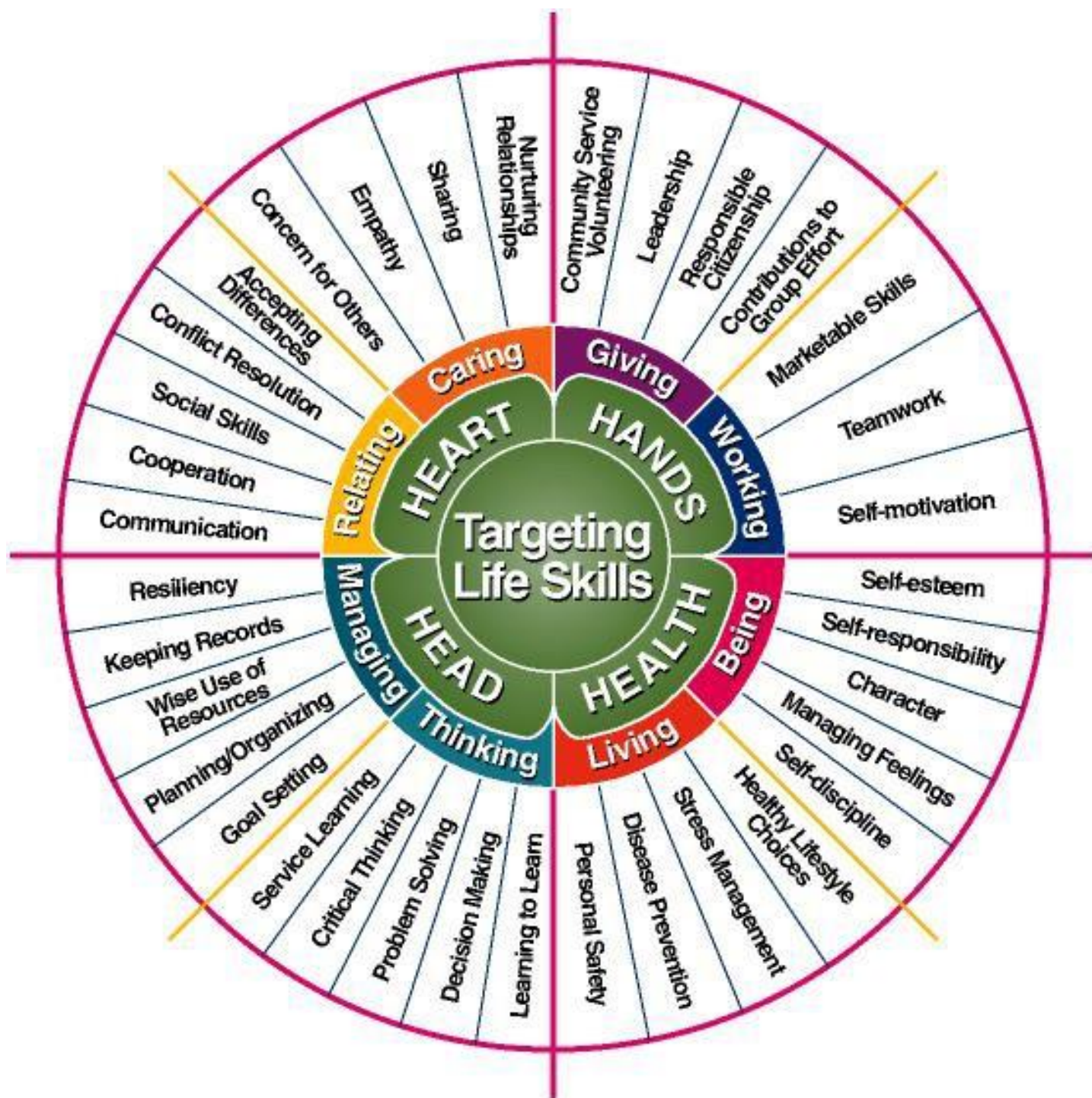
- a) Release all tension in fingers and drawing hand, all at once, while continuing to draw bowstring back without stopping.
- b) Continue bow arm towards target.
- c) Continue focusing on target.

10) Follow Through

- a) The drawing hand should continue back beside neck with fingers relaxed and ending up behind the ear.
- b) Keep bow arm up.
- c) Maintain follow through until arrow hits target.

11) Relax & Evaluate

- a) Relax after each shot.
- b) Evaluate the feeling of each shot to determine if you accomplished the goal you were trying to achieve.
- c) If not, you should refocus your efforts on the feeling of the proper shot and try again.



Iowa State 4-H Youth
Development – Targeting
Life Skills Model
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THE TEN COMMANDMENTS OF ARCHERY SAFETY

- 1) I will always treat my bow and arrows as a firearm and not point them at anything that I do not intend to shoot.
- 2) I will not nock my arrow or draw a bow when a person is in front of me, and I will always shoot toward a target.
- 3) I will never "dry" fire a bow without an arrow (pull back on a bow string with no arrow in place).
- 4) I will never shoot an arrow straight up.
- 5) I will never release an arrow where I cannot see the entire flight of the arrow.
- 6) I will never shoot an arrow that is too short for my draw or too weak for my bow.
- 7) I will not shoot at a target that is too thin to stop my arrow.
- 8) I will not shoot toward houses, highways, livestock, or where there are people.
- 9) When shooting with another person, I will not go forward to retrieve my arrows until an "all clear" sign has been given. When looking for arrows beyond the target, I will set an arrow in the top of the target to warn others that I am behind the target.
- 10) I will not use damaged equipment. I will check arrows before shooting, for loose feathers/vanes, points, and nocks, and repair before using. I will check for frayed strings and inspect arrows and bows for cracks, and destroy them if damaged in this way.

Introduction

Using the Basic Archery Lesson Plans

Ronald A. Howard Jr.,

Archery involves a fascinating group of sports for people of all ages. The fundamentals are simple. The requirements are few. A new archer can be shooting well within a short time, if he or she has the benefit of a planned approach to developing the basics of form.

The lessons outlined in this section of the *4-H Shooting Sports Guide* cover the basics of archery. They present the beginning archer with a broad, sound foundation for learning the discipline and enjoying archery over a lifetime. Many approaches have been used to teach archery. Some are effective; others interfere with learning. The approach in these lessons has proven successful with young people and adults across the country. The lessons are my own, but no lesson plan springs from a vacuum. The ideas, efforts and assistance of many other people contributed to their current form. Jim Mackey introduced me to good archery form and tutored my early development. Lloyd Brown and Charlie Kroll had strong influences during the regional shooting sports workshops, as did every instructor, neophyte or tournament archer who participated. The Old Bowhunter, Bill Wadsworth, and many colleagues in bow hunter education developed, talked through or demonstrated many of the techniques and approaches used. Hundreds of young people were test cases without knowing their contribution. Numerous publications also had an influence. Some are cited as references; others remain anonymous building blocks of thought, style or philosophy.

Archery Marksmanship and Safety

These lessons from the fundamental core of basic archery marksmanship instruction. The safety section may be shortened if the young people are already familiar with shooting safety. Only the safety considerations of archery equipment and shooting may need to be covered. The sequence of the first four lessons, however, was carefully and deliberately chosen to maximize learning and minimize the risk of developing form faults. Avoid the temptation to jump directly to sight shooting with compound bows. Instinctive shooting with light (15-to 25-pound draw weight) re-curve bows optimizes shooting form development, so good shooting principles are best established in that context. Note the value of repetition in several of the lessons. Try to avoid rushing the learner through development of their basic skills. The repetition is helpful.

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If you have lesson plans that have proven themselves effective, use this series only to make a good thing better. If not, try this sequence as a means of introducing kids to archery. This portion of the material (safety, basic archery form, instinctive shooting and sight shooting) should be an absolute minimum of instruction for all beginning archers. It may prove to be a helpful review for those with more experience.

Understanding Archery Equipment and Competitive Events

The lessons on the compound bow, bow tuning and making archery equipment are taught as part of the basic core by some instructors. Others reserve them for slightly more advanced participants.

Shooting compound bows allows the archer to shoot a heavier bow with faster arrows. The higher efficiency and engineered advantages with heavy draw weights have made compound bows extremely popular with bow hunters. Target archers also have discovered those advantages. Aside from the additional tuning and safety considerations for compound bows, the fundamentals of good shooting remain the same.

Bow tuning and equipment making sessions are excellent programs for rainy or cold weather lessons when an indoor activity is needed. The skills involved increase the ability and satisfaction of the archer. In addition, the items may be exhibited by the participants.

The archery game lesson introduces a few of the target shooting games available to the archer. The lesson exposes young people to the games through classroom activity or field experience. Young people may find their interests are broadened by discovering FITA (Olympic-style shooting), USAA, NFAA, IBO or other types of formal target events. Target games that keep the learning *fun* keep interest high for young people. They have great value to the leader, coach or instructor. Clout shooting and flight shooting take advantage of the beginning archer's urge to see how far an arrow will go. Shooting flying targets with flu-flu arrows attracts attention and interest. Add your ideas to make the shooting exciting and fun. Those elements are vital to continued success.

Bowhunting

The subject matter covered in the bow hunting series is complex and sometimes demanding. Like the other archery disciplines, bowhunting depends on developing fundamental skills before applying them to a discipline. Ethical considerations and values education are focal points of bowhunting instruction. Bow hunting introduces several additional needs, responsibilities and skills for the archer. The standards in bow hunter education are set by the National Bow Hunter Education Program (NBEP), developed by the National Bowhunter Education Foundation. These lessons draw strongly on that program. Many states, provinces and several other countries have adopted that instruction as the basis for certification programs in bowhunting. Normally that requires at least 8 to 10 hours of instruction by qualified instructors. The 4-H Shooting Sports Program endorses this established program, just as it endorses the use of state hunter education programs. Interested and qualified leaders are strongly encouraged to become certified as NBEP instructors through their state coordinators. An excellent instructional outline is available through NBEP, but this guide outlines lessons to be presented in a series of short 4-H club meetings.

Fundamentals of Archery Marksmanship and Safety

- Basic Archery Lesson 1- Archery Equipment, Safety and Range Commands
- Basic Archery Lesson 2 - Developing Proper Archery Shooting Form
- Basic Archery Lesson 3 - Instinctive Shooting with a High Anchor
- Basic Archery Lesson 4 - Shooting with Sights

Understanding Archery Equipment and Competitive Events

- Basic Archery Lesson 5 - Shooting Compound Bows
- Basic Archery Lesson 6 - Making Archery Equipment
- Basic Archery Lesson 7 - Bow Tuning
- Basic Archery Lesson 8 - Target Archery Games

Basic Archery Lesson 1

Archery Equipment, Safety, and Range Commands

Ronald A. Howard Jr.*

Objectives

Participating young people and adults will:

1. Become familiar with the history of archery.
2. Understand the basic rules of safe archery shooting.
3. Recognize and understand the range commands being used in the program.
4. Recognize and demonstrate various pieces of archery tackle and their parts.
5. Determine eye dominance.
6. Learn how to select an appropriate bow.
7. Learn how to string and unstring a recurve bow properly.
8. Have fun while learning.

Roles for Teen and Junior Leaders

- Present portions of the lesson.
- Lead demonstrations.
- Tutor or quiz participants on identifying equipment and accessories.
- Act as range officers for demonstrations.
- Assist in setting up bows for next session.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Arrange for transportation to meeting site.
- Arrange for refreshments.
- Deliver parts of the program.
- Demonstrate shooting safety points.

Best Time to Teach

Any time of year but prior to live shooting

Best Location

Classroom or other comfortable site

Time Required

About 40 minutes to 1 hour

Materials/Equipment

- longbow, recurve bow and compound bow
- wood, fiberglass, aluminum, and graphite arrows
- set up target bow (if available)
- set up hunting bow (if available)
- assorted bow stringers (see Fact Sheet: *Bow Stringers*)
- arm guard, finger tab and shooting glove
- release
- bow square
- nocking points and point pliers
- masking tape and marking pen, whistle
- tape or rope for shooting line

References

National Archery Association, Instructor's Manual, third edition. P. Baier, J. Bowers, C.R. Fowkes and S. Schoch.

National Archery Association of the U.S., Colorado Springs, CO. 1982.

Archery: Steps to Success. K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.

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Archery: A Planning Guide for Group and Individual Instruction. J.W. Smith, ed.

American Alliance for Health, Physical Education, Recreation and Dance, Reston, VA. 1972.

Bowhunting Deer: International Bow Hunter Education Manual W.H.

Wadsworth. International Bowhunter Education Foundation. Murray, KY. 1978.

4-H and Youth Development Specialist, Texas Agricultural Extension Service.

Teaching Outline

Presentation

I. Origins of archery

- A. Hunters and warriors
- B. Shooting at “long” range
 - 1. Hunting or warfare
 - 2. Target shooting
- C. Types of early bows
 - 1. Self and composite bows
 - 2. Shapes and length
- D. Modern archery (mid – 1800’s)
 - 1. Influence of Civil War
 - 2. Ishi, Saxon Pope, Art Young
- E. Developments in materials and engineering
 - 1. Bow technology
 - fiberglass, graphite, and laminated limbs
 - compound bows
 - wheeled bows
 - cam bows
 - cam-limb bows
 - overdraws
 - sights
 - 2. Arrow technology
 - shaft material
 - fletching
 - 3. String changes
 - Dacron
 - Kevlar
 - Fast Flight
 - cables
- F. Similarities to the old days
 - 1. Hand-eye coordination
 - 2. Need for practice
 - 3. Shooting principles
 - 4. Safety considerations

II. Archery Safety

- A. Arrows
- B. Actions
 - 1. Penetrating
 - 2. High momentum
 - 3. Low shock
 - 4. Dangerous until stopped

Application

DISPLAY illustrations of early hunters, American Indians or ancient warriors.

ASK – for how long was the bow the main tool of the hunter and weapon of the warrior? Try to get answers spanning pre-history to the 1600’s.

DEMONSTRATE equipment as it is discussed. ANSWER questions as the group poses them.

ASK – how is archery the same today as it was long ago? Look for answers mentioned here.

DEMONSTRATE penetration and shock differences between arrows and bullets if a safe range is available. (*See Fact Sheet 20: Penetration and Shock.*)

- C. Relative penetration ability
 - 1. Greater than rifle
 - 2. Straight up dangerous
- D. Offensive parts
 - 1. Arrow at both ends
 - 2. Fletching
 - 3. Bow limbs
 - 4. String
 - 5. Nocking point indicator
- E. Faulty, inadequate, or mismatched equipment
- F. Weapon or fun?
 - 1. Your choice
 - 2. Mental control or physics
 - 3. Yours while on the string
 - 4. Need for respect and care
 - user responsibilities
 - enforcing safety
- G. Principles of archery safety
 - 1. Clear zone of fire
 - 2. Pointed
 - 3. Target identification
 - 4. Watch nocks and points
 - 5. Loaded only for shots
 - 6. Always treat with respect
 - 7. Avoid shooting if tired, distracted or under the influence of any drug
 - 8. Be extremely careful when retrieving arrows
 - 9. Be sure all tackle is in perfect working condition and free from damage
 - 10. Always hold to strictest codes of conduct, ethics, and sportsmanship

ASK – why is an arrow shot straight up dangerous?
DISCUSS responses.

USE an air bow or a demonstration shot in a safe area to stimulate thinking.

ASK – what are some of the possible safety concerns with archery tackle or shooting?
ADD any items they fail to mention.

ASK – what make the difference between a weapon and a recreational tool? Work for answers that stress the intent and use of the equipment.

DISCUSS firearms safety and how it relates to archery safety. ASK – what differences between bows and firearms result in changes in safety considerations.

DISCUSS penetration and sharp points on both ends of arrows. DISCUSS also the need for a larger cleared area for the limbs to operate safely.

III. Orientation to Archery Tackle

- A. Bows
 - 1. Riser
 - grip or handle
 - arrow shelf
 - sight window
 - handedness
 - arrow rest
 - arrow plate
 - plunger or button

ILLUSTRATE/DEMONSTRATE each item as it is discussed. Be sure all participants can see clearly

2. Limbs
 - face or belly
 - back
 - tips and string nocks
 - cams or eccentric wheels
- B. Bowstrings
 1. Construction
 - Dacron, Kevlar or Fast Flight
 - one-looped strand
 2. Servings
 - end loops
 - center (mono)
 3. Nocking point indicator

DISCUSS advantages and disadvantages and uses of each material.

- C. Arrows
 1. Shaft materials
 - wood (cedar)
 - fiberglass
 - hollow
 - solid
 - graphite tubing
 - aluminum alloy
 2. Spine or stiffness
 - matched to bow
 - need for matching
 3. Nocks
 - string holding device
 - different types
 4. Points
 - target points
 - field points
 - broadheads
 - blunts
 - other types
 5. Fletching
 - feathers and vanes
 - index (cock) vane
 - types of fletching
 - straight
 - offset
 - helical
 - flu-flu
 - purposes
 - matching to use
 - target
 - hunting
 - others

ILLUSTRATE “archer’s paradox” – need to bend to fly straight

6. Cresting or signature
 - decoration and identification
 - identifying each shaft individually

D. Other accessories

1. Arm guard
 - purposes
 - location
2. String-hand protection
 - finger tab
 - clean release
 - how worn
 - shooting glove
 - mechanical release

E. Quivers

1. Types of quivers
2. Purpose of quivers
3. Types used here

IV. Eye Dominance

A. Determining eye dominance

1. Importance of master eye
 - naturally
 - ease in retraining hands
 - difficulty in retraining eyes
2. Use partner method
 - overlapped hands
 - looking at partner's nose
 - bringing hands to eye
 - watch for "cheating"
3. Selecting bow for eye dominance
 - string-hand and dominant eye on same side
 - sight window on bow- hand side (opposite side from dominant eye)

B. Terminology for instructions

1. String-hand side
 - dominant-eye side
 - refers to drawing hand
2. Bow-hand side
 - off or non-dominant side
 - hand that holds bow

DEMONSTRATE use of arm guard and finger tab or glove. ASK – what is main purpose of arm guard? Lead them to conclude: 1) keeping the clothing away from the string and 2) preventing string slap.

Have participants PUT ON a tab with supervision and help.

DEMONSTRATE how to determine the master eye. Have participants pick a partner and determine their master eye. (*See Fact Sheet 3: Determining Eye Dominance.*)

ILLUSTRATE bow selection. HELP each participant pick a bow for their eye dominance.

Have each archer stand with their bow hand toward their partner and draw their string hand back. CHECK to be sure they understand the terminology.

V. Safe stringing techniques

- A. Safety for archer and bow
 - 1. Unacceptable methods
 - step-through
 - push-pull
 - 2. Acceptable methods
 - cord stringers
 - wall stringers
 - box stringers
 - bow presses
 - bow relaxers

- B. Caution about dry firing

DEMONSTRATE, without stringing the bow, the dangers to archer or bow in using these methods. STRESS that they are NOT RECOMMENDED.

DEMONSTRATE proper use of one or more bow stringing devices. Have archers PRACTICE stringing and unstringing bows under supervision of adult or junior leaders.

VI. Range Procedures

- A. Relationship to other shooting
 - 1. Need for control
 - 2. Need to assure safety
 - 3. Everyone responsible
 - watch for unsafe conditions
 - obey all commands immediately
- B. Whistle system/Voice commands
 - 1. Two whistle blasts – “Archers to the shooting line”
 - archers walk carefully to the shooting line
 - one foot on either side of the shooting line
 - keep arrows in quiver,
 - 2. One whistle blast – “Commence firing”
 - remove arrows one at a time from quiver, load bow, shoot at target
 - when all arrows have been shot, step behind waiting line, place bow on rack, wait for signal to walk forward to remove arrows from the target
 - 3. Three whistle blasts – “Retrieve arrows”
 - walk carefully toward your target to retrieve arrows
 - stop at the target line for additional instructions

DISCUSS a useful set of range procedures. LIST some reasons for standard range commands. REVIEW archer responsibilities.

DISCUSS appropriate ways to be sure commands are obvious. ILLUSTRATE each one using adult or junior leaders.

HAVE each archer work through a series of commands without equipment.

ASK – why should the line captain be the first one down range?

ASK – why is it important to limit the number of people at a target? EMPHASIZE potential danger from nocks on pulled arrows.

4. Four or more whistle blasts in rapid succession – “Cease fire”
 - dangerous condition
 - stop shooting, even if ready to release
 - place arrow back in quiver
 - wait for signal to resume shooting
 - watch for undershot arrows
 - danger to archers
 - * sharp nocks
 - * tripping
 - danger to shafts
 - bending or breaking
 - line captain observes searches for overshot arrows
 - signal to other archers
 - * bow over target
 - * arrow upright
 - search as a group
 - line captain returns to line last
 - tell archers to be prepared to shoot next meeting

ASK – why is it important to watch where you are stepping? EMPHASIZE the damage to either anatomy or arrows.

ASK – why must persons be so careful when looking for overshot arrows? STRESS being out of sight down range.

ASK – why should the line captain be the last one back

- C. Field shooting changes
 1. Toe to line or stake
 2. Bow across target face
- D. Spacing on shooting line
 1. Beginners at least 2 to 3 meters (6 to 10 feet) apart
 2. More advanced archers need less room
 3. Change in arrow handling
 - arrows nocked on upright bow
- E. No bows drawn or arrows nocked except on shooting line
- F. Range behavior and etiquette
 1. Appropriate clothing
 2. Distraction
 3. Sportsmanship and ethics

DEMONSTRATE proper way to nock an arrow, first using the bow as a shelf (beginners), then coming straight over shoulder and upper limb.

EMPHASIZE the need for concentration, respect for others and caution in all forms of shooting.

VII. Conclusions

- A. Archery is as safe as YOU make it
- B. Basics have not changed with technology advances
- C. Range safety is everyone’s job
- D. Proper bow handling is ease and mostly common sense
- E. Some possible exhibits
- F. Next time we start shooting

REINFORCE points of safety and range behavior. EMPHASIZE the need for all archers to be actively involved in the safety of their sport

Lesson Narrative

Introduction

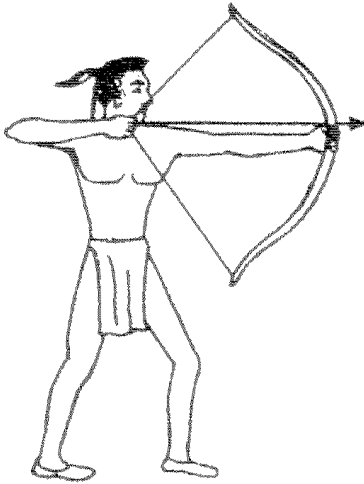
Archery equipment has been used by hunters and warriors since prehistoric times. The bow could be shot at long ranges, allowing the archer to stay away from potentially dangerous animals or enemies. Archery target shooting is also old. Without a doubt, even cave dwellers held contests to see who could shoot the best.

Early bows ranged from simple staves of wood that were shaped for better performance to strongly re-curved bows that were reinforced with horn, bone or sinew to increase toughness, speed or cast. Bows were designed to meet specific needs. Those to be used while standing or walking were much longer than those used while riding horseback. Thus, the **English longbow** was a far different design than the short, **re-curved bows** used by the Mongols and the Turks.

Modern American archery dates from the middle of the 19th century. As the war between the states ended, many people who had to live off the land were denied access to firearms. They relied on bows to live. The Compton brothers wrote of their experiences with the bow during that period. When Ishi, the last Yana Indian, taught the art of making and hunting with archery equipment to Art Young and Saxon Pope, those men began to popularize bowhunting. The rebirth of archery in the United States began.

Developments in materials and engineering produced a number of resilient substitutes for wood. Laminated bows used the strength and cast of fiberglass and the lightness of wood to increase the speed of the bow. Designs changed, adding cast by re-flexing or re-curving the limbs. Still later, mechanical advantages were added as compound bows were developed and their limbs were fitted with eccentric wheels, cams or even crammed limb tips to make the bows faster still.

During this time, other parts of the archer's equipment were also changing. Arrow material changed from wooden dowels to fiberglass, aluminum, or graphite tubes. **Fletching**, once mainly turkey or waterfowl feathers, now includes both hard and soft plastics. Strings went from woven strands of waxed linen to Dacron, Kevlar or Fast Flight strands with monofilament servings. Arrow shelves were extended toward the string, permitting use of shorter, lighter arrows, producing less arrow flex and greater arrow speed. Sights were added to enhance accuracy and to assist in precise shot placement.



Archery moved into the age of technology, but it continues to be a sport involving hand-eye coordination, consistency, and the need for practice to become proficient. Archery remains a sport with relatively slow projectiles shot over relatively short ranges. Basic knowledge and awareness of common safety considerations are necessary for safe, responsible, and enjoyable use of archery equipment. Let's look at some archery equipment and ways for using it safely.

Archery Safety

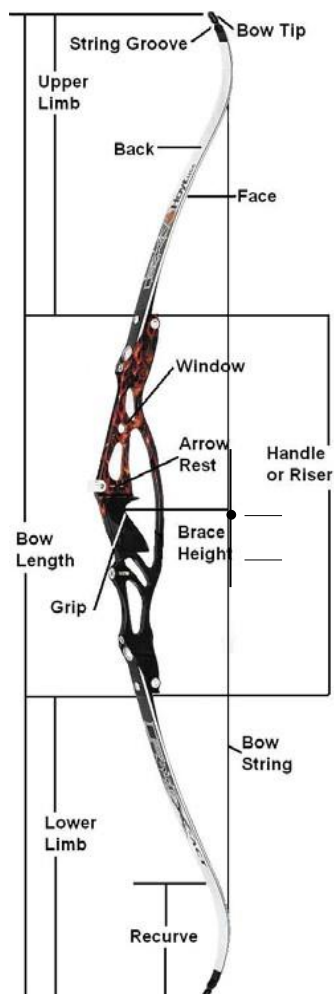
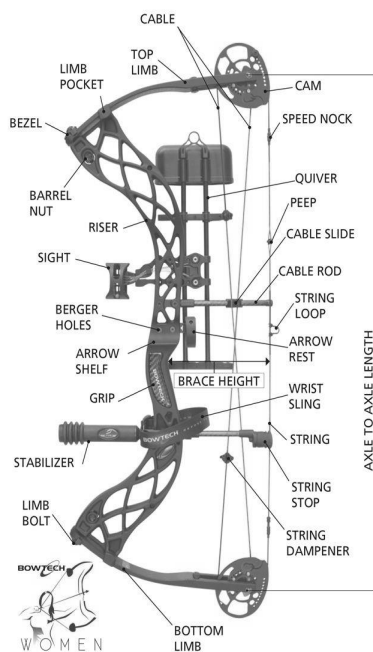
Arrows are dangerous until they come to a complete stop. The entire flight path, from release until the arrow stops, must be clear and safe. This is the same as having a safe field of fire with a firearm. As with firearms, the arrow should only be pointed in a safe direction. Unlike firearms, however, straight up is not a safe direction. An arrow shot straight up poses an extreme danger while a bullet shot straight up poses very little threat. The arrow is much more dangerous than a high - powered rifle in that situation.

Archery equipment is designed to penetrate with a heavy, relatively slow projectile that has a large amount of momentum. Even target bows have enough momentum to drive an arrow through a human being. Arrows produce very little shock (**hydrostatic shock**) on impact, but they penetrate much more effectively than rifle bullets. That fact can easily be demonstrated by shooting both types of projectiles into a container of sand or a hay bale. Unlike firearms, archery equipment has multiple points of potential danger to the user or persons standing nearby. The point of the arrow, the arrow's nock, the tips of the limbs, the nocking point indicator and the string and/or cables of the bow all can produce an injury. Faulty, inadequate, or mismatched equipment can also pose a threat to safety.

Bows and arrows can be dangerous penetrating tools, or safe, exciting, and entertaining recreational arms. The difference lies in the mind and the control of the user. While the arrow remains on the string and the string is in your fingers, the arrow is under your mind's control. When the string is released your control comes to a stop and the law of physics takes over.

Archery equipment must be treated with respect and care. All the principles for safely handling firearms apply to archery equipment as well. The user alone is responsible for safe, responsible, and appropriate use. If any doubt exists about the absolute safety of a shot, do not release the string. The safety of archery is in your hands. So, it is essential that simple principles of safe shooting be accepted and enforced. Many of the principles of safe shooting can be summarized in these simple statements.

1. Always be sure that the path to the target and beyond is clear.
2. Never point a drawn arrow at anything you do not intend to shoot.
3. Always be certain that the target is clearly visible, safe to shoot and appropriate.
4. Always be aware of the danger areas at the end of the arrow and the tips of the limbs.



5. Place an arrow on the string only when you are ready to take a shot. Never fool around with your archery tackle. Respect it.
6. Never use archery equipment while your mental ability is impaired by fatigue, distractions, or the influence of any drug.
7. Always exercise caution when retrieving arrows or removing them from a target.
8. Always be sure that all archery tackle is in perfect working condition and free from damage before it is used.
9. Always abide by the strictest codes of behavior and ethics applied to the archery sport in which you are participating. Including specific range rules.

Perhaps you can think of others that might be added.

An Orientation to Archery Tackle

Bows

A bow consists of a handle or **grip**, a center section (**riser**) and a pair of **limbs**. The grip or handle is usually shaped to permit the bow hand to seat well. Just above it is a cut out area known as a **sight window**. The sight window is on the left-hand side of the bow for right-handed archers and on the right side for lefties. The **arrow shelf** is at the bottom of the sight window. It normally is not used to support arrows in modern bows. Instead, an **arrow rest** is positioned just above the shelf. The portion of the rest that lies along the side of the sight window is called an **arrow plate**. Sometimes it is adjustable. Often archers install a spring-loaded **plunger** or button to aid in tuning the bow. The entire riser section may be constructed of the same materials as the limbs, or it may be a separate piece of wood or metal. The limbs are usually solid fiberglass, graphite or laminated glass and hardwood. Conventional bows (recurve bows and longbows) have nocks at the end of each limb to hold the string in place. Compound bows have **wheels** or **cams** at the tips of the limbs. They also have **cables** and some other items not found on the conventional bows. The part of the bow that faces that archer is called the **face** or belly of the bow. The part that faces the target is called the **back**.

Bow Strings

Almost all modern bow strings are made from a continuous strand of Dacron or some other string material looped several times. Thus, when one strand of a string is broken, the entire string is broken. Most strings have loops on both ends to fit the string nocks or other means of attaching to the bow. Those loops are protected by windings of heavy thread known as **servings**. A middle serving, often of monofilament, protects the string from wear where the arrow and the fingers touch it during shooting. The middle serving should have one or more **nocking point indicators** (metal, plastic or thread) to locate the arrow in the same place on the string for each shot.

Arrows

The projectiles or **arrows** are tubes or bolts of wood, fiberglass, graphite, or aluminum. The stiffness, or **spine**, of these shafts is matched to the **draw weight** (strength) of the bow. The end of the arrow that is placed on the string has a **nock**, usually a plastic device with a notch that holds the string. The other end has some type of point, depending on the type of shooting being done. **Target points** are usually conical or bullet shaped. **Field points** usually feature a point with an elongated and somewhat thinner tip than the main body of the point. Broadheads usually have two or more cutting edges attached to a central ferrule. Several other types of points are also available, but they are used by more advanced archers.

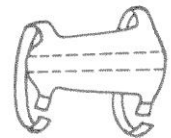
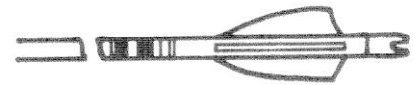
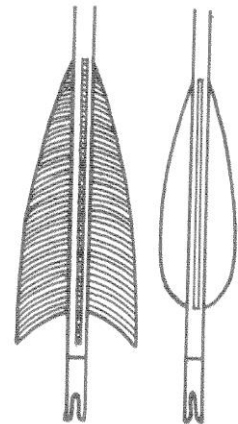
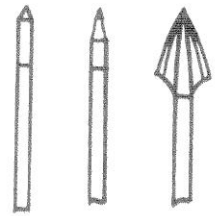
Near the nock, the arrow is equipped with some type of **fletching**. Usually the fletching consists of three shaped feathers or plastic vanes, but some arrows use four or even six vanes or feathers. The fletching may be straight, slightly angled or helical, depending upon the intended use. Its purpose is to help stabilize the arrow in flight. Hunting arrows usually have at least three large vanes or feathers. The fletching on target arrows may be much smaller. **Flu-flu arrows** have massive amounts of fletching to limit the flight distance of the arrow.

Just beyond the fletching, the shaft may be marked with a pattern of painted stripes, called cresting or a signature. The cresting is used either to decorate or to identify the ownership of the shafts. Many target archers, and a few bow hunters, mark each arrow individually so they can watch for differences in performance between them.

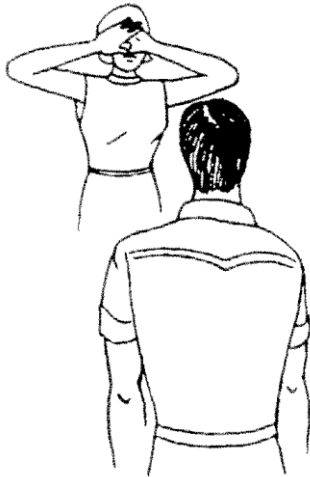
Other Accessories

The beginning archer needs a few other items to be fully equipped. An **arm guard** is needed for the bow arm. It should be worn on the inside of the arm between the wrist and the elbow. Arm guards come in a wide variety of types, but all of them help to reduce the pain of string slap (usually an indicator of poor shooting form) and to keep the clothing out of the string's path. Several types of gear are used on the string hand. Archers use **finger tabs**, **shooting gloves** or **mechanical releases** to hold the string. All of them have merits and drawbacks. For learning purposes, a finger tab is recommended. The tab is worn on the inside of the index, middle and ring fingers of the dominant or string hand. Most tabs have a split that lines up between the index finger and the middle finger to permit split finger shooting. A single finger attachment is used on the middle finger of the shooting hand most times.

Many types of **quivers** are available for the first few trips to the shooting line, your "coach" will be the quiver, handing you the arrows one at a time. Later we will switch to using ground quivers. As you progress, you will want to get a quiver (or quivers) that match your shooting needs.



Eye Dominance



Before you learn to shoot, you need to determine your eye dominance. *Fact Sheet 3: Determining Eye Dominance* provides more information about it and ways to test it. Pick a partner to help test for eye dominance. Stand facing your partner about 2 meters (6 feet) apart. Place one thumb over the other and cross your fingers over the fingers of the other hand, leaving a small triangle. Raise both hands together, keeping both eyes open and the head straight toward your partner. Look at your partner's nose through the opening. The partner should note which eye can be seen through the opening. Now, keeping the nose in the opening, bring your hands slowly back to your face. Your partner should watch for any "cheating" where the hands seem to wander from eye to eye. The eye that your hands return to is your dominant eye. Now switch roles and try it again. Do not be concerned if your handedness and eye dominance are different. A significant minority of the people in the world are cross dominant.

Your best shooting will occur when the dominant eye is on the same side as the drawing or string hand, and the "off" eye is on the same side as the bow hand. All directions will be given using those terms. The handedness of the bow is determined by holding it as you would when shooting. The sight window is on the opposite side of the bow from its handedness. That is, a right-handed bow (for a right-eyed archer) will have the sight window cut into the left side of the bow and be held in the left hand. Once you have selected a bow that is appropriate to your eye dominance, discuss its parts with your partner. If you need help, ask a parent or junior leader for assistance or advice.

Stringing and Unstringing Bows Safely

There are many ways to string or unstring bows. Most compound bows are simple left strung all the time, but recurve bows are usually unstrung between uses. Two methods that *should not* be used are the **push-pull method** and the **step-through method**. The push-pull technique is gentle to the bow but has too many dangers for your eyes. We do not recommend it, even when it is done properly. The step-through method is less dangerous to the archer, but potentially damaging to the bow. We do not recommend it either.

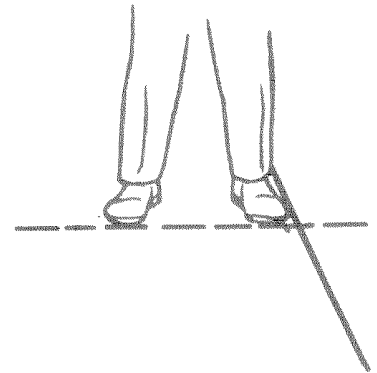
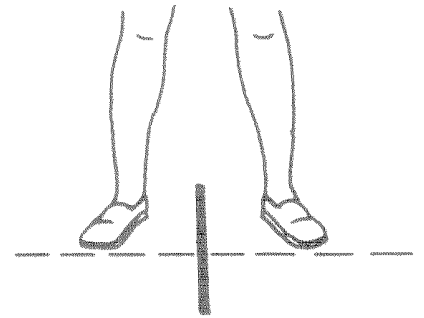
Use some type of bow stringer. They are inexpensive to buy or make, and they save both eyes and bows. Try stringing and unstringing the bow you have selected several times while being observed by your parent. Do NOT draw and release the bow without an arrow on the string! Dry firing a bow is dangerous both to the bow and to the archer.

Range Procedures

Like other forms of shooting, archery operates under controlled conditions to ensure the safety of all participants. Everyone, not just the Range officer or line captain is responsible for safety. Any unsafe condition must be brought to the attention of the person in charge IMMEDIATELY. All range commands, whether verbal, visual or whistle must be obeyed immediately. Small groups may be controlled with simple voice commands, but larger groups or tournaments are better addressed with whistle, horn or light commands. For our purposes, keeping the commands as close to those used in other shooting sports is best to avoid confusion.

Several modifications apply in **field shooting**. Rather than straddling the line like in target archery, the archer toes the shooting line or stake. In addition, when retrieving an overshot arrow, the archer should place their bow directly across the face of the target to let following archers know that someone is down range and possible in the line of fire. Some archers use an arrow stuck upright in the target butt as an indicator, but the bow is a super sign.

In both types of shooting, archers should be far enough apart to ensure they do not interfere with one another. We will be spacing ourselves about 2 meters (6 feet) apart since our first shot will be made using the bow as a shelf for the arrow while nocking it. Later, as you become more skilled at handling your equipment, we can reduce the spacing between archers to about half that distance. At that point the arrows will be placed on the string while the bow is held vertically. Arrows are never nocked until the command to shoot is given, and bows are never drawn except during live firing or on command.



Verbal Command	Whistle Command	Action
Archers to the shooting line	Two blast	Archers come to the shooting line and straddle it
Make ready.		Archers prepare to shoot
Is the line ready!		“Ready” or “not ready”
Commence firing.	One blast	Archers begin firing
End is complete.		Shooting is complete
Retrieve (or score) your arrows	Three blasts	Follow line commander to target butts; wait for scoring or pull arrows from target
Cease fire!	Four or more blasts in rapid succession	Immediately STOP shooting – unsafe condition; wait for commence firing command or one whistle blast to resume shooting

NOTE: The line captain ensures that all archers have returned to the ready area before returning from the butts.
 *In tournament shooting the archer must remain at least arm’s length away from his or her arrows until they have been told to pull them by the scorer.

Conclusion and Summary

That concludes the lesson on archery equipment and safety. Are there any questions?

Be sure to review this material before our next session. At that time, we will start developing good shooting form on the range. Please mark the bows you have selected by writing your name on a piece of masking tape. Put the tape on the back of the sight window from the arrow rest to the top of the sight window.

Summary Activities

1. Have junior leaders or parents review archery terms and safety considerations with small groups of participants.
2. Have junior leaders or parents supervise young people in stringing and unstringing bows using cord, box, and wall stringers.
3. Without equipment, have participants practice range rules and behavior either inside or on an outdoor range.
4. If they are not already equipped with nock sets, have each participant locate and attach a nocking point indicator to their selected bow with the assistance of a leader or junior leader

Exhibit and Sharing Ideas

1. Make posters of range rules, archery safety principles or archery tackle with parts identified.
2. Construct quiz boards that match parts with points indicated by letters, numbers, or other means.
3. Construct and demonstrate a bow stringer.

Basic Archery Lesson 2

Developing Proper Archery Shooting Form

Ronald A. Howard Jr. *

Objectives

Participating youth and adults will:

1. Demonstrate and practice the fundamentals of proper archery shooting form.
2. Understand and apply the “11 steps to the 10 rings” when shooting.
3. Successfully shoot groups using instinctive shooting methods.
4. Establish mental and physical skills leading to consistently good shooting form.
5. Demonstrate proper form through “coaching” other archers.
6. Have fun while learning.

Roles for Teen and Junior Leaders

- Demonstrate proper shooting form.
- Demonstrate form faults for correction by participants.
- Serve as on-line assistants.
- Serve as line captains or range officers.
- Provide positive reinforcement of proper form for students with form faults.
- Assist with locating overshot and undershot arrows.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Provide or coordinate transportation to the range.
- Serve as coaches for one or two “coach-pupil” pairs on the shooting line.
- Provide or coordinate refreshments.
- Assist with developing exhibits or conducting summary activities.

Best Time to Teach

Any time of year

Best Location

Range space (indoor or outdoor) is required

Time Required

Approximately 1 hour

Materials/Equipment

- light recurve bows (15 to 30 per- cent left handed)
- matching arrows (26 to 31 inch lengths)
- finger tabs
- arm guards
- large target butts
- small stick-on dots (aiming points)
- ground quivers (*see Fact Sheet 7: Ground Quivers*)
- posters showing shooting steps
- shooting line, tape, or materials to make one
- whistle (if group size warrants)

References

National Archery Association Instructor's Manual, third edition, P. Baler, J. Bowers, C.R. Fowkes and S. Schoch. National Archery Association of the U.S., Colorado Springs, CO. 1982.

Archery: Steps to Success, K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.

Teaching Archery: Steps to Success, K.M. Haywood and C.F. Lewis, Leisure Press, Champaign, IL. 1989.

Archery: A Planning Guide for Group and Individual Instruction. J.W. Smith, ed. American Alliance for Health, Physical Education, Recreation and Dance, Reston, VA. 1972.

Teaching Outline

Note to Instructors: The outline is condensed to reduce the amount of space required. Good teaching style will likely require several repetitions for beginning archers. DISCUSS and DEMONSTRATE proper shooting form (*instructor should not shoot*). PRACTICE the mimetic steps suggested without equipment, with an air bow or just a bow. Finally USE live firing with an emphasis on successfully shooting groups, disregarding the location of the groups on the target. LIMIT each archer to about three to four arrows per end. SHOOT no more than four or five ends per archer before pausing to DISCUSS the elements of form and giving the kids a chance to REST. This approach not only encourages development of good shooting form, but also helps prevent poor shooting habits caused by fatigue.

Presentation

Application

I. Introduction

- A. Simple basics of good shooting
 - 1. Relaxed body
 - 2. Intensely focused mind
 - 3. Archer's paradox
- B. Comfortable position
 - 1. Easy to repeat
 - 2. Minimum muscle activity
- C. Practiced form needed
 - 1. Concentration on one form item
 - 2. Instilling good habits
 - 3. Consistency needed
 - Form
 - Results
 - perfect practice
 - 4. Successful form taught
 - same for all archery
 - basic to good shooting

ASK what is needed to shoot a bow successfully. Gently REJECT answers that emphasize strength and great physical skill.

EMPHASIZE consistent form and developing sound basic skills as well as concentration.

II. Archery form basics

- A. Eleven steps to success
 - 1. Stance and posture
 - 2. Nocking an arrow
 - 3. Setting a hook
 - 4. Bow-hand grip
 - 5. Raise & extend bow
 - 6. Draw
 - 7. Anchor
 - 8. Aim
 - 9. Release
 - 10. Follow through
 - 11. Relax and evaluate
- B. Need to establish each step
 - 1. Good shooting routine
 - 2. Mind free to concentrate
 - 3. Always emphasize safety

Have a parent or junior leader DEMONSTRATE one shot with a bow or with an air bow indoors.

ASK what the parts of this shooting sequence are. Use questions to get the participants to LIST the items included here.

REINFORCE the need for constant safety awareness.

C. Stance

1. Normal standing position
 - relaxed
 - comfortable
2. Foot position
 - straddling line
 - shoulder width apart
 - line through toes to target
 - square stance value
 - straight line to target
 - string slap avoided
 - muscle fatigue
3. Hips and shoulders in line with target
4. Head
 - erect and relaxed
 - rotate toward bow- hand shoulder

Using a rope, tape or other shooting line, have each participant **PRACTICE** taking a comfortable and square stance.

Using an arrow in place of the string or an air bow, **DEMONSTRATE** why a square stance keeps the string away from the body.

NOTE that this is particularly important for female archers.

D. Nocking an arrow

1. Bow used as shelf for beginners
 - at least 10 feet apart
 - sight window up
 - slide arrow forward
 - set arrow on rest
 - rotate index vane up
 - draw back to string
 - nock under nocking point indicator (between if 2 used)
2. Bow held vertically
 - reasons in target shooting
 - cant bow slightly to drawing hand side
 - rotate slightly to let shaft clear string.
 - keep the shaft pointed down range
 - reach forward, placing arrow on rest
 - index vane out
 - slide back to string
 - nock under indicator

DEMONSTRATE nocking an arrow using both techniques. Have each participant **PRACTICE** each technique with arrows pointed in a safe direction and without placing them on the string.

E. Setting a hook

1. Hooked finger tips draw bow string
 - back of hand flat
 - scout salute
 - thumb on little finger
 - fingers bent at second joint

DEMONSTRATE and **PRACTICE** making a salute, then a hook. Have archers use finger tabs. **CHECK** to be sure they are worn properly

2. Draw types

- split-finger draw
 - Turkish
 - index finger above nock
 - ring and middle fingers under nock
- Apache draw
 - cheekbone anchor
 - three fingers under nock
 - excellent close range anchor
 - nock very close to eye

3. String placement

- string at first joint of fingers or slightly deeper
- keep back of hand flat during draw
- “finger pinch” or arrow swinging away from rest
 - curling hand during draw
 - correcting it
 - * salute
 - * deeper grip

F. Bow-hand position and grip

1. Relaxed grip

- bow floats in hand
- touch tips of index finger and thumb
- use sling to hold bow in hand

2. Hand shake with bow

- hand vertical
- bow handle in web between thumb and fingers (U-shape)

3. Bow-arm elbow rotated out

- arm swings parallel with the ground
- bow-arm shoulder and elbow locked out

DEMONSTRATE each draw type
EMPHASIZE the use of the split finger draw and high anchor (corner of the mouth).

PRACTICE string placement with an air bow or by drawing a conventional bow *only one inch*.

DISCUSS “finger pinch” and how to correct it.

Have participants PRACTICE gripping a bow with a light touch.

PRACTICE elbow rotation by pushing against a wall or post with a flat hand and rotating the elbow out.

CHECK rotation by swinging hand toward chest.

4. Two primary wrist positions
 - high wrist: wrist in line with forearm
 - one contact point
 - bow floats in web of hand
 - like free- floated rifle barrel
 - less sensitive to minor changes in grip and hand position
 - preferred by many bow-hunters
 - low wrist: hand above line of forearm
 - handle seated in relaxed hand
 - like glass-bedded rifle barrel
 - uniform grip yields consistent results
 - preferred by target archers
 - * reduced fatigue
 - * consistent seating of bow in hand

G. Raise and extend bow into shooting position

1. Focus attention on target
 - bow arm elevated about 15 degrees
 - string arm in line with shaft
 - hook set on string
2. Rotate bow to shooting position
 - pivot arms at shoulders
 - raise to shoulder level
 - bow arm fully extended
 - string forearm in line with shaft
3. Many “instinctive” archers extend and draw in one motion

H. Draw

1. Smooth motion
 - flex elbow using arm muscles
 - pull elbow back with shoulder and back muscles
 - draw to anchor point
2. Concentration on target deepens during draw

DEMONSTRATE high-wrist position. DISCUSS its advantages/disadvantages and normal use.

ASK why might bowhunters prefer this style. Good answers focus on changes in form because of excitement.

DEMONSTRATE low-wrist position. DISCUSS its advantages/disadvantages and common uses.

ASK why might target archers prefer this type of wrist position. Good answers focus on reduced effects of muscle fatigue and consistent form.

DEMONSTRATE and PRACTICE raising the entire unit.

DISCUSS the mechanics of drawing an arrow.

Have participants PRACTICE using an air bow, if one is available or use mimetics without equipment.

POINT OUT – No sky draws and watching for an “over bowed” condition

I. Anchor

1. Consistent anchor point
 - “rear sight”
 - checkpoints
2. High Anchor
 - corner of mouth
 - index finger tip on upper canine tooth
 - thumb behind angle of jaw
 - point of cheekbone for Apache draw
3. Low anchor discussed later with sights

J. Aim

1. Instinctive shooting
 - concentrate on spot
 - small spot gives more accuracy and precision
2. Pause to check alignment
 - make sure you are set
 - shoot or let down within a few seconds
 - deliberate shooting
3. Drawing hand firmly anchored
4. Bow arm fully extended

K. Release

1. Very simple action
 - relax hook
 - pull elbow back
2. “Live” release
 - relax fingers
 - draw elbow back
 - fingers flow alongside of face
 - bow rocks forward

L. Follow through critical to good shooting

1. Hold release position
 - until arrow hits target
 - bow arm extended in shooting position
 - string hand at end of release position
2. Avoid shooting when tired
 - leads to poor form
 - faults with follow through
 - poor shooting
 - frustration

ASK – “Why is a consistent anchor point important?” DISCUSS the dominant eye’s function as a rear sight.

DEMONSTRATE the corner of the mouth anchor and secondary checkpoints used with it.

Have participants TRY various combinations with or without equipment.

POINT OUT that true instinctive archers do not aim, but concentrate on the target. COMPARE to throwing a ball.

REINFORCE the important of pausing momentarily at full draw to check position and hold.

Have participants DRAW *one draw* and relax fingers to feel a release.

DEMONSTRATE and PRACTICE a live release by pulling hooked fingers against each other with the hands across the chest, relaxing the string hand while pulling. Note movement of the hands and arms.

DEMONSTRATE a proper follow through using an air bow or shooting on the range. DISCUSS the bow arm and string arm.

ASK – why is it important to hold the follow through until the arrow hits?
SEEK answers that center on avoiding bad form, like letting hands drop.

M. Relax before next shot

1. Concentration on entire end or match impossible
2. Treat each arrow as the only one
3. Cycle of concentration, relaxation, evaluation

III. Shooting the first arrow

A. Spacing

1. 8 to 10 feet minimum
2. Maximum of two to three archers per target
3. Minimum of one adult coach/instructor per two archers

B. Shooting by the numbers

1. CRO, is the flight ready?
 - coaches respond
 - repeat if needed
2. The flight is ready
3. Take your stance
4. Nock an arrow
5. Set your hook
6. Adjust your grip
7. Raise the unit
8. Draw to anchor
9. Focus on aiming point
10. When ready, release and follow through
11. Relax and Evaluate your shot
12. Shoot your other two arrows when you are ready
13. When you have finished
 - ground your bow on the quiver
 - take one step back off the line

C. Retrieving arrows

1. Only one person at target
2. Line captain leads
 - watch for undershot arrows
 - damage to arrows
 - damage to feet
3. Pull arrows at butts
 - clear area behind shafts
 - support target beside shaft
 - pull straight back
 - slight twist helps

DISCUSS the importance of treating each arrow as if it were the only one.

ASK – can you concentrate to the maximum for very long? POINT OUT the need to relax between shots.

Have “coaches” CHECK each step with their archers as the line captain walks the group through a shot. Parents, junior leaders or other instructors should back up the coach in EVERY coach-pupil pair.

REPEAT until all members have shot an end of three arrows.

ENSURE that the line captain leads the group in retrieving all arrows and follows them back to the shooting line.

ASK – why is this important? DISCUSS their responses.

DEMONSTRATE the proper way to remove arrows from a shooting matt, butt or target. Let each member PRACTICE in turn

4. Retrieve overshot arrows as a group
 - bow across target face as signal to other archers
 - arrow upright in butt as signal
5. Line captain follows group back to line

IV. Shooting Groups

- A. Importance of groups
 1. Consistent form
 2. Consistent location
 - correcting impact point
- B. Group, not location, important
 1. Keep same aiming point
 2. Maintain form
- C. Shoot maximum of 9 to 12 arrows

V. Moving group to desired impact point

- A. Group necessary first
- B. Move aiming point
 1. Place new aiming dot
 - direction you want point of impact to move
 - distance you want point of impact to move
 2. Shoot group using new aiming dot
 3. Correct by trial and error

VI. Summary

- A. Perfect practice makes perfect
- B. Perfect, consistent form gives consistent results
- C. Steps to a good shot
 1. Stance and posture
 2. Nocking an arrow
 3. Setting a hook
 4. Bow-hand grip
 5. Raise & extend bow
 6. Draw
 7. Anchor
 8. Aim
 9. Release
 10. Follow through
 11. Relax & evaluate

REMIND archers about leaving a clear signal for other archers when searching for overshot arrows.

EMPHASIZE that tightly grouped arrows show consistent form and good concentration.

AVOID any comments on the location of groups. REINFORCE proper form and *avoid calling attention to any form faults.*

ASK – why is it important to shoot groups before trying to move the point of impact? SEE answers above.

DEMONSTRATE how to move the point of impact with a new aiming dot using either diagrams or actual groups. Have each archer try to MOVE their group to the original aiming dot.

REINFORCE each of these steps with the archers on the firing line. Try to keep the number of arrows shot relatively low (9 to 20 total) between REST and REFLECT breaks.

Lesson Narrative

Introduction

Successful archery shooting is easy, but people tend to make it hard. Intense concentration and good muscular development are essential. The ability to remain relaxed is also very important. To most people the combination of intense concentration and relaxation seems impossible. Like the archer's paradox where the arrow must bend to fly straight, both concentration and relaxation are necessary for top performance.

Like other types of shooting with single projectiles, archery requires that the archer be relaxed and comfortable. Since concentration on the sight or the target is critical to success, the tasks required to fire a shot must be practiced until they can be done without conscious effort. Once they become routine, the mind is free to focus on hitting the mark. This process involves the archer developing consistent form from shot to shot. As the consistency in form improves, consistency in shot placement improves. By focusing on the elements of good form we will make consistently good shooting easier to develop. Some steps will feel strange or even uncomfortable at first. However, they have been proven successful over many years by archers from all over the world.

No matter what kind of archery you select, the basics of proper shooting form are the same. By developing sound, consistent form early in your shooting development, you can reach higher levels of achievement in the chosen sport.

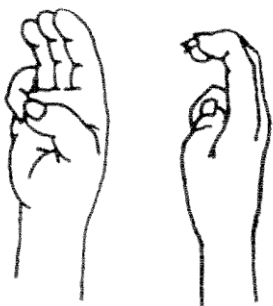
Archery Basics

Only a few steps are required to shoot an arrow successfully. You must take a proper stance, grip the bow properly, nock an arrow, grip the string properly, raise and extend the bow arm to shooting position, draw, anchor, aim, release, follow through, and relax and evaluate. That seems simple enough, but the mind cannot cope with that many things all at once. These steps must become established, well-practiced habits. Once you have a fixed shooting routine and good shooting form, the mind can be set free to concentrate on the target or the sight pin for more precise shooting.

Stance

A good shooting stance involves a relaxed, erect posture. The feet should be straddling the shooting line, shoulder-width apart. A line drawn across the tips of the toes should point to the center of the target. Some people find that moving the bow-hand foot back a few centimeters (up to about 6 inches) is more comfortable, but that may cause some problems in keeping the rest of the body in line. It forces muscles to work, increasing the potential for fatigue and inconsistency. Lines drawn through the hips and through the shoulders should also point to the center of the target. The head should be erect, relaxed and rotated toward the bow-hand side. Pick a point as a target, establish an imaginary shooting line and try getting into this stance with your partner's assistance. Once you are comfortable, switch roles, repeating the exercise until both of you feel comfortable.

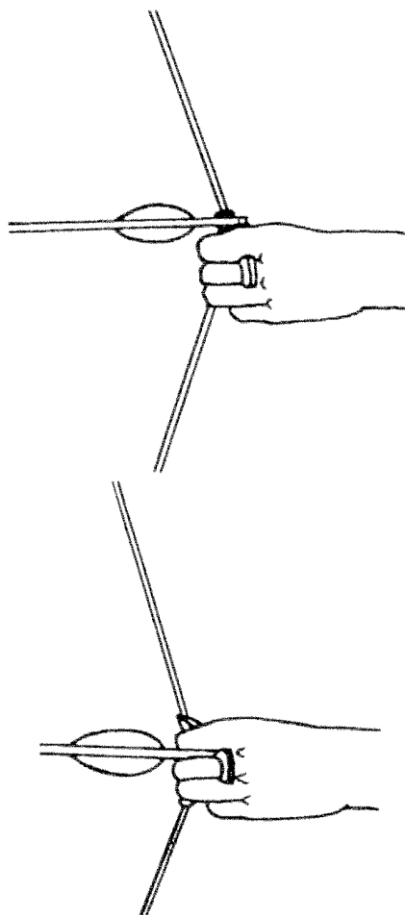
**The tip of the arrow
should be pointed
down range!**



Nocking an Arrow

You will learn two ways to nock an arrow. The first is only for learning ease. The second is for accepted target shooting etiquette. We will practice both styles *without* placing the arrow on the string. Be sure you are standing at least 2 to 3 meters (6 to 10 feet) away from other groups and that the arrows are never pointed toward another person. Rotate the upper limb of the bow toward the string hand so that the sight window is up. Using the sight window as a shelf, slide an arrow forward. Rotate the arrow until the index vane (cock feather) is up (facing away from the sight window). Draw the arrow back to the string. Although we will not actually nock the arrow now, the nock is positioned below the single nocking point indicator (toward the lower limb tip) on the middle serving. Some archers prefer to use two nocking points, placing the arrow on the string between them. Try this several times with each partner.

Next, hold the bow almost vertical, canted slightly toward the string hand. Rotate the string slightly (just enough to allow hand to clear it) toward the string hand side. Grasp an arrow near the fletching and reach forward, placing it on the arrow rest. With the arrow on the rest, draw the nock back to the string. Again, be sure the index vane or cock feather is positioned away from the sight window. **The tip of the arrow should be pointed down range during the entire nocking process.**



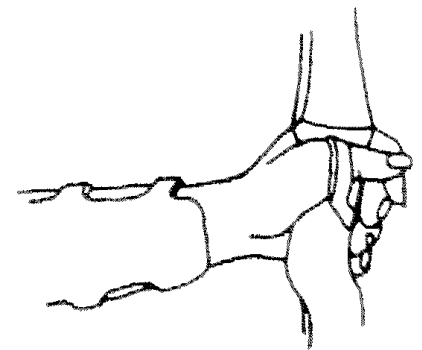
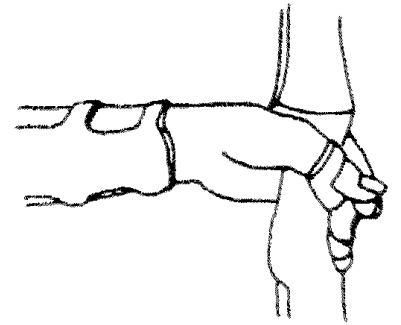
Setting a Hook

The string hand uses hooked fingertips to draw the string and the arrow into position for a shot. The back of the hand should remain flat throughout the drawing and shooting sequence. An easy way to ensure that is to use a three-fingered salute. Hold the hand upright, palm forward. Bring the little finger of the drawing hand toward the center of the palm and hold in place with the tip of the thumb. That keeps the hand flat. Next, bend the remaining three fingers into a hook. This approach is used with either a tab or a shooting glove.

The fingers may be placed on the string several ways. The most commonly used approach is to place the index finger above the arrow and the nocking point indicator and the remaining two fingers below it (*split-fingered or Turkish draw*). Another common approach is to place all three fingers under the nock (*Apache draw*). It is very effective for short range shooting, but carries some risk because the hook is placed very close to the dominant eye. In either case, the fingers are placed on the string at about the last joint of the fingers. A slightly deeper grip, almost to the second joint, is quite acceptable when using a tab. Tabs give more consistent results than gloves with most archers. The problem known as “finger pinch,” where the arrow lifts away from the rest, is commonly caused by curling the hand during the draw. It can be cured by taking a slightly deeper grip on the string (almost to the second joint) and/or by folding the little finger and the thumb into the palm of the drawing hand.

Bow-hand Grip

Two types of grips are used by most archers. Both are relaxed, allowing the bow to move freely on the release. For those of you who are afraid of dropping the bow, either use a sling or lightly touch the tip of the thumb to the tip of your index finger. The grips share several common elements. Both are begun as if extending the hand in a handshake. The hand is held vertically, and the bow fits into the U-shaped opening between the thumb and the fingers. The wrist remains in direct alignment with the forearm. The elbow is rotated out, so that the forearm can move readily toward the center of the chest when the elbow is flexed. A high-wrist grip allows the bow's handle to seat only in the web between the thumb and the forefinger. In this grip the wrist remains straight, aligned with the forearm both horizontally and vertically. The low-wrist grip allows the muscles controlling the hand to relax. This causes the hand to rise above the forearm and the bow handle to seat against the palm of the hand. This grip is like having a completely bedded rifle barrel. Like that situation, perfect and consistent bedding of the bow's grip gives very consistent shooting performance. Slight changes from shot to shot, however, produce changes in the point of impact. On the other hand, the high-wrist grip is like using a free-floated rifle barrel. The only point of contact is well established, and the bow does its own seating in the hand. Most target archers use a low wrist because they get better performance with it. Many hunting archers use a high wrist because it is less sensitive to slight differences in hand position or pressure. Try both with your partner, drawing the bow only one inch.

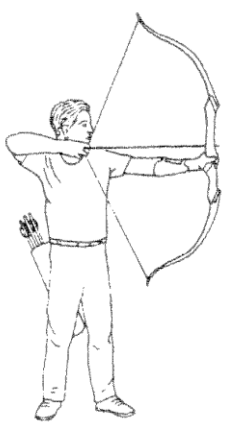


Raise and Extend Bow

Once the stance and hand positions are established with a nocked arrow, the entire unit is brought into shooting position at the same time. Start with the bow arm extended about 15 degrees from the body and on a line toward the target. The forearm of the string hand should be set on the string. Moving the arms from the shoulders, fully extended and pointing at the target. The forearm of the string should be extended forward. Many instinctive archers will extend and draw in the same motion, coming to their anchor point as the bow arm settles at full extension. Use two steps here to avoid developing form faults.

Draw

Pull the string back toward the anchor point. At beginning of draw, the upper arm muscles flex the elbow. Then the elbow is drawn back using muscles of the shoulder and back. The draw should be a smooth motion, keeping the forearm in line with the arrow shaft.



Anchor

We will use a high-anchor point in this session. Most archers anchor the tip of the index finger against the corner of the mouth or the canine (eye) tooth on the dominant side. Often a secondary anchor point is used. The thumb may be placed along the angle of the jaw or behind the ear, or it may be nestled against the back of the jaw bone. Since the anchor point establishes the location of the “rear sight” even for instinctive archers, it is essential that the anchor point be consistent. Later we will establish another type of high anchor and a low anchor for use with sights.

Aiming

In instinctive archery, aiming is simply an intense concentration on the target. Pick a tiny spot and concentrate all your attention on it. As in rifle shooting, releasing before you are satisfied with the hold or waiting too long during the aiming phase will lead to large groups and inaccurate shooting. Experienced instinctive archers pause briefly, perhaps a second or two, to be sure of their hold before releasing the string. Although this is not a true sight picture, the archer does form a mental image of the proper relationship between the bow and the target. Throughout the aiming sequence, the string hand should remain firmly locked to the anchor point. Try coming to an anchor point without equipment right now.

Release



A proper release is achieved by simply relaxing the fingers of the drawing hand while pulling the string-hand elbow back slightly. To feel a live release, hook the fingers of one hand into the hooked fingers of the other hand. Holding the hands across the center of your chest, pull with both hands. Note that this requires you to use your back muscles, just as in drawing a bow. Relax the fingers of the drawing hand. The elbows rotate back quickly for a few centimeters (inches). This is exactly what should happen in a live release. The fingers of the shooting hand should flow along the side of the face.

The bow should rock forward at the same time. Your partner will be watching for a live release by observing the position of your hands during the follow through.

Follow Through

A proper follow through is essential to consistent, accurate shooting with all types of equipment. Archers must pay attention to follow through. The bow arm and string arm should maintain their positions until the arrow is in the target. Fatigue is the prime factor in improper follow through.

Relax and Evaluate

Relax after each shot. Evaluate the feeling of each shot to determine if you accomplished the goal you were trying to achieve. If not, you should refocus your efforts on the feeling of proper shot and try again.

Instructor note: Each person should first practice these steps individually without equipment or use an air bow. Once they are practicing good form with each step, assemble the steps into a shooting sequence. When the sequence is fixed in the archers' mind, take them to the line for live shooting. Coaches need to be involved here –adult or junior leader assistance is extremely important. Be sure the range is short enough that the kids are hitting the target right away.

Shooting the First Arrow

For now, the emphasis should be on shooting consistent groups using proper shooting form. We are not using a target face because scores are not important at this stage. In fact, they may distract from our real purpose. Let's have the first flight of archers and their coaches to the line. Space yourselves about 2 to 3 meters (8 to 10 feet) apart, with the coaches holding the arrows and standing on the string-hand side of the archer. Archers should be wearing their arm guards and finger tabs and be straddling the shooting line. We are going to shoot the first arrow "by the numbers."

1. *Coaches, is the flight ready?* The flight is ready.
2. *Take your stance.*
3. *Nock an arrow.*
4. *Set your hook on the string.*
5. *Adjust your grip.*
6. *Raise and extend bow to shooting position.*
7. *Draw to your anchor point.*
8. *Focus on the aiming dot.*
9. *When ready, release and follow through.*
10. *Relax & evaluate.*
11. *You may shoot the other two arrows when you are ready.*
12. *When you have finished, place your bow on the ground quiver (or "ground" it) and take one step back off the line.*

Repeat this process with reversed roles before retrieving the arrows.

Only one member of each group should retrieve arrows. Follow the range officer to the butts. Be careful not to step on or hurt yourself on undershot arrows. Do not go behind target for overshot arrows until those in the targets are pulled, then we will all search together.

Remember to pull all arrows straight back to avoid bending them. To remove an arrow from the matt, place one hand on the matt with the thumb and the rest of the hand supporting it. Grasp the arrow near the matt and pull straight back while twisting the shaft slightly. After all the arrows have been retrieved, return to the shooting line.

Shooting Groups

Now that all of us have had a chance to shoot "by the numbers," let's see if we can shoot some tight groups. Remember to concentrate on the same point throughout the series. We are not concerned with where the group is, but rather with its size. Consistent form produces smaller groups. Coaches, watch for the elements of form we have been practicing. Keep your comments positive. Reinforce what to do, not what might have been done wrong. We will shoot about three ends of three arrows each before we take a short break.

Moving Groups to the Aiming Point

We can move the group to the center of the target once you can produce groups. Simply shoot a group, then place another aiming dot on the opposite side of the original one and the same distance out. That is, if the center of your group is at 7 o'clock to the dot and about 10 inches out, place a new dot at 1 o'clock and about 10 inches out. Focus your attention on the new aiming point and see where the group hits. Use trial and error to move the hits to the center of the original target.

Summary Activities

1. Once archers are successfully shooting groups and hitting about where they are looking, attach balloons to target butts with short pieces of string. Let the archers try breaking them. To add challenge, each coach-pupil pair could shoot as a team, keeping track of the number of balloons broken and the number of arrows shot.
2. Try moving the firing line and allowing the archers to compensate for the change in flight path taken by the arrows. In this case, be very careful not to get beyond the average ability of weaker archers. You want to keep all the arrows on the target.
3. Divide the participants into smaller groups. Have each group discuss elements of good shooting form, things they learned about archery today and elements of form they want to improve.

Exhibit and Sharing Ideas

1. Develop a set of posters or diagrams showing the steps of good archery shooting. Display them or use them to give a demonstration on archery technique to another group or club.
 2. Make a ground quiver with a bow support for range use.
 3. Shoot several groups using different anchor points to illustrate what happens to group size and placement. Label each group, and be prepared to discuss the reasons for the placement and size.
 4. Illustrate how to move a group of arrows to a new point of impact.
- Start a shooting journal to help improve your shooting. If you already one, list some of the things you learned today.

Instinctive Shooting with a High Anchor

Ronald A. Howard, Jr.*

Objectives

Participating youth and adults will:

1. Demonstrate ability to shoot effectively using instinctive shooting techniques and proper form.
2. Practice the elements of safe, responsible and accurate archery shooting in a coach-pupil context.
3. Demonstrate ability to shoot groups and move them to the desired point of impact without the aid of sights.
4. Have fun while learning.

Roles for Teen and Junior Leaders

- Serve as line captain, scorer or assistants.
- Demonstrate shooting technique and ways of correcting the point of impact.
- Observe coach-pupil teams to reinforce elements of proper shooting form.
- Assist archers having difficulty.
- Assist with locating overshot arrows.
- Prepare balloons or other materials for the fun shoot.
- Conduct, score or officiate at the fun shoot.

Parental Involvement

- See Roles for Teen and Junior Leaders Above.
- Arrange or provide transportation to the range.
- Arrange for or provide refreshments.
- Give personal examples of shooting exercise.
- Participate in the fun shoot, giving both coach and pupil a chance to teach an adult.

Best Time to Teach

Any time of year

Best Location

Any safe shooting range, indoor or outdoor

Time Required

Approximately 1 hour (lesson may need to be repeated several times)

Materials/Equipment

- light recurve bows (15 to 30 percent left handed)
- target arrows matched to the bows in 26- or 31-inch lengths
- arm guards
- finger tabs
- target butts
- target pins
- large targets
- shooting line or materials for one
- whistle
- pads and pencils for scoring
- materials needed for fun shooting

References

National Archery Association Instructor's Manual, third edition. P. Baler, J. Bowers, C.R. Fowkes and S. Schoch. National Archery Association of the U.S. Colorado Springs, CO. 1982

Archery: Steps to Success. K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.

Teaching Archery: Steps to Success. K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.

Archery: A Planning Guide for Group and Individual Instruction. J.W. Smith, ed. American Alliance for Health, Physical Education, Recreation and Dance, Reston, VA. 1972.

Teaching Outline

Presentation

I. Review of basic shooting form

- A. Stance
 - 1. Feet
 - 2. Posture
 - 3. Head
 - 4. Hips
 - 5. Shoulders
- B. Hand positions
 - 1. String hand and hook
 - 2. Grip on string
 - 3. Bow hand and grip
 - 4. Elbow rotation
- C. Drawing process
 - 1. Raised as unit
 - 2. Flexing elbow
 - 3. Pulling elbow back
 - 4. Fixing on anchor point
- D. Anchor and aim
 - 1. Consistent anchor point
 - 2. Target concentration
- E. Release
 - 1. Relax fingers
 - 2. Pull elbow back
- F. Follow through
 - 1. Fingers flow along face
 - 2. Bow rocks forward
 - 3. Hold until arrow hits target

II. Live shooting with aiming dot

- A. Caution “coaches”
 - 1. Watch form
 - 2. Reinforce proper form
 - 3. Avoid citing poor form
- B. Caution archers
 - 1. Perfect practice
 - 2. Concentrate on form
 - 3. Concentrate on groups
 - 4. Repeat until satisfied

Application

ASK – what are the basics of good archery shooting form? Have participants LIST elements of form that lead to consistently good shooting.

Have participants or junior leaders DEMONSTRATE proper shooting form step by step.

Have archers MIMIC the process without equipment.

REMEMBER to pause frequently to let the archers rest.

AVOID going more than two to four ends without resting, reinforcement and positive evaluation.

III. Live shooting with target face

- A. Compare groups with “dot groups”
 - 1. Increase in group size
 - 2. Increases in aiming area
 - 3. Concentrate on small spot
- B. Move groups to gold using the techniques from last lesson.

IV. Practice with live shooting

- A. Light competition
 - 1. Emphasis on improvement
 - 2. Personal progress
- B. Change distances or games
 - 1. Avoid boredom or excess challenge
 - 2. Introduce game for fun
 - balloons
 - bow bird
 - clout
- C. Conclude with summary and review
 - 1. Steps in good shooting
 - 2. Perfect practice
 - 3. Consistent form
- D. Repeat lesson until satisfied

USE comparison with shotgun shooting or throwing a ball.

ASK – how many had bigger groups this time than on the dot target?

COMPARE size of “aiming” points. **Live shooting with target face**

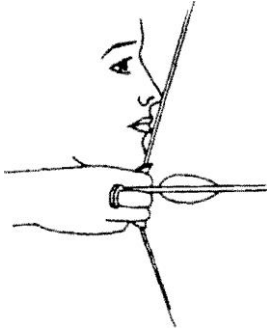
REINFORCE proper form and concentration on a small spot. REFER to previous lesson for form.

INTRODUCE one or more of the proposed activities to offer a different type of shooting experience for the participants.

Have participants REVIEW the activities of the day and DISCUSS things they need to practice to help their own shooting.

This lesson may be REPEATED as many times as necessary to have the young people shooting confidently. If it is repeated, be sure to VARY THE FORMAT to keep interest high.

Lesson Narrative



We learned the fundamentals of good shooting form last session. This time we will apply those fundamentals to instinctive shooting.

Instinctive archery shooting is like throwing a ball. The ball is not aimed; it is merely thrown while concentrating on a target.

Sometimes it is thrown with amazing accuracy and speed. The instinctive archer uses a similar style. Intense concentration on the exact spot he or she intends to hit, along with experience, results in hitting the mark without obvious aiming.

The hands and eyes work together during the concentration phase of the shooting sequence to point or aim the arrow at its target. This is like a shotgun archer pointing at the intended target without obvious sight awareness. Unlike the shot gunner, however, the archer cannot be satisfied with simply "being close." The single projectile needs to strike precisely where it is intended for a good hit to be made.

Practice is the key to success with instinctive shooting, and learners should be shooting well after a short period.

Let's review the elements of good shooting form from last lesson. The archer needs to take a comfortable and relaxed stance. Feet should be about shoulder-width apart with a line through the tips of the toes pointing to the target. Both the hips and the shoulders should be in line with the target as well. The head should be erect and turned toward the bow-arm shoulder.

The nocked arrow is situated with its index vane or cock feather facing away from the sight window. The string hand is flat and the fingers are hooked at the first and second joints. The nock is located between the index finger and the ring finger on the drawing hand. The bow hand holds the bow very lightly, with a handshake-like grip. The elbow of the bow-arm is rotated outward.

Both arms are rotated into shooting position from the shoulders. The drawing hand is pulled back by flexing the elbow, then drawing it back with the shoulder and back muscles until the fingers are firmly locked to the anchor point.

After a brief pause at full draw to check alignment, the string is released by relaxing the fingers while pulling that elbow back. The fingers flow along the side of the face and the bow rocks forward slightly. The shooting position is held until the arrow is in the target. Consistent form produces consistent groups, and groups can be moved by changing the point of concentration on the target face. Let's limber up by shooting a few groups on a target that has only an aiming dot on it.

.....*Conduct active shooting session now*.....

Let's put up a target face and see if we can shoot some reasonable scores at this distance.

.....*Conduct active shooting session now*.....

How many of you had groups that increase in size when we went to the larger target face? Why do you think that happened? One of the reasons is that we have a larger aiming point now than when only the small dot was used. Another is that you tried to move your point of impact during the shooting session, sometimes before you had established a group for reference. Remember to concentrate on only a small spot and to keep that spot consistent through each end. Once a group placement has been established, you can move your group to the gold rather easily.

Remember that practice alone does not make perfect. Perfect practice makes perfect. Every archer needs to concentrate on consistent and proper form until those elements become fixed. Even then, they should be reviewed frequently. Those principles of good marksmanship apply to all sorts of shooting: target, hunting or just for fun. Go ahead and shoot one more end. Coaches, let's record the scores on this one.

..... *Conduct active shooting session now*.....

Now, let's shoot a couple more ends to see if we can improve on that score. We are looking for personal improvement, not the highest gross scores.

..... *Conduct active shooting session and analysis now*

Now, let's lighten up a little and try shooting just for fun. The object of this first game is to see who can break the most balloons. We will start back here and work our way forward after every rotation. Each archer gets one arrow at each station.

..... *Play game.*

Let's try a little wing shooting. These special arrows are called **flu-flus**. They are designed to limit the flight distance of the arrow, and they are sometimes used in shooting small game or game birds. We will be shooting this disc target, called a **bow bird**. Archers will stand on the shooting line. I will call the toss. Try to hit the target at the peak of its climb (it is almost still for a split second at that point). Be sure to take only shots that are completely safe. Non-shooting participants should be alert for any dangerous situations and call out "Cease Fire!" or "No!" if they see any potential for a dangerous shot. (This target can also be rolled to simulate a rabbit. Balloons released on the ground in a light breeze do the same thing.)

..... *Play game*.....



We have been pretty good at hitting a small target. How would you like to try one that is about 50 feet in diameter? There is one small catch. The target is a long way away and it is flat on the ground. The object is to see how close to the stake with the flag on it you can shoot an arrow. This is called clout shooting, and we will look more closely at it when we try different archery games.

We have had a lot of fun today, and you have come a long way in your shooting. Remember the steps in good archery shooting. Continue to practice good form each time you shoot. Remember that perfect practice makes perfect and that consistent form brings consistent results. Next time we will try a different anchor point and a different shooting style, using pin sights to help in aiming.

Summary Activities

1. Have small groups repeat the steps of good archery shooting form, reinforcing the steps to the 10 rings with each other.
2. Conduct a shoot, using one or more of the games listed above. Let participants shoot within their known accuracy range, and be sure that all of them have a reasonable chance for success. Try multiple events if time permits.
3. Discuss form with the group, letting each one discuss parts of the action they find difficult. Also, discuss what steps they might take to correct and practice that form.

Exhibit and Sharing Ideas

1. List some of the things you learned today in your shooting journal.
2. Record your scores at various distances and in all the events you tried today. Enter them in your shooting journal with the date, location and any comments you might want to add.
3. Tell someone who is not in the 4-H Shooting Sports Program about your experiences with instinctive archery shooting. Record their reactions and your own feelings about the sharing time in your shooting journal.

Shooting with Sights

Ronald A. Howard, Jr.*

Objectives

Participating youth and adults will:

1. Demonstrate ability to shoot effectively using simple pin sights and proper shooting form.
2. Practice the elements of safe, responsible and accurate archery shooting in a coach-pupil context.
3. Demonstrate ability to shoot groups and adjust the sights to move the point of impact to the desired location.
4. Have fun while learning.

Roles for Teen and Junior Leaders

- Serve as line captain, scorer or assistants.
- Demonstrate techniques.
- Observe coach-pupil teams to reinforce elements of proper shooting form.
- Assist archers having difficulty.
- Prepare balloons for the fun shoot.
- Score or officiate at the fun shoot.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Arrange or provide transportation to the range.
- Assist with locating overshot arrows.
- Arrange or provide refreshments.
- Share personal shooting experiences.
- Participate in the fun shoot, giving both coach and pupil a chance to teach an adult.

Best Time to Teach

Any time of year, but after instinctive shooting has been learned

Best Location

Any safe shooting range, indoor or outdoor

Time Required

Approximately 1 hour (may be repeated several times)

Materials/Equipment

- light recurve bows (15 to 30 percent left handed)
- target arrows matched to the bows in 26- or 31-inch lengths
- arm guards and finger tabs
- roll of masking, electrician or duct tape
- long dressmaker's pins with enamel or plastic heads
- felt-tipped pen for marking sight settings
- target butts
- target pins
- large targets
- shooting line or materials for one
- whistle
- pads and pencils for scoring
- materials needed for fun shooting

References

National Archery Association Instructor's Manual, third edition. P. Baler, J. Bowers, C.R/Fowkes and S. Schoch. National Archery Association of the U.S., Colorado Springs, CO. 1982.1
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 - 3. Bow hand and grip
 - 4. Elbow rotation
- C. Drawing process
 - 1. Raised as a unit
 - 2. Flexing elbow
 - 3. Pulling elbow back
 - 4. Fixing on anchor point
- D. Anchor and aim
 - 1. Centered under chin
 - consistent anchor
 - cleft of chin
 - center of lips
 - tip of nose
 - 2. Reasons for low anchor
 - sight adjustment room
 - raising rear sight
 - longer range shooting
 - 3. Process
 - raise chin slightly
 - draw string to center
 - lower chin until lips and tip of nose touch string
 - 4. Relax fingers
 - 5. Pull elbow back
- E. Follow through
 - 1. Fingers flow along neck
 - 2. Bow rocks forward
 - 3. Hold until arrow hits target

Application

REPEAT the review from the previous two lessons.

DISCUSS and DEMONSTRATE the low (under the chin) anchor and checkpoints to be sure it is consistent.

ASK – why is it helpful to lower the anchor point?

NOTE the relationship to raising the rear sights on a rifle or pistol.

DEMONSTRATE and have participant PRACTICE the low anchor without equipment or with an air bow.

REPEAT with live shooting on range

WATCH forearm alignment with the arrow shaft.

II. Setting up to shoot with sights

- A. Making a pin sight
 - 1. Put tape on back of the bow at the sight window.
 - 2. Align bow with target and check approximate level of sight window with bull
 - 3. Insert pin between tape and back of bow at noted spot
 - 4. Align pinhead with outside edge of arrow
- B. Shoot three arrows
 - 1. Consistent aiming point
 - 2. Consistent anchor
- C. Chase group center with pin
 - 1. Low arrow: lower pin
 - 2. High arrow: raise pin
 - 3. Left arrow: move pin left
 - 4. Right: move pin right
- D. Repeat trial and error until arrows hit where aimed.
- E. Mark tape for distance and archer
- F. Repeat for other distance

III. Sight Selection

- A. Target sights
 - 1. Extended sight bar
 - 2. Long sight radius
- B. Hunting sights
 - 1. Single pin
 - 2. Multiple pins
 - 3. Lighted pin.
 - 4. Tree-stand sights

IV. Other gear

- A. Release aids
 - 1. Clean release
 - 2. Extra equipment to carry
 - 3. Potential for errors
 - forgetting it
 - improper use
- B. Aperture sights
 - 1. Precise aiming
 - 2. Better scores
 - 3. Loss of light
 - 4. Conclusion during shot
- C. Other gear and gadgets.

Have adult or Junior leaders ASSIST each participant set up his or her sights

EMPHASIZE the need for tight groups to properly adjust sights. ASK – how do the anchor point and the eye form a rear sight.

DEMONSTRATE sight adjustment and the change impact point. STRESS importance of using the same aiming point and good groups.

DEMONSTRATE bows with different types of sights.

DISCUSS reasons for the single pin and the long sight radius. EMPHASIZE precise aiming

DISCUSS advantages and disadvantages of the various hunting sights. ASK – why might you want a lighted pin or a special sight for shooting from the tree stands? NOTE need for consistent form that does not confuse the archer during a time when excitement may be high.

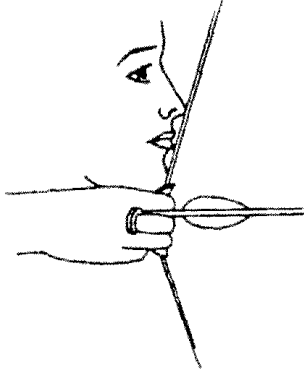
DEMONSTRATE the use of a mechanical release and DISCUSS the advantages and disadvantages of releases.

Have archers who use them or who have quit using them discuss topic.

ASK why an archer might use a string peep in field shooting or hunting. DISCUSS some possible advantages and disadvantages. DISCUSS and DEMONSTRATE additional items of your choice.

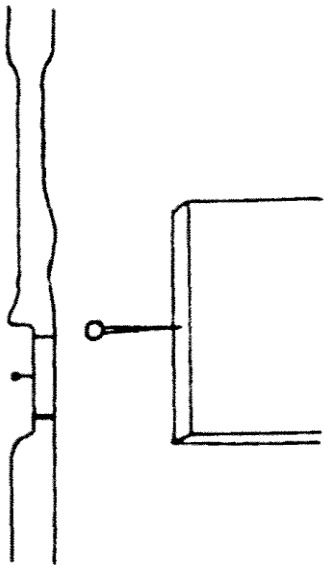
Lesson Narrative

Fundamentals of Sight Shooting



The fundamentals of shooting with sights are the same as for any other type of archery. Although they are the same, most archers change anchor points when shifting from instinctive to sight shooting. Usually the new anchor point is below the chin. This raises the rear sight (the eye), giving the archer more room in the sight window to adjust the front sight. Hunting archers sometimes keep the high anchor because it is familiar and they shoot at short distances. Target archers competing in USAA or FITA events usually cannot set their sights for longer distances without using the low-anchor point.

The string should touch the center of chin (that is why many chins are slightly cleft - to accept a properly drawn bowstring), the center of the lips and the tip of the nose. The string is drawn to the center of the chin with the head raised very slightly. Then the chin is lowered under the string and meets the other two anchor checkpoints. As with instinctive shooting, the ideal position for the drawing arm places the forearm in direct line with the shaft. On release, fingers of the drawing hand should flow backward along archer's throat and side of the neck. Other form elements are like those in previous sessions. Be sure you check each other on following the basics.



Making a Simple Sight

Elaborate and expensive sights can be used, but a good teaching sight can be made from masking tape, duct tape or weather stripping foam and a dressmaker's pin. Pins with enamel heads in white, yellow, orange or red are easy to see and use. Stick a strip of tape or foam on the back of the bow at the sight window. Stick the pin into the foam or under the tape, leaving the enamel head in the sight window. A good starting point places the pin about the same distance above the arrow rest as the eye is above the anchor point. The head of the pin should stick out into the sight window about as far as the edge of the arrow is from the dominant eye, about 1.5 centimeters (3/4 inch). This arrangement should place the arrows close to the point of aim at close range (15 to 25 yards). The sights can be adjusted by trial and error to place the group center on the point of aim.

Adjusting the Sights

When adjusting rifle sights, the rear sight is moved in the direction the hits are to move. In contrast, archers adjust the front sight. In front sight adjustment, chase the point of impact with the sight.

Before adjusting, the archer must know where the arrows are hitting relative to the point of aim. That means that the ability to shoot tight groups is essential. A minimum of three arrows should be shot to establish the point of impact. Use the same sight setting, anchor point and point of aim. If the sight setting places the first arrow completely off the butt or target and your form was good, adjust the sight after that arrow to get on the target. Using the "chase the arrows with the pin" approach, move the sight to the left if the hits are to the left, upward if they are high, and so forth. With the simple tape and pin sight, adjustments may need to be made by trial and error. With sights having a screw adjustment, **windage** (lateral right or left) adjustments can be aided by counting the number of turns in any given change and noting the resulting change. Then calculate the approximate number of turns needed to reach the desired setting. That reduces the amount of trial and error during the beginning stages of sight set-up.

Once the sights are set to your satisfaction, mark the pin and the tape with the distance and your initials. Ideally, every archer should have a personal bow for this exercise. Several archers can use a single bow if different pin colors are used. Repeating the entire process for each distance desired will have the bow set up for the shooting situations you are using. The rest is up to the archer and adequate practice.

Using Sights for Targets and Hunting

Using sights for either target shooting or hunting involves the same principles, but with some practical differences. Target archers often extend the sight out from the back of the bow, giving themselves a longer sight radius. The longer sight radius aids in precision sighting. Almost all target archers use a single sight pin that is adjustable for elevation with marked locations on the sight bar for different distances. Where permitted, they may use aperture rear sights known as **string peeps**, levels or other devices to aid in precision sighting. Some field archers use similar techniques.

Most field archers and hunters use slightly different techniques. The extended **sight bar** is used much less frequently, particularly by hunters. The improvement in sighting precision does not equal the disadvantages in the field. The longer sight bar is easily entangled in vegetation, and the sight is much more prone to damage or being knocked out of adjustment in field handling. Many archers in these sports opt for a protected sight with a guard to protect the pin or pins. Considerable difference of opinion exists among hunters and field archers about the number of pins that should be used. Some use multiple pins that are color coded and pre-set for selected distances. Others use a single pre-set pin and hold over or under targets at other distances. Those using multiple pins like the precision of holding the pin on the point of aim after selecting the proper pin for the distance. Those using a single pin feel it is less confusing and requires the same amount of accuracy in judging distances. Generally, more experienced hunters choose the single pin, while target archers who do a considerable amount of shooting use multiple pins and often a string peep.

Other Gear

An aperture rear sight or string peep can improve sighting precision. The string peep can force an archer to develop consistent form in some phase of shooting. String peeps may make sighting more difficult under low light conditions, and they may require one-eyed shooting for some archers. Under FITA rules they are not legal on recurve and/or long bows.

Release aids are popular with many archers. The mechanical release has several advantages. They produce a clean release with a single point of contact with the string. They may help archers attain consistent form if the drawing hand position or finger tension is a problem. Those who elect not to use a release often look at the device as excess baggage or another artificial element in archery shooting. Others find them confusing or fear they might release a shot unintentionally. The best advice for young archers is to keep your shooting as simple as possible while learning. Once the fundamentals are established with and without sights, the archer can experiment with other devices and styles.

Summary Activities

1. Use coach-pupil method to check shooting form and sight adjustment on the range.
2. Let participants set the sights on their bows for the type of shooting and distances used. Consider types of shooting the archer is planning to do when selecting a sight combination.
3. Illustrate and demonstrate sight correction procedures and proper adjustment of sights.
4. Hold a club shoot with courses of fire appropriate for skill levels of the participants. Use a handicapping system or some other type of grouping to make sure the archers compete on an equal basis.
5. Hold a novelty shoot where archers can use sights if they desire.

Exhibit and Sharing Ideas

1. Make a model or illustration and discuss arrow trajectory using personal equipment or that provided in the program. (See *Fact Sheet 5: Trajectory and Trajectory Experiments*.)
2. Display targets shot using instinctive and sight shooting techniques. Compare advantages and disadvantages in your journal.
3. Exhibit a model, poster or diagram of proper sight shooting form or sight adjustment. Explain the processes on labels or in your shooting journal.

Shooting Compound Bows

Ronald A. Howard Jr.

Objectives

Participating youth and adults will:

1. Understand the functioning and variety of compound bows.
2. Be able to select compound bows to fit their uses.
3. Be able to match archery equipment for optimum performance.
4. Develop shooting skill with compound bows.
5. Have fun while learning.

Roles for Teen and Junior Leaders

- Demonstrate use of bows.
- Demonstrate trajectory curves.
- Aid archers with equipment.
- Serve as assistant range officers or line captains.
- Score targets.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Conduct shooting demonstrations.
- Arrange or coordinate transportation.
- Arrange or provide refreshments.
- Assist in record keeping, scoring or range management.

Best Time to Teach

Any time after basic shooting form with and without sights has been developed

Best Location

Combination of classroom or quiet instructional area and safe shooting range.

Time Required

1 hour

Materials/Equipment

- various compound bows (wheels, cams, cam limbs, overdraws, fast- flight systems)
- archery accessories
- personal shooting equipment
- target butts
- targets

References

Hunting with Easton Aluminum Shafts. Easton Aluminum, Van Nuys, CA.

Target Shooting with Easton Aluminum Shafts. Easton Aluminum, Van Nuys, CA.

National Archery Association

Instructor's Manual, third edition. P. Baler, J. Bowers, C.R. Fowkes and S. Schoch.

National Archery Association

Fact Sheet 5: Trajectory and

Trajectory Experiments. Bow or

arrow manufacturer's catalogs, advertising materials and

owner's manuals may also prove useful.

Teaching Outline

Presentation

I. Evolution of archery tackle

- A. Bow materials
 - 1. Wood
 - 2. Composites
 - 3. Fiberglass
 - 4. Glass composites
 - 5. Graphite and boron
- B. Bow styles
 - 1. Longbow
 - 2. Reflex
 - 3. Recurve
 - 4. Compound

II. Compound bow

- A. Basic parts
 - 1. Riser or handle
 - 2. Limbs
 - 3. Wheels or cams
 - 4. Cables
 - 5. String
- B. Compound bow advantages
 - 1. Mechanical advantage
 - relaxation at full draw
 - ease of holding anchor
 - redistributing draw force
 - 2. Increased energy transfer
 - greater energy recovery
 - higher arrow speed
 - reduced arrow stress
- C. Compound bow disadvantages
 - 1. More moving parts
 - noise
 - complex tuning
 - possible damage
 - 2. Aesthetics
- D. Comparison of compound types
 - 1. Wheels
 - multi-wheel bows
 - two-wheel bows
 - 2. Cams
 - 3. Cam limbs

Application

DISCUSS changes in archery equipment over time.
EMPHASIZE the similarity in functions and recent advances in archery engineering.
DEMONSTRATE materials if available.

DEMONSTRATE bows or show illustrations of various designs.

POINT OUT parts of a typical compound bow. ILLUSTRATE several types if possible.

DIAGRAM draw force curves of various bow types.

ASK participants to discuss some advantages and disadvantages of the various types.

SUPPLY any basic elements they miss.

COMPARE draw force curves, energy transfer and shooting “feel” of wheel, cams and cam limbs.

4. Overdraws
 - arrow mass and speed
 - flatter trajectory
 - sensitivity to form
 - pivot point of bow and arrow not the same
 - exaggeration of errors
 - minimum arrow mass of six grains per pound of draw weight

DISCUSS and ILLUSTRATE overdraw use and need for very consistent form.

III. Shooting compound bows

- A. Basic shooting form
- B. Extra noise sources
 1. String noise
 2. Cable noise
 3. Rest noise
 4. Axle noise
- C. Equipment safety precautions
 1. Mismatched equipment
 2. Damaged equipment
- D. Trajectory comparison
 1. Relationship of velocity and trajectory
 - acceleration of gravity
 - time in flight
 2. Flatter trajectory increases ability to hit
 - reduced demand on range estimation
 - quicker flight time

ASK archers to REVIEW the basic elements of good shooting form.

DEMONSTRATE ways of reducing noise levels.

STRESS the potential danger of mismatched equipment and the need to inspect for damage.

Have an archer or assistant SHOOT compound and recurve bows of like draw weight using similar arrows and arrows matched to the bows.

SUMMARIZE findings and use of compound bows.

Lesson Narrative

Although the fundamentals of archery have remained the same, archery equipment has changed a great deal in recent years. Centuries ago archers used self-bows, bows made from a single stave of wood. Some bows were reinforced with sinew, horn, bone, or other materials; but native woods were the main bow materials. Designs varied in both shape and length. The long, straight, or slightly reflexed English long bow was quite different from the short, recurved bows used by the Mongols and the Turks. The function of the bow was reflected in its form.

As composite materials, like fiberglass, were developed, they found use in the bowyer's trade. Laminated limbs, recurved designs and the use of stiffer, stronger materials increased bow cast and speed. The compound bow introduced a major change in bow design. The use of eccentric wheels and cables altered the mechanics of drawing the bow. That eased the drawing process and reduced the force needed to hold the bow at full draw. The mechanical advantage also allowed more of the energy stored during the draw to be transferred to the arrow during the shot. The result was a faster arrow at the same draw weight. Also, the less abrupt, longer acceleration reduced stress on the arrow. This made the use of lighter, "softer" spine arrows possible, adding to the increased speed. Archers, particularly bowhunters, were quick to take advantage of the new technology.

Recent years have seen further advances. Development of better materials, like graphite and boron fiber composites, has added stiffness to limbs with reduced limb mass. Design changes, like the introduction of timed cams or cam limbs, have increased speed and/or "feel" for archers. Thus, the modern archer has choices that were beyond the dreams of archers only decades ago.

Basic Compound Bow Design

Compound bows and "stick" bows have the same basic components. Both have limbs, riser, handle, arrow shelf, arrow rest, arrow plate, a sight window and a string. Compound bows also have cables and eccentric wheels of some sort to provide the mechanical advantage. The cables transfer the drawing forces to the limbs, which are usually shorter and stiffer than those of recurve bows. The eccentric wheels or cams alter the shape of the draw force curve. It changes from one that rises uniformly or increases in slope with increasing draw length to a fiat-topped curve with two "valleys" - one at the resting state and the other at full draw. That change is the key to the efficiency of the compound bow.

Compound bows have several advantages over recurve bows of similar draw weight. First, they transfer a greater proportion of stored energy to the arrow. More work done in drawing the arrow to the anchor point and bending the limbs becomes kinetic (moving) energy in the arrow.

Secondly, the reduced stress on the arrow permits the use of a lighter arrow with less spine. That, too, increases arrow speed. Finally, fatigue-induced errors in shooting form may decrease because of reduced holding weight. Hunting archers find this an advantage when waiting at full draw for their quarry to move into a better position.

Disadvantages of the compound bow arrow related to their moving parts or the same features that yield advantages. Reducing the holding weight, for example, makes variations in release more critical.

Relatively minor errors may produce serious changes in arrow flight. The bow's mechanics require a more complex tuning process and cause more difficulty in noise reduction. In addition, the extra moving parts and the greater stress placed upon the limbs, cables, strings, and other bow parts increase the potential for breakage during use.

Compound bows tend to be heavier than recurve bows of the same draw weight. The increased weight may make them more stable, but it may add to fatigue as well. Many archers feel that the mechanical appearance of the compound bow makes it ugly, too. Beauty, it seems, remains in the eye of the beholder.

Wheeled bows, those with round eccentrics, and bows with cam limbs tend to have smoother draw force *than* cam bows. Cams store more energy and shoot faster arrows than wheels, however.

The quest for more arrow speed has produced further technical changes in bow design. Overdraws, devices that shorten the draw length from rest to anchor point, permit the use of a shorter, lighter, and softer spine arrow. At full draw the tip of the arrow is located inside the handle (and the bow hand) of the bow. The Archery Manufacturer's Organization (AMO) recommends a minimum arrow weight of six grains per pound of draw weight for safety. Increases in speed are offset somewhat by the demand for greater consistency in shooting form. Since the arrow rest is not directly over the pivot point of the bow, small changes in bow-hand position can cause substantial changes in impact location. Bow-hand form is critical when using an overdraw. Arrow speed cannot compensate for poor form.

Shooting Compound Bows

Compound bow shooting uses the same basics of form used in shooting recurve bows. Compound bows are less forgiving of form faults, so consistent form is essential to precise shooting. Poor form results in more noise, erratic grouping of arrows and faster arrows hitting in the wrong places. Extra care with form and equipment is necessary. The rest is practice, practice, practice.

Summary Activities

1. Have each archer try a variety of compound bow types to compare the performance and "feel. "
2. Have each participant practice shooting a compound bow of their choice until they are proficient.
3. Have a participant shoot a compound bow with several different arrow weights to see the impact on arrow speed and accuracy.
4. Have each participant select and set up a compound bow for target or hunting purposes.

Exhibit and Sharing Ideas

1. Display a model or diagram of a compound bow labeling all its functioning parts.
2. Compare trajectories of several bows with equal draw weights but different designs. Present the results as graphs and discuss them in your notebook or put them in poster form. Sample targets may be included.
3. Make a compound bow from a kit and display your finished bow.
4. Exhibit a series of targets illustrating a change in skill level using a compound bow.
5. Complete a trajectory experiment as outlined in the *Fact Sheet 5: Trajectory and Trajectory Experiments*. Exhibit the results of your experiment in an appropriate form with full documentation in your shooting journal or notebook.
6. Exhibit an item you have made for use with compound bows, for example, a bow scale, string jig, compound bow stringer, bow rack or similar item of your choice

Making Archery Equipment

Ronald A. Howard Jr. *

Objectives

Participating youth and adults will:

1. Understand the basics of constructing personal archery equipment like strings and arrows.
2. Construct selected pieces of archery equipment.
3. Develop skills related to making archery tackle.
4. Determine other types of archery equipment they may wish to make with the aid of instructors or alone.
5. Have fun while learning.

Roles for Teen and Junior Leaders

- Provide extra hands and tutor participants who need help.
- Demonstrate procedures for making specific items.
- Demonstrate use of personally made items.
- Encourage and assist members with tasks that give them trouble.
- Conduct workshops to make an item of interest.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Provide shop space and equipment for workshops.
- Arrange for or provide transportation.
- Assist with other types of equipment they make.
- Arrange for additional leadership on this topic.
- Arrange for or provide refreshments.

Best Time to Teach

Any time after personal equipment has been selected and basic shooting form is mastered

Best Location

Well-lighted and well ventilated shop area

Time Required

1 hour (workshop sessions will add to the teaching time)

Materials/Equipment

- material requirements vary with the item being made. Refer to teaching outline or individual fact sheets for detailed lists.

References

Bowhunting with Easton Aluminum Arrow Shafts. Easton Aluminum, Inc., Van Nuys, CA.

Target Archery with Easton Aluminum Arrow Shafts. Easton Aluminum, Inc., Van Nuys, CA.

National Archery Association Instructor's Manual, third edition. P. Baler, J. Bowers, C.R. Fowkes and S. Schoch. National Archery Association. Colorado Springs, CO. 1982.

Bowhunting Deer. W.H. Wadsworth, ed. National Bowhunter Education Foundation. Murray, KY.

A Sand County Almanac. A. Leopold. Oxford University Press, New York, NY. 1966. (Paperback: Sierra Club – Ballantine Books.)

Teaching Outline

Presentation

I. Value of making equipment

- A. Increases enjoyment
 - 1. Greater investment
 - Time
 - Energy
 - fun
 - 2. Doing it yourself
 - Independence
 - more understanding
 - personal satisfaction
 - increasing involvement
- B. Leopold on archery
 - 1. Risk of failure
 - 2. Avoiding gadgets

II. Types of equipment to make

- A. Simple equipment
 - 1. Climbing blocks
 - 2. Hauling lines
 - 3. Safety lines
 - 4. Ground quivers
 - 5. Strings
 - 6. Arrows
 - 7. Wall bow stringers
 - 8. Dip tubes
- B. Moderately complex equipment
 - 1. String jigs
 - 2. Bow or arrow stands
 - 3. Bow stringers
 - 4. Wooden bow boxes
 - 5. Bow or arrow racks
 - 6. Target stands
- C. Complicated equipment
 - 1. Tree stands
 - 2. Cresting lathes
 - 3. Cut-off tools

III. Making arrows

- A. Materials needed
 - 1. Shafts
 - 2. Nocks
 - 3. Adapter inserts or points
 - 4. Fletching material
 - 5. Adhesives
 - 6. Lacquer

Application

ASK participants if they prefer homemade things like jelly, bread, berry pies or soups better than the ones they can buy in bags or cans at the grocery store.

ASK – why do we have preferences? SEEK answers like just the way I like it, better quality, did it myself, etc.
USE the mood set to start discussion of making archery equipment.

READ Leopold's *A Sand County Almanac*: "A Man's Leisure Time" (about middle of essay) to show the role of uncertainty in recreation.

USE either personally constructed or purchased equipment as examples.

POINT OUT that some archery equipment projects may be major.

If a workshop is going to be held, be sure to prepare participants for it by handing out a list of needed materials after this DEMONSTRATION is completed. *See Fact Sheet 6: Making Arrows.*

B. Equipment needed

1. Fletching jig
2. Dip tube
3. Cresting lathe

C. Procedure

1. Shaft selection
 - Materials
 - Spine
 - length
2. Shaft preparation
 - cleaning
 - cleanser and hot water
 - lacquer thinner
 - alcohol
 - base lacquer dip
 - optional but wise
 - bonding base
 - ventilation needed
3. Clean base of fletching
 - remove mold release agents
 - lacquer thinner or alcohol
4. Nock application
 - clean, true base
 - sandpaper pinched against nock taper
 - rotate shaft
 - one drop of cement
 - straight alignment
 - press and twist
 - check alignment
5. Adapter or point installation
 - adhesives
 - melt able adhesives
 - epoxy
 - alignment with shaft
 - precautions
 - avoid getting adhesive inside threads
 - test for alignment
6. Fletching
 - select fletching pattern
 - adjust for proper vane placement
 - apply fletching of choice
 - feathers more forgiving
 - vanes faster and tougher
 - clamp per directions on adhesive

Have a teen leader or parent DEMONSTRATE making one or more arrows while you DISCUSS the process.

USE arrows in different stages of completion as examples.

POINT OUT dangers of using these materials without adequate ventilation.

DEMONSTRATE this step and DISCUSS its importance.

EXPLAIN the importance of the steps in this process.

EMPHASIZE the need to have the insert in line with the shaft.

DISCUSS the uses of different fletching patterns and materials.
EXPLAIN some factors in selecting vanes or feathers.

ILLUSTRATE the impact of poor quality bonding, using a junk shaft and poorly applied fletching.

7. Cresting
 - personal signature
 - arrow identification

IV. Making a bowstring

A. Materials needed

1. String material
 - Dacron
 - Fast Flight
2. Nylon serving thread
3. Monofilament serving material
4. String wax
5. Chalk or grease pencil

B. Equipment needed

1. String jig
2. Serving jig

C. Procedure

1. Adjust string jig to length
 - use old string
 - set on previous mark
2. Attach string material to lower loop post
3. Wind string material tightly around posts
 - follow manufacturer's instructions
 - use for fine tuning
 - finish on same end as begun
4. Rotate end block
5. Serve center of lower loop
6. Rotate end block
7. Wrap loose ends of string material around loop base
8. Finish serving end loop
9. Whip finish
10. Mark location of upper loop
11. Repeat above process with upper loop taking care to keep the upper loop centered
12. Twist string to adjust length
13. Wax string and work with small leather pad
14. Switch to monofilament serving material
15. Mark center serving location
16. Push monofilament end through center of string
17. Serve center of string
18. Whip finish monofilament
19. Place on bow and set nocking point(s)

Have a teen leader or other volunteer construct a bowstring as a demonstration.

DISCUSS the uses of each material and piece of equipment.

DEMONSTRATE using an old bowstring.

ILLUSTRATE the proper way to attach string material. DISCUSS why a single broken strand in a string is significant.

Be SURE the lower loop is properly sized to fit the bow snugly.

DEMONSTRATE the whip finish and have kids try to do one on scraps of material. DISCUSS need for keeping the loop centered.

DISCUSS the purpose of the center serving and the value of monofilament for this purpose

V. Making climbing block

- A. Materials needed
 - 1. 2x4 (inch) stock
 - 2. Rope (400-pound test)
 - 3. Camouflage paint as desired
- B. Equipment needed
 - 1. Saw
 - 2. Drill with ½ inch bit
 - 3. Sander or rasp
- C. Procedure
 - 1. Cut 5-inch section of 2x4
 - 2. Locate center of 2-inch side about 1 ¾ to 2 inches from top
 - 3. Drill ½-inch hole at mark
 - 4. Rasp or sand all eight corners to a slight bevel
 - 5. Sand bevels smooth
 - 6. Spray paint to camouflage
 - 7. Pass one end of rope through hole, around block, and through one again
 - 8. Tie bowline on end of rope
 - 9. Melt ends of rope to seal

PASS AROUND some climbing blocks and DEMONSTRATE or DISCUSS their use.

POINT OUT that many of the items needed are available as scraps.

A drill press is helpful but not necessary.

Measurements are not critical.

DISCUSS the significance of the beveled corners.

DEMONSTRATE and have kids PRACTICE tying a bowline.

VI. Making a hauling line

- A. Materials needed
 - 1. Parachute cord or similar line
 - 2. Small snap(s)
- B. Equipment needed
 - 1. Knife
 - 2. Small lighter or match
- C. Procedure
 - 1. Cut line to desired length
 - 2. Seal ends with lighter
 - 3. Secure snap(s) at end(s)

If archers are interested in bowhunting, have each one make a hauling line.

DEMONSTRATE the use of a hauling line for the participants and let them PRACTICE using their own.

VII. Making a safety line

- A. Materials
 - 1. Heavy braided Dacron line
- B. Equipment needed
 - 1. Knife
 - 2. Lighter or match.
- C. Procedure
 - 1. Cut line to desired length
 - depends on size of archer and tree diameter
 - 15 to 25 feet usually enough
 - 2. Seal ends of rope with flame
 - use caution
- D. Using the safety line
 - 1. Tie a bowline around the upper body
 - 2. Rotate the knot to the center of the back
 - 3. Attach the rope to the tree
 - chest high or higher
 - enough line to shoot
 - keep line short enough to prevent stepping off stand
- E. Automotive or airline seatbelts may be used too

DEMONSTRATE the use of a safety line or belt.

STRESS that every tree hunter should use a safety line.

Have each participant MAKE a shooting safety line and PRACTICE using it from a tree stand.

DISCUSS the reason for keeping the line chest high or higher and relatively short.

DEMONSTRATE how the safety line can help in shooting.

VIII. Other items you can make

- A. Tree stands
- B. Skinning gambrel
- C. Bows
- D. Leather accessories
- E. Flint arrowheads
- F. Others you determine
- G. Care, caution, and effort

BRAINSTORM other items that could be made to enhance archery or bowhunting enjoyment.

Lesson Narrative

In *A Sand County Almanac*, Aldo Leopold stated that the best leisure activities involved some element of uncertainty or risk. He went on to say that archery was one of those activities. He hunted with bows he had constructed, arrows he had made and points that had been handcrafted from sheets of steel like Leopold, or other famous archers such as the Comptons, Saxon Pope, Art Young or Ishi, today's archer can increase shooting enjoyment by making some of his or her own equipment. Making personal equipment also can promote safety, understanding, and shooting skill.

An archer can make simple equipment or more complex items that require a great deal of time and skill. Many accomplished archers have tried their hand at making bows. The increased popularity of the longbow has resulted largely from a sense of history and interest in making bows. The bowyer's art is complex and will not be covered in this lesson.

We will concentrate on making bowstrings, arrows, a string jig and a couple of types of bow stringers. Along the way, we will learn some of the skills needed to maintain archery equipment.

Many archers enjoy making their own arrows. It is easier to match the arrows to your size, shooting style and other equipment when you make your own. The arrows maybe customized to fit personal desires as well. Those custom touches may be as simple as nock or fletching color. They may include customized fletching, a personal crest and individual identification of shafts. The starting point is selecting shafts with the proper spine and length in the desired material.

Making Arrows

Many archers enjoy making their own arrows. It is easier to match the arrows to your size, shooting style and other equipment when you make your own. The arrows maybe customized to fit personal desires as well. Those custom touches may be as simple as nock or fletching color. They may include customized fletching, a personal crest and individual identification of shafts. The starting point is selecting shafts with the proper spine and length in the desired material.

Shaft selection is discussed in the bow tuning lesson. Use a table of potential shaft sizes from a manufacturer as a guide, but also use your personal experience. Shafts for target or field use maybe cut to the actual draw length as determined by using a draw-check arrow. Those for hunting purposes should be cut a few centimeters (3/4 to 1 inch) longer than the distance from the string to the back of the bow. This provides adequate clearance for the broadhead and a margin of safety for the archer. Dealers will cut the shafts to length for a small fee, or they may be cut with an abrasive cut-off wheel. Pipe cutters, hack saws and similar cutting tools should not be used. The slight burring at the cut area should be removed to provide a uniform tube diameter for inserting points or screw-in adapters.

After the shafts, have been cut to length and de-burred, the points or adapters can be inserted. On fiberglass arrows, the nock inserts can be installed at the same time. Most archers prefer to use an epoxy for fiberglass and similar types of arrows. Heat set or melt able adhesives are used for installing inserts on aluminum shafts. Wooden shafts need not be cut to length or tapered until they have been completed. If screw-in adapters are used, a few precautions can increase your satisfaction with the installation. Place a small amount of petroleum jelly on the threads of a field point. Screw the point fully into the insert before it is installed. That keeps excess glue from getting into the threads and fouling the insert. Melt a small amount of glue on the insert. Twirl the insert to spread the glue evenly over its surface while pre-heating the end of the shaft. Insert the adapter with a twisting motion to spread the glue evenly. Hold it tightly in place for a few seconds to let the glue set. (Some people twirl the tip of the shaft under cool water to hurry the process.) Once the glue has set, the arrow can be spun on its tip to check for proper insert alignment. If necessary, reheat and adjust the insert so the arrow spins without wobbling. Once the insert is aligned and the glue has set, the field point can be removed. The arrow is ready for the next step.

Before the shafts are used to construct arrows, they must be cleaned. Manufacturers make special solvents for preparing arrow shafts, but other solvents or home cleansing techniques can be used effectively. The shafts can be scrubbed with a cleanser, wiped clean with alcohol or cleaned with lacquer thinner or remover. Once they are clean and dry, they should not be touched with oily fingers. The bases of the fletching should also be cleaned with a thinner or alcohol to remove any remnants of the release agent from the molding process.

Once the shafts are cleaned, most arrow makers apply a thin coat of lacquer to the area where the crestring and fletching will be applied. Some adhesive manufacturers recommend their lacquers for providing a good base for the adhesive. The lacquer base tends to promote excellent bonding. Lacquer color is a matter of choice. Drawing a very light line around the shaft where the lacquer should stop is a good practice for consistent results. Lacquer is most easily and consistently applied by using dip tubes. Merely insert the shaft to the line, allow it to drain briefly, and hang it up to dry. The lacquers used for archery applications are tough and difficult to remove, so protect your work area. Adequate ventilation is also essential.

After the shafts dry completely, remove the lacquer from the nock area or remove any irregularities in the lacquer from that area. Place a drop of glue on the tapered portion of the shaft, and insert a nock with a slight downward twisting motion. The nock should fit tightly and evenly on the nock taper. Refer to the shaft maker's materials or another chart of nock sizes to select the proper nock for the shafts used. Care in applying the nocks will ensure the nock is properly aligned with the shaft.

The next step is to apply the fletching. Set up your fletching jig per the manufacturer's instructions. Select the fletching style you prefer. Set a shaft in the jig, being sure the nock engages properly in the nock receiver. Position a feather or vane as you want it on the shaft and mark the clamp where the end of the fletching crosses it. Apply an even bead of glue along the base of the fletching material and slip the clamp into the jig. Follow the manufacturer's advice on the length of time each vane or feather must remain in the clamp. Usually 3 to 4 minutes is adequate. Remove the clamp. Rotate the nock receiver to bring a new area of the shaft into position. Repeat the process until all the fletching has been applied. Finally, place a small drop of fletching cement on the leading and trailing edges of the base of each feather or vane.

If no cresting is desired, the arrow is complete. All you need to do is screw in a point of your choice and head for the range. If the arrow is to be crested, a few more minutes' work is required. The crest is your signature. Design one that is pleasing to you. Remember that light colors should be applied first. They are easily covered by darker ones. Use an assortment of brush sizes to get the effect you want. Having a junked shaft to use as a practice area is often very helpful, as is keeping your lacquer rather thin. Congratulations! You have just finished your first set of arrows.

Making a Bowstring

There are many advantages to making your own bowstrings. You can easily adjust length, string weight and the thickness of the servings, making it easier to fine tune your equipment. Making a bowstring requires a few tools and materials: a string jig, a serving bobbin, nylon serving thread and monofilament for the center serving. The techniques are easily mastered and the process is relatively quick. Let's go through them one step at a time.

The first step is to establish the proper length for the string. If you have a string that has been working well on your bow, use it for a pattern. With Dacron strings, you may want to shorten the string stretching when the string is put on the bow. Mark the base of the string jig to indicate the ideal string length for your bow. That will make duplicate strings easy to produce later. Remove the old string from the jig and, following the directions on the string material, wrap the required number of strands around the ends of the jig. Leave a little extra material on both ends of the thread for knotting and finishing. Both of these should be on the same end of the string.

Pivot the end of the string jig on the end having the two tied-off strands. Following the directions with your serving bobbin, serve the middle portion of the end loop with nylon thread. Once that middle portion is served (the part that will become the end loop), rotate the end of the jig back into line. Adjust the string position slightly so that the serving thread will conceal the end of the other side of the serving and begin to form the loop. Either wind the loose ends of each strand around their side of the serving or wind the strands in a crisscross pattern over the area to be served. Serve the remainder of the end loop area (about 4 to 60 inches) and whip finish the serving thread.

While the string is in this position, mark the loop area on the other end of the string with wax pencil or chalk. (*Note:* some inks damage some types of string materials.) Once the loop area is marked, rotate that end of the string jig, serve the loop and finish off the other end of the string as before.

At this point, many archers like to “set” the string. Place the string on the bow, wax it completely and rub it vigorously with a small patch of leather. This process conditions the string and settles the strands into place. Many manufacturers recommend that the string be twisted slightly in the same direction that the individual strands are twisted to increase its strength. Note that all servings should be made in that same direction.

Once you have established the proper length for the string, mark the top and bottom of the center serving with chalk. Generally, the top of the center serving should be about 2 to 3 inches above the arrow rest. The bottom should be about 5 to 6 inches below it. The main functions of the center serving are to protect the string from abrasion, to provide a smooth area aiding release and to provide a snug fit for the nock. Feel free to build yours to fit your shooting style.

On recurve bows the center serving can be applied while the string is on the bow. The cables of compounds complicate the matter a bit. In either case, the string could be removed from the bow and replaced on the jig for serving the center. Although nylon can be used in the center of the string, most archers prefer to use a monofilament center serving. Mono comes in several diameters and colors. Select a combination that is pleasing to the eye and one that fits your nocks snugly. Starting at the top mark on the string, insert the monofilament through the string and leave several inches of the free end protruding through the string. Hold that free end along the string and wind start of the serving over it. Continue winding in the same direction as the twist in the string (and the same direction in which the string will roll on release) until most of the area to be served is covered. As you near the end of serving, insert a loop of monofilament (loop side toward the unfinished end of the serving) and continue to wind at least 12 to 15 additional turns of serving material. Keeping the serving tight, snip off the monofilament and insert the loose end through the loop. Pull the loop through, drawing the free end under the wrapped monofilament; and pull it up tight. Trim the end and apply a drop of fletching cement.

To have the string function properly, it must have a nocking point indicator of some type. Some archers wrap one of dental floss or a similar material. Others use metal/plastic nock sets. Place the string on the bow and position the nocking point as desired. If you have found the best location for your bow's tuning, simply repeat the placement (you should have that noted or marked on your bow square). If not, try various locations until the bow is tuned properly. Hunters and target archers alike should have extra, pre- stretched, conditioned, and tested strings with nock sets available in their field gear.



Making Tree Climbing Blocks

While the target archer may not appreciate climbing blocks, the tree stand hunter will find them very helpful. Ethical hunters avoid damaging trees by using non-invasive ways of climbing trees. The climbing block is an excellent way to do that, and can be made from scraps of 2 x 4 construction lumber. Each block should be about 5 to 5 1/2 inches long and cut square on both ends. Approximately 1 3/4 inches from one end of the block, drill a centered 1/2-inch hole through the 2-inch side of the block. Rasp or sand off all eight corners of each block slightly. At this point, you may want to paint the blocks with a dark paint or camouflage paint to preserve and conceal them. Using 400 to 600-pound test nylon or Dacron rope that has been dyed a dark color, pass one end through the hole, around the wide side of the block and back through the hole again. Make a small loop close to the edge of the block using a bowline knot. Cut the opposite end of the rope to a length suitable for the trees you are likely to be climbing. I usually make mine about 15 to 20 feet long. About 6 to 10 of these blocks will get the hunting archer into most tree stands.

The climbing blocks are used by wrapping the rope around the tree at the desired location, passing the end of the rope through the bowline loop and cinching it down as tightly as possible. The line is then passed back around the tree and cinched under the block (called **frapping**) with a couple of turns of rope before passing back around in the opposite direction and repeating the process. Once the block has been frapped in place, the remainder of the rope can be tucked under the block to keep it from blowing in the wind. The block will shift when weight is first applied to it, but after that it should remain stable.

Making a Hauling Line

Any archer that hunts from a tree stand should wear a safety belt or safety line every time they enter a tree stand. Safety belts can be purchased at modest cost, but you can also make one from a heavy piece of braided Dacron rope. A length of rope about 4.5 to 7.5 meters (15 to 25 feet) in length is adequate for most areas. The ends should be sealed with a flame. Take care not to start a fire or get burned on the molten polymer.

The safety line attaches the archer to the tree to prevent dangerous falls. Start by tying a bowline snugly around your upper body. Keep the rope high on the chest. Turn to face the tree while standing at about the distance you want as your limit. Attach the line chest height or higher on the tree. Another bowline is adequate, but any strong and easily untied knot (a clove hitch for example) will do. Rotate the knot to the center of your back. Test the arrangement to see if you have enough room to shoot before hauling your equipment into the tree stand. A secure safety line can improve your shooting if it is used as a support when shooting from a tree stand.

Other Things You Can Make

Archers can find plenty of things to make for themselves, and all of them can add to your enjoyment of the sport. Some of them, like the climbing blocks or hauling line can be made quickly and simply. Some, like arrows or bowstrings, take a little more time and planning. Lots of others are complicated projects that may take many hours of work to complete. Examples include items like tree stands, bow presses, string jigs, cresting lathes or bow cases. Let your skills and your imagination be your guide, and try your hand at making your own archery equipment.

Summary Activities

1. Have each participant complete a selected project from the lesson. Select one that will be useful to nearly all the archers, like a hauling line or a shooting safety line for bow hunters.
2. Have each participant make at least one arrow simultaneously with the entire group.
3. Have each person participate in making one or more bowstrings. Demonstrate the proper technique first, then let the participants try their hand at applying the servings.

Exhibit and Sharing Ideas

Nearly any item that is personally constructed by the archer could be displayed as an exhibit in shows or fairs. In addition, some of the items would make excellent demonstration topics or be potential activities for a workshop conducted by young people. Some of the more complex items could be used as projects for science fairs. A few of these functional items may even become fund-raising projects. Opportunities for active and continuing demonstrations at sportsmen's field days, shoots, bowhunter education programs or National Hunting and Fishing Day exhibitions are also abundant. Let your imagination be your guide

Links to Other 4-H Programs

The relationship to woodworking, wood science or other mechanical sciences and engineering projects is obvious. Wildlife links are also clear and abundant. Heritage projects, outdoor skills, forestry and photography also have direct connections to some of the items being constructed or their use. Many of these items present an opportunity to explore science and technology as well. Let your imagination be your guide and stay alert for areas of interest shown by the young people in your group.

Bow Tuning

Ronald A. Howard Jr. *

Objectives

Participating youth and adults will:

1. Understand the principles of bow tuning.
2. Set up a bow for their shooting style and purposes.
3. Understand relationships among various bow tuning factors.
4. Have fun while learning.

Roles for Teen and Junior Leaders

- Assist participants with interpreting bow tuning situations
- Demonstrate tuning problems and solutions.
- Supervise range use and operation.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Arrange for or provide transportation to the range.
- Arrange for or provide refreshments.
- Reinforce tuning solutions at home.

Best Time to Teach

When participants are ready to switch from a learning bow to a personal bow, and after sound basic shooting form with and without sights has been achieved

Best Location

Anywhere with access to a suitable indoor or outdoor range

Time Requires

20 to 90 minutes

Materials/Equipment

- nocking point indicators or dental floss
- nocking point pliers
- bow square
- felt-tip pen
- strings of various lengths
- variety of arrows (lengths, diameters, spines, weights) equipped with screw-in adapters
- points of different weights and types
- adjustable side plate, cushion plunger or thin leather
- Barge cement
- target and butt (foam, pressed sugar cane or excelsior preferred)
- Allen or hex wrenches
- spray foot powder
- moleskin
- string silencers
- bow stringers

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Teaching Outline

Presentation

I. Importance of tuning equipment

- A. Balance and adjustment
- B. Effects on performance
 - 1. Accuracy
 - 2. Success in shooting
 - 3. Safety
- C. Typical tuning elements
 - 1. Arrow characteristics
 - shaft stiffness or spine
 - diameter
 - wall thickness
 - weight
 - shaft length
 - point mass
 - fletching
 - type
 - style
 - amount
 - 2. Bow characteristics
 - nocking point location
 - arrow plate location
 - plate or plunger tension
 - feather or vane clearance
 - noise reduction

II. Matching shafts to archers

- A. Archer's paradox
 - 1. Differs with purpose
 - 2. Spine changes with length
- B. Selecting length
 - 1. Differs with purpose
 - Target arrows cut to actual draw length
 - Hunting arrows cut slightly long
 - 2. Spine changes with length
 - Shorter arrow stiffer than longer one of same diameter
 - ratio of diameter to length important
 - relate findings to spine chart

Application

ASK – why do you think it could be important to have archery equipment properly tuned?
SEEK answers that cover the range of reasons for tuning.

ASK – what parts of each bow and arrow combination should be considered in balancing and tuning your equipment to meet your shooting purposes?
DISCUSS all responses and ADD any that might not have been considered

NOTE that every combination of archer, bow, arrow and other equipment tends to alter the tuning at least slightly.

INTRODUCE the notion of the archer's paradox: arrows must bend in order to fly straight.

ASK why having arrows too long or too short might not be wise. DISCUSS all answers, referring to first lessons.

Using a draw-check arrow, have each pair of archers record their actual draw length.

DEMONSTRATE by having a volunteer attempt to bend two pieces of thin dowel.
ASK – why the short one is harder to bend.
NOTE that the same applies to arrow shafts.

3. Speed and momentum change with length
 - mass increases with length
 - more energy needed to accelerate greater mass
 - momentum the product of mass and velocity.

ASK participants which they can throw farther – a baseball or a lead ball of the same size? DISCUSS the reasons.

C. Selecting stiffness

1. Using selection guides
 - draw weight
 - shaft length
 - choices of shafts
 - diameter
 - wall thickness
 - material
2. Relationship to length
3. Relationship to point mass
4. Influence of style and form

PROVIDE and have young people STUDY a shaft selection chart. NOTE that several weights or diameters of shafts may be listed for a given draw weight and length.

D. Effect of spine variation

1. Deviation to bow-hand side
 - too stiff
 - improper bow set up
 - shooting form
2. Deviation to string-hand side-too soft
 - improper bow set up
 - heavy arrowhead
 - shooting form

POINT OUT that bowhunters may prefer too stiff a shaft to one that is too soft, BUT personal shooting style and other factors have a strong influence. URGE each one to experiment until they find the optimum shaft for their bow, purpose and shooting style.

ILLUSTRATE the effects of these factors by having an assistant shoot several groups using carefully selected shafts. CAUTION: *do not use excessively soft shafts in heavy bows, they may shatter under pressures!*

III. Fletching and points

A. Purpose

1. Assist in flight control
2. Provide stability

USE an arrow for a visual aid. ASK – what purpose the fletching serves.

B. Fletching types

1. Feathers
 - more resistance
 - more forgiving
2. Vanes
 - less affected by weather
 - less drag – faster
 - more sensitive to changes in release

DEMONSTRATE and DISCUSS the types and styles of fletching material available. LEAD young people in considering the facts in selecting paper fletching type and styles for some selected purposes

C. Styles and amount

1. Styles

- spin wings
- straight fletch
- offset fletch
- helical fletch
- flu-flu fletching
- others

2. Materials

- soft or stiff plastics
- feathers
- fur

3. Amounts

- adequate for task
 - small amounts for light target shafts
 - larger ones for heavy hunting shafts
 - extreme amount to limit flight
- balancing speed and control

DISCUSS trade-offs in speed and control, using specific situations as examples.

PASS AROUND samples of different fletching materials for close observation.

USE arrows for different purposes as examples to start s DISCUSSION of this topic.

Have a leader SHOOT several styles under different conditions to show effects or DISCUSS their reasons for choosing a given style, type and amount.

D. Points

1. Form follows function

- mass
 - target only
 - practice for hunting
- shape
 - conical
 - bullet
 - field point
 - broadhead
 - blunt
 - other types

DISPLAY and DISCUSS several types of heads.

DISCUSS advantages and disadvantages of the various shapes and the reasons for more weight in heads used for hunting practice.

IV. Tuning considerations for bows

A. Nocking point location

1. First adjustment for vertical flight stability
2. Too low or too high causes porpoising or planing
3. Typically, about 9 millimeters (3/8 inch) above arrow rest
4. Placement more critical when shooting broadheads
5. Bare shaft correction method

DEMONSTRATE the influence of moving the nocking point too high or too low by moving the arrow on the string. DISCUSS the critical placement of nocking points with broadheads.

DEMONSTRATE the bare shaft method of adjusting this feature.

- B. Arrow plate thickness or cushion plunger adjustment
1. Second adjustment for horizontal flight stability
 2. Errors cause fishtailing
 3. Bare-shaft method
 4. Other instructions for tuning
 - manufacturer
 - good manual or text

- C. Checking arrow clearance
1. Shaft or vanes striking bow during shot may cause poor shooting
 2. Adjust for clearance with cushion plunger, arrow plate or change in peak weight
 - string-hand side – too stiff or peak weight low
 - bow-hand side – too soft or peak weight high
 3. Re-check for fishtailing after checking clearance

V. Basic bow tuning

- A. Select appropriate shaft size and length
- B. Select appropriate fletching
- C. Tune for vertical stability (getting rid of porpoising)
- D. Tune for horizontal stability (getting rid of fishtailing)
- E. Tune for clearance (re-check horizontal tuning afterward)

DEMONSTRATE this feature using a cushion plunger, adjustable arrow plate or thin layers of leather or moleskin. DEMONSTRATE the bare shaft method and PASS OUT samples of bow or cushion plunger tuning directions from archery manufacturers.

SPRAY foot powder on the riser near the arrow rest to DEMONSTRATE ways of checking for vane clearance.

SUGGEST a workshop on bow tuning (now or later) to adjust personal equipment for optimal performance.

Lesson Narrative

Archery equipment must be properly tuned if an archer is to enjoy accurate, successful, and safe shooting. Tuning involves balancing the bow with the other equipment used, adjusting the bow for optimum performance and adapting the equipment to the archer's shooting style. The fundamentals of proper shooting form must have been mastered to a reasonable degree, with the archer capable of shooting group successfully. Tuning involves factors of both the arrow (material, thickness, diameter, weight, length and attachments) and the bow (nocking point location, plate or plunger adjustment and arrow rest performance).

Arrow Selection

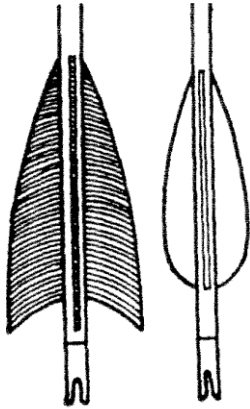
Typically, tuning starts with selection of arrows. Arrows should be matched to the bow carefully, and to each other. High quality arrows are extremely consistent from shaft to shaft and are straight. Spine or stiffness of the arrow is the most vital factor in good performance. Spine is a dynamic and complex feature of arrow behavior. It involves the type of arrow material, shaft length, shaft diameter, wall thickness, structure and mass of the arrow and its attachments. The weight and structure of the arrowhead, the type of insert and the style and amount of fletching influence the spine to some degree.

The archer's paradox is that an arrow must flex to fly straight. The amount of flexing is critical to good arrow flight. Longer arrows of the same construction and size are "softer" than shorter ones, so arrow length influences stiffness. Target archers usually cut their shafts to their true draw length. Bowhunters usually cut the shafts 2 or 3 centimeters ($\frac{3}{4}$ to $1\frac{1}{4}$ inch) longer than the true draw length to keep the broadhead away from the back of the bow and their hand. Running a simple test or consulting a spine chart will confirm the relationship between length and stiffness.

Arrow weight, and therefore speed and momentum, are influenced by shaft length, too. The longer arrow has greater mass and inertia. Although it may have somewhat greater momentum, it is more difficult to propel at the same speed or velocity as a lighter shaft. Overdraws permit use of shorter, lighter, thinner shafts, achieving higher velocity while maintaining adequate spine for good performance in heavy bows. Shooting style, arrowhead mass and other factors can also be important. The archer must determine the best combination for his or her shooting style and equipment.

Shooting form, bow tuning (set-up) and arrow spine deviations can cause impact changes. Arrows that consistently hit on the bow-hand side may be too stiff if the other factors have been checked. Those that strike to the string-hand side are likely to be too soft, or the head is too heavy for the arrow spine. Bowhunters should be particularly cautious, since performance with heavy broadheads may be quite different from that seen with field points used in practice.

Fletching



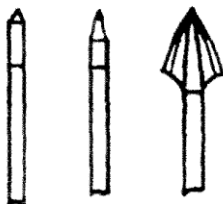
Fletching helps control the arrow in flight. The drag and spin provide stability to the shaft, although a properly tuned bow, should shoot bare shafts equally well at short ranges. The two primary fletching materials used today are feathers (primarily domestic turkey feathers) and plastic vanes. The former is cut to length and burned to shape. The latter come in hard and soft materials, a variety of styles and thicknesses and a pre-cut or cast shape. In general, feathers offer more control. Archers speak of them as being "more forgiving of minor form faults. At the same time, feathers are much more affected by weather and susceptible to wear. Vanes are more "slippery" in the air. They may increase arrow speed slightly, but at the cost of being less forgiving of shooting form faults. They are also much more resistant to weather changes.

The amount of fletching required depends on use of the arrow. Normally flight arrows have the smallest amount of fletching. Target arrows are next. Hunting arrows usually have very large areas of fletching to guide the heavy arrows under uncertain conditions. Target archers may be satisfied with three 2- to 3-inch vanes; or they may opt for more flight stability with "spin wings," a thin, curled type of vane. Hunting archer or field archers usually use four 4-inch vanes or three 5-inch ones to adequately control the heavy arrows in heavy bows.

Fletching may be applied in line with the shaft (straight fletch), slightly offset or in a spiral (helical fletch). These styles are listed in decreasing order of speed and increasing order of control or stability. Selection of a fletching style involves trade-offs between speed and control. Usually the choice in style reflects personal experience and preference.

Some archers use strips of brightly dyed rabbit fur at the back of their fletching to increase their ability to follow the arrow. Others use either spirally wound feathers or six full-length feathers to control the cast of the arrow. These **flu-flu arrows** are used in shooting at flying targets or small game and game birds.

Point Selection



Arrowheads come in a wide array of types and styles. Target points are no longer limited to the traditional short, sharply pointed cone. **Bullet-shaped points** are now preferred by many archers because they tend to be deflected less when they strike another arrow in a tight group. Each archer should try these styles of points to see which one they prefer personally. Traditional **field points** now have shorter or longer tips, and may even resemble an elongated bullet point. As with the target points, the archer should examine and experiment to find the ones that perform optimally for them. **Broadheads** come in so many styles and types that they can be confusing. NO hunting broadhead should be barbed. Broadheads should meet these four criteria: razor sharp, tough enough to withstand impact with bone or the ground, large enough to be legal and make an adequate wound channel, and true and consistent in flight.

Archers will find uses for other types of heads as well. **Judo heads** or those of similar design are outstanding for roving. **Blunts** are used for small game. **Snaro heads** may be used for flying game. Look at an archery catalog and see which types you might want to try. Remember, size and mass of the head will affect arrow performance tuning considerations. While the target archer may want to tune specifically for target shooting, the bowhunter may want to tune for the broadhead of choice, selecting practice points that mimic their broadhead's performance.

Tuning Your Bow

Three major factors need to be considered when tuning bows for optimal performance. These factors are vertical stability (porpoising or planing), horizontal stability (fishtailing) and clearance. In general, it is wise to tune the bow in the order stated

Porpoising may be caused by shooting faults as well as by improper location of a nocking point. An arrow that oscillates up and down in flight shows porpoising. Bowhunters may refer to the same situation as "planing." Moving the nocking point up or down slightly will usually correct the situation. As a starting point, locate the nocking point about 9 millimeters (3/8 inch) above true perpendicular. Using a target at relatively close range (about 15 meters or 15 yards), shoot three bare shafts and three fletched ones using the same aiming point. If all six arrows are in the same group, the nocking point is correctly situated. If the two groups are not together, move the nocking point slightly in the direction of the bare shafts and repeat the test. Once you have located the nocking point indicator properly, note it in your journal and mark your bow square as a reference for later use.

Fishtailing is a lateral (side to side) oscillation in arrow flight. It may be caused by shooting form faults, as well as improper tuning. Tuning to eliminate fishtailing involves adjusting either the tension on a cushion plunger or the amount of "center shot" on the bow. Initially, the string and arrow should bisect the limbs on a recurve bow and be approximately 3 to 4 millimeters (1/8 to 3/16 inch) into the sight window on a compound bow. Using the same bare-shaft technique outline above and following the instructions with your cushion plunger (if one is installed) or your bow manufacturer, adjust the arrows for straight flight. If the bare shafts are to the bow-hand side of the fletched ones, decrease the tension on the cushion plunger or move the side plate closer to the bow. If the bare shafts are to the string-hand side of the fletched ones, increase the tension or move the side plate out from the bow. If major adjustments are necessary, it may indicate that the arrows are improperly spined for the bow. Arrows that are too stiff will impact to the bow-hand side. Those that are too soft will impact to the string-hand side. In general, if you can adjust the two groups to within approximately 10 centimeters (4 inches) of each other at 12.5 meters (15 yards) then spine is within acceptable limits for good arrow flight.

Clearance adjustment is designed to eliminate contact between the arrow and the bow during a shot. Power applied to the fletched end of the arrow and the area on either side of the arrow rest can leave tracks of any impact. If moving the pressure point in or out slightly does not correct the problem, a change in spine may be needed. If the nock end hits the riser beyond the arrow rest, increase the spine or the length of the pressure point. If the shaft is hitting the riser on the inside of the arrow rest, it may be too stiff for the bow set up. Any time a clearance adjustment is made, adjustment for horizontal stability or fishtailing should be rechecked.

Basic bow tuning is a complex process, but one that can be mastered using a step-by-step procedure. First, you need to determine your draw length and the appropriate shaft size at that length. Next, select a fletching style and amount that fit your needs. Third, the bow should be tuned for vertical stability by adjusting the nocking point. Next, tune for horizontal stability. Then, check the set up for clearance. After these factors have been set, a final check of all equipment should be made. The rest is up to you.

Summary Activities

1. Have each archer tune his or her bow in a clinic setting.
2. Have assistants or archers fire groups and let the participants analyze what tuning considerations should be made. If possible, include some form or dominant eye faults to challenge them.

Exhibit or Sharing Ideas

1. Illustrate tuning problems and correction with a series of targets or illustrations.
2. Give a demonstration on tuning a bow for performance.
3. Examine the physics of arrow performance and discuss the importance of tuning to achieve optimum performance.

Target Archery Games

Ronald A. Howard Jr.*

Objectives

Participating youth and adults will:

1. Understand some of the shooting games available in the archery discipline.
2. Select a type of shooting that interests them.
3. Experience some of the shooting opportunities available in the local area.
4. Have fun while learning.

Roles for Teen and Junior Leaders

- Demonstrate various shooting games.
- Act as line captain, scorers and judges.
- Lead groups of archers through courses of fire.
- Present descriptive discussions of shooting games.

Parental Involvement

- See Roles for Teen and Junior Leaders above.
- Arrange for or provide transportation to field events.
- Arrange for or provide refreshments.
- Arrange for and/or manage specific shooting events.
- Conduct shoots during field trips or workshops.

Best Time to Teach

Any time after basic shooting form has been mastered

Best Location

Classroom or other quiet location and appropriate ranges

Time Required

1 hour (actual shooting experiences could cover several hours each)

Materials/Equipment

- assorted target types (USAA/FITA, NFAA, IBO, etc.)
- bow-bird targets
- stake and flag
- clout rope
- balloons
- flu-flu arrows

References

Target Archery with Easton Aluminum Arrow Shafts. Easton Aluminum, Inc., Van Nuys, CA.
National Archery Association Instructor's Manual, third edition. P. Baler, J. Bowers, C.R. Fowkes and S. Schoch. National Archery Association, Colorado Springs, CO. 1982.
Archery: Steps to Success. K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.
Teaching Archery: Steps to Success. K.M. Haywood and C.F. Lewis. Leisure Press, Champaign, IL. 1989.

Teaching Outline

Presentation

I. Archery games varied

- A. Informal shooting games
 - 1. Roving
 - 2. Other practice games
 - backyard practice sessions
 - balloons
 - other types

- B. Formal archery games
 - 1. Target archery
 - 2. Field archery
 - 3. Bowhunting targets
 - 4. Novelty shoots
 - creativity reigns
 - some formal types

II. Target archery

- A. International shooting (FITA)
 - 1. Limited to conventional tackle
 - 2. Outdoor FITA events
 - faces 122 cm and 80 cm
 - five color targets
 - 1 to 10 scoring
 - 1440 points possible
 - twelve ends of 3 arrows at each distance
 - men: 30,50,70,90meters
 - women: 30,50,60,70 meters
 - juniors
 - * 12 to 15 years' old
 - * 30, 40, 50, 60 meters
 - cadets
 - * under 12 years' old
 - * 15, 25, 35, 45 meters
 - 3. Indoor FITA events
 - target faces
 - five colors
 - 1 to 10 scoring
 - 40 cm face at 18 meters
 - 60 cm face at 25 meters
 - 30 arrows in 10 ends
 - 300 possible points

Application

ASK – how many of you have ever shot a target archery game? Try to EXTRACT idea that any shooting can be a types of target archery.

POINT OUT various types of formal games but keep descriptions brief.

OUTLINE rules and types of shooting in FITA/USAA competitive events.

If possible, SET UP event based on rules of one or more of events listed.

An extremely valuable experience for most archery participants is to OBSERVE or PARTICIPATE IN an organized shoot of some type.

Local archery clubs may be willing to put on a shoot for 4-H youth, or invite them to participate in the regular shoots of the club.

EXPLORE opportunities close to home before deciding what your limitations are.

B. USAA events

1. USAA 900 Outdoor
 - 15 ends of 6 arrows
 - 5 ends per distance
 - adults: 40, 50, 60 meters
 - juniors: 30, 40, 50 meters
 - Cadets: 20, 30, 40 meters
 - five color, 122 cm faces
2. Easton Team event
 - like USAA 900
 - 12 ends of 5 arrows
 - 4 ends per distance
3. Columbia Round
 - like USAA 900
 - 12 ends of 6 arrows
 - 4 ends per distance
 - adults: 30, 40, 50 meters
 - juniors: 20, 30, 40, meters
4. Collegiate 600
 - 12 ends of 5 arrows
 - 4 ends per distance
 - 30, 40, 50 meters
 - five color, 122 cm faces
5. Durye Round
 - 15 to 18-year-old youths
 - five color, 80 cm faces
 - 30 yards
 - 90 arrows in 15 ends of 6

C. NFAA

1. Multiple classes based on equipment being used
2. Flint Rounds
 - 56 arrows from 7 positions
 - scoring 3, 4, 5
 - four arrows per end
 - positions for 30-yard Flint Round
 - 25 yards, 12-inch face
 - 20 feet, 6-inch face
 - 30 yards, 12-inch face
 - 15 yards, 6-inch face
 - 20 yards, 12-inch face
 - 10 yards, 6-inch face
 - 12-inch face, 1 arrow each at 30, 25, 20 and 15 yards

- positions for 20-yard Flint Round
 - 50 feet, 8-inch face
 - 20 feet, 6-inch face
 - 60 feet, 8-inch face
 - 45 feet, 8-inch face
 - 40 feet, 8-inch face
 - 30 feet, 6-inch face
 - 8-inch face, 1 arrow each at 60, 50, 45 and 30 feet
- 3. Field archery tournaments
 - variable terrain
 - variable distances
 - variable target types
 - variable target sizes
 - usually 14 to 28 targets
 - variety
 - of types
 - animal rounds
 - bowhunter rounds
 - silhouette rounds
- D. Novelty shoots
 1. Roving
 - organized or unorganized
 - “winners” select targets
 2. Jugs, balloons, other targets
 3. Wands or strips
 4. Numbered faces
 5. Card games, tic-tac-toe, and other types of targets
- E. Clout shooting
 1. Horizontal 48-foot target
 2. Center flag
 3. 36 arrows in 6 ends of 6
 4. Distances
 - 165 meters – men over 15
 - 125 meters – women over 15
 - 110 meters – youth under 15 years’ old
 - 110 meters – youth under 15 years’ old
- F. Flight shooting
 1. Shooting for distance
 2. Classed by equipment type

(Continued)

- G. Archery golf
 1. like golf
 2. “putting”
 - ball on stand
 - Target face
- H. Creating your own game
 1. plenty of potential
 2. what you or your group likes
 3. many other examples
 - moving silhouettes
 - flying targets
 - archery “skeet”
 - bow disk
 - use your imagination
 - 3D animal targets

Lesson Narrative

Archery includes many different games, both formal and informal. International competitive shooting, including the Olympic Games, is governed by **FITA**, the Federation Internationale de Tir a l'Arc. The governing body for FITA-style shooting in the United States is USA Archery. These organizations govern archery shooting based on large, round, multi-colored targets shot at known distances over level ground.

Most other forms of target shooting with archery equipment take place under the governance of the National Field Archery Association. **NFAA** shooting varies more than **USAA** shooting, and includes activities for bow hunters. Several other organizations also sponsor specific formal competitive events for archers.

International shooting and American competitions in that style are relatively long-range games. These events are the equivalent of high-power rifle competitions, using open ranges and relatively large, multi-colored targets. Men, women, and young people of different ages use different courses of fire. Cadets, kids under 12 years old, shoot at targets from 15 to 4 meters, while men over the age of 18 shoot at ranges from 30 to 90 meters. Targets for these events are either 80 centimeters (shorter ranges) or 122 centimeters (longer ranges) in diameter. The inner, gold-scoring area is worth 10 points and the outermost white scoring area is worth 1 point. International archers must use conventional tackle (compound bows are not permitted), but most American shoots allow them. Nearly all archers use sights, stabilizers and similar equipment; but release aids and several other devices commonly seen in other types of competitions may not be used.

Field archery is more complex. Both indoor and outdoor shoots are governed by **NFAA**, which uses smaller targets with a different scoring system at shorter ranges. Field courses are usually set up with a variety of terrain, target sizes, shooting angles and target types. Archers may cover a course of 14 to 28 targets in each round of shooting. Animal targets are used in some types of shoots. Usually round targets are black and white or blue and white with three scoring rings (scored 5, 4, 3 from the center out). Archers are usually classed by both age and the type of shooting equipment used, from bare bow to unlimited. Compound bows dominate the field, even though all types of equipment can be seen.

In addition to these formalized types of shooting, archers may enter other types of formal or informal shooting games. They can play golf, often using different types of arrows for different types of shots. They can shoot at huge, 48-foot horizontal targets at long range in the game of **clout shooting**. They can try their hand at **wing shooting** using hand-thrown bow birds or even mechanically launched disc targets. Some archers rove the woods and fields shooting at safe targets, like clumps of grass, leaves or small rotten stumps.

Others may play "poker" by shooting at cards on a target face or tic-tac-toe by shooting at the spaces on a target or balloons on a target butt. Any of these are appropriate shooting games for the archer.

While the formal games have documented rules, the informal games you invent can have any set of rules you decide. You are only limited by your imagination. The main things to remember in games are:

1. Safety must be carefully and completely considered always.
2. Perfect practice makes perfect shooting (good shooting form is essential to all shooting).
3. Keep it fun by balancing skill and challenge.

Have a good time trying some archery games, competitive ones with other archers or skill-building ones you can play alone. It is almost impossible not to enjoy yourself while shooting arrows down range.

Summary Activities

1. Shoot at least one type of formal target archery game. If possible, try several different types of target shooting during a series of field trips where the sites and the opportunities present themselves.
2. Have participants research different archery games and present a summary of the rules and courses of fire to the group.
3. Attend an archery shoot and observe the processes used in conducting it. Assist or co-sponsor a shoot if the young people are prepared to do so.
4. Organize and conduct an invitational archery shoot of your choice for the youth in our area or in neighboring counties.

Exhibit and Sharing Ideas

1. Construct a model of an archery shooting field or range and explain the course of fire used.
2. Photograph a tournament or match and tell the story with photographs and appropriate captions.
3. Research an archery game. Write rules, course of fire and history. Exhibit in your shooting sports notebook or journal.
4. Exhibit your notebook or journal with scores, comments and notes on a series of events in which you have participated.
5. Demonstrate an established game for your club or other groups.
6. Arrange a shoot for other members of your club or another group, featuring a game of your preference.

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Glossary of Terms in Section 3

Determining Eye Dominance

Ronald A Howard Jr. and James V. Peter, Jr. *

Eye Dominance

Most people have a dominant eye, just as they have a dominant hand or foot. When a person looks at an object with both eyes, the dominant eye aligns directly with the object unless an obstruction interferes with a clear line of sight. Under normal conditions, when a finger is pointed at an object, or two or more objects are aligned visually, the dominant eye determines the alignment. Just as some people are truly ambidextrous, a very small number of people have indeterminate eye dominance. The majority, however, have a dominant eye. In most cases eye dominance and hand dominance are on the same side, but many people are cross-dominant. That is, their handedness and eye dominance are on opposite sides.

Humans have binocular vision – they get slightly different images from each eye and blend them in the brain to yield one image and a sense of depth or distance. With both eyes, open, you have a wider field of vision with more peripheral vision and better motion detection. In short, you simply see better when both eyes are used. Experience shows that

shooting skills are learned more easily and often better developed when a shooter learns from the dominant eye side. Where eye dominance and handedness are on the same side, new shooters easily use the dominant side. Cross-dominant shooters have a greater challenge, but they do better when they learn to shoot with the dominant eye.

Some shooters, particularly those with successful experience in shooting with the non-dominant eye, are reluctant to switch. The switching process usually involves a brief period of reduced success and frustration, followed by improved skill levels beyond their original level. Some experienced shooters have learned to shoot one-eyed, closing the dominant eye or obstructing it with a shield, blinder, spot of tape of a small object on the lens of the shooting glasses. Others have learned to override their dominant eye through practiced concentration or to compensate in some other fashion. Fewer than 1 percent of all shooters must shoot one-eyed because of dominance switching. In most cases, the shooter learns to use both eyes and shoot from

the dominant-eye side.

Learning one-eyed or with the dominant eye obstructed or closed increases stress and fatigue, and reduces concentration and quickness. Results indicate reduced performance levels, increased frustration for the shooter and slower learning.

Learning to shoot well is a challenge. You need every advantage to meet that challenge effectively. Learning from the dominant-eye side is a major advantage.

How to Determine Eye Dominance

Four basic methods for determining eye dominance are described. Those that provide a check for “cheating” are more effective in an instructional setting. Regardless of the method selected, the exercise should be repeated several times. Instructors should remain alert for eye-dominance related problems with shooting performance.

Coach-pupil Method

Shooters should get into their coach-pupil pairs, standing several arm-lengths apart and facing each other squarely. The “pupil” should place one thumb over the other, then cross the fingers of the top hand over those of the bottom

one. This leaves a small, triangular opening. Raise the hands, keeping both eyes open, and center the “coach’s” nose in the triangular opening. At this point the coach should note which eye is visible in the opening. Then the “pupil” should bring his or her hands slowly back to the face, keeping the “coach’s” nose in the opening. The hands should come to the dominant eye. Coaches must watch closely for wavering between the eyes, an indication of “cheating” or forcing the hands to a predetermined eye. The exercise should be repeated several times to confirm original results with both partners checking their eye dominance.

Option: Shooters could cup their hands together, leaving small openings between the bases of the little fingers and the thumbs. A card or a sheet of notebook paper with a small hole centered in it could also be used.

Distant-object Method

Use any of the methods of making an aiming device outlined above. Center a distant object in the opening. Make sure both eyes stay open and face the object squarely.

Finger-point Method

With a pointing method, a distant object or a partner is used. The finger is pointed naturally at the object with

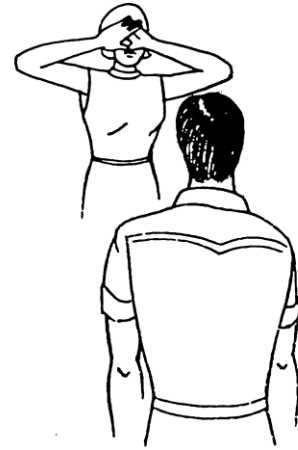
both eyes open and the face square to the object. The eyes are covered or closed alternately. When the dominant eye is closed, or covered, the finger appears to jump away from the original location.

Tube Methods

Kaleidoscopes, toilet paper tubes and similar objects can be used with many young people to determine eye dominance. When the person is not aware of being tested for eye dominance, the tube will almost always be brought to the dominant eye. This also occurs with spotting scopes, telescopes, and similar tools where one-eyed viewing is needed.

Troubleshooting for Coaches and Instructors

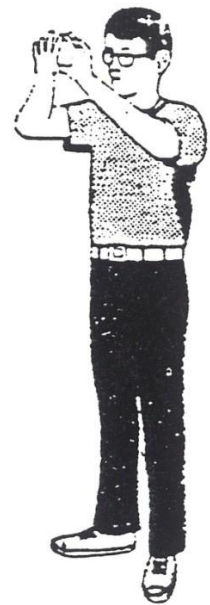
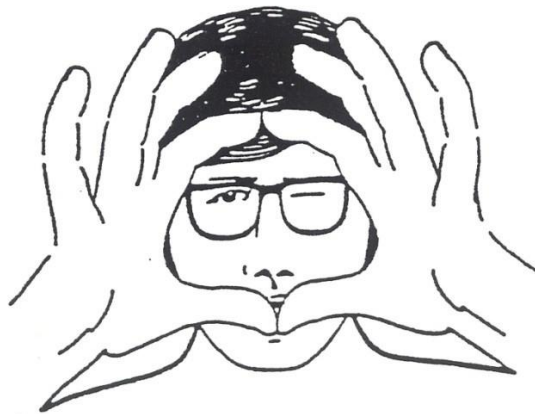
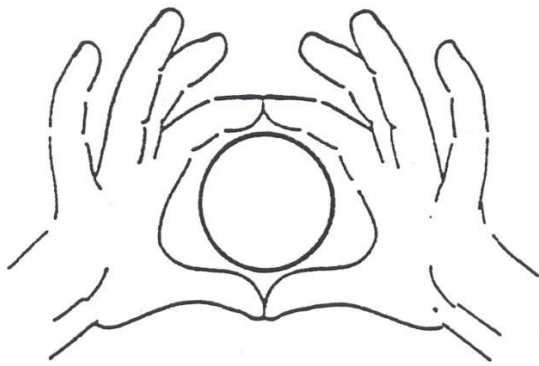
Some shooters will bring the opening back to their own noses because they are looking at the paper or their hands rather than at the target. Those who use the finger-point method will see two fingers if they focus on their hand rather than on the target. If inconclusive results are obtained, try another method. Make note of that shooter, however, and watch for evidence of switching dominance in the act of shooting. Consistently missing to one side of the target usually indicates an eye-dominance related problem.

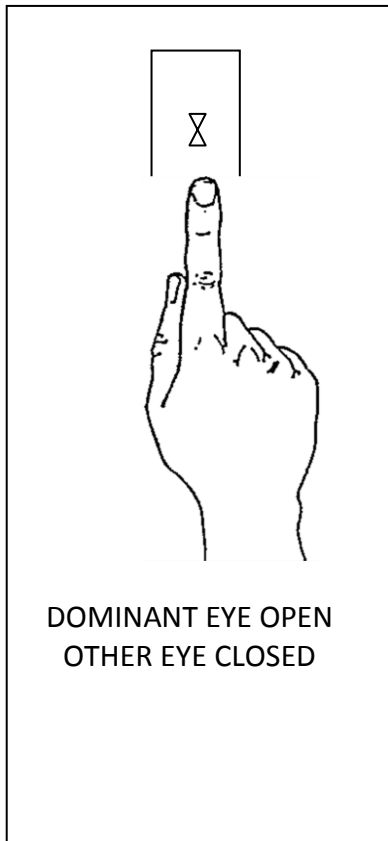


A Note of Caution

Vision problems can have a serious impact on shooting ability. Often, they go undetected by the shooter or those around them. Unless you are an ophthalmologist or optometrist, avoid “diagnosing” vision problems, but be aware of the types of problems a shooter with vision problems may face. Discuss any potential problems you observe with the shooter and his or her parents. Like teachers who notice reading problems or other vision related difficulties, the shooting instructor may notice things that even the shooter misses. Finally, be sure that all shooters are wearing adequate eye protection while they are on or near the firing line. Some people recommend the use of shooting glasses even for archers. Eyes are precious and vision is vital to shooting. Let’s do our part in protecting them.

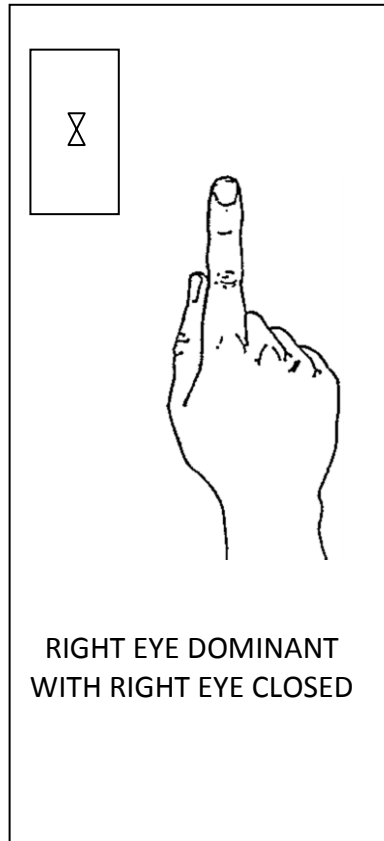
DOMINANT EYE





Check for Eye Dominance

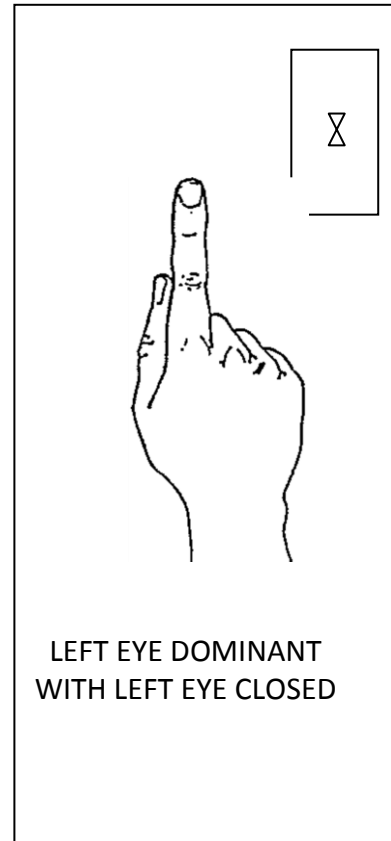
With both eyes open, point your finger at a small object 10 - 20 feet from you.



Right Eye Dominance

Close your left eye and the object will not move.

Close your right eye and the object will appear to jump to the left of your finger.



Left Eye Dominance

Close your right eye and the object will not move.

Close your left eye and the object will appear to jump to the right of your finger

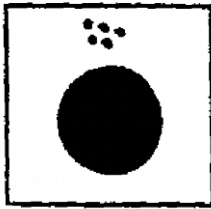


Figure A-1: Two fingers of left hand simulate rear sight. Index finger of right hand simulates front sight. Represents perfect sight alignment.

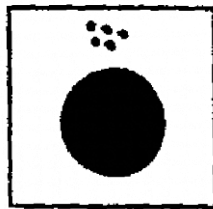


Figure A-2: Keeping tight hand stationary, move left hand down to simulate moving rear sight down.

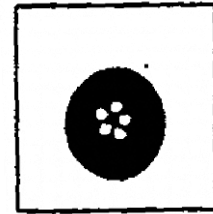


Figure A-3: After the rear sight (left hand) is moved down, realign sights. Thus, right hand moves down to simulate moving muzzle down.

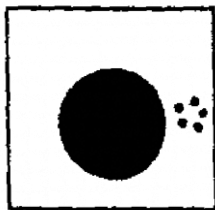
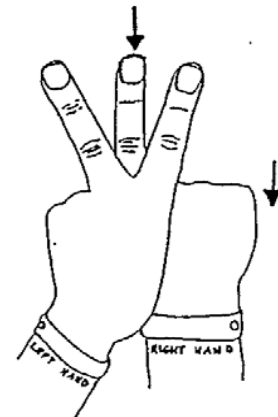
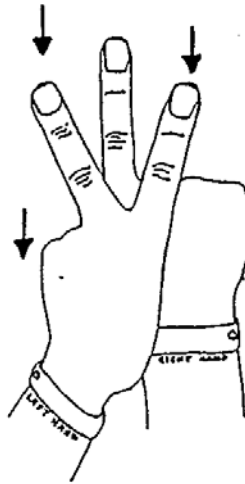
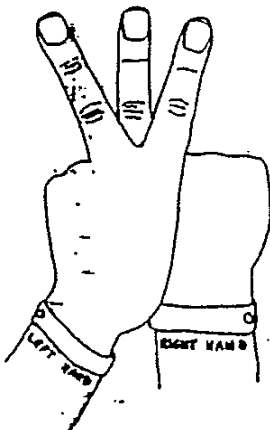


Figure B-1: Two fingers of left hand simulate rear sight. Index finger of right hand simulates front sight. Represents perfect sight alignment

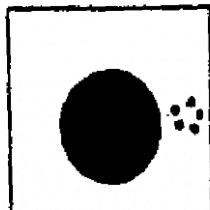


Figure B-2: Keeping right hand stationary, move left hand to the left to simulate moving rear sight to the left.

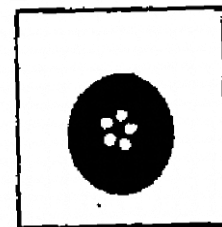
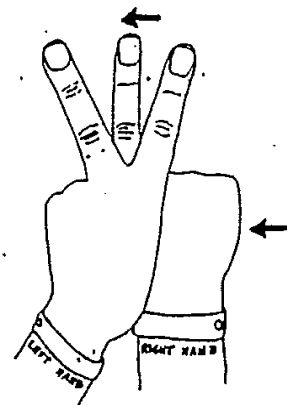
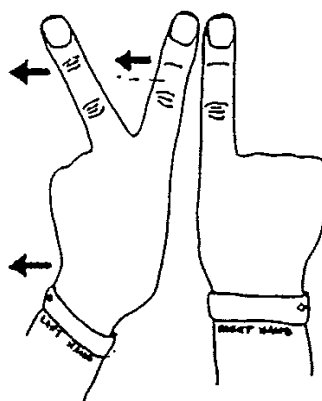


Figure B-3: After the rear sight, left hand) is moved left, realign sights. Thus, right hand moves left to simulate moving muzzle left.



Non-threatening Hands-on Instruction

James V. Peter, Jr.*

A major element of shooting is stance. When working with shooters, particularly beginners, instructors frequently must use their hands to position them or correct their form or assisting them with equipment and shooting clothing. Even though close contact with the shooter is essential for effective instruction, the instructor must be careful to avoid any action that could appear improper or cause the student anxiety. A few simple actions can ensure a working relationship between instructor or coach and student without any question of anxiety or impropriety.

Respectful, non-threatening treatment of shooters begins with demonstration. Use a junior leader or an assistant to demonstrate proper posture or position and then as to how instructors will handle/assist shooters to correct their posture or position. By telling the shooter what you are about to do you can further reduce his or her anxiety. Ask permission before touching and tell the shooter you are going to push his or her torso forward, raise an

elbow or reposition a hand. The posture of your hands when contacting the student can also ease anxiety. Except in an unsafe situation where immediate and decisive action is required, it is seldom necessary to “grab” a student or the firearm. When your hands are held relatively rigid with the fingers straight and the thumbs resting on the top of the hands, they are much less threatened. Pressure from the palms of flattened hands (fingers not curled) can accomplish most positioning and controlling needs. This is called “Non- threatening Hands on Instruction.”

Non-Threatening Hands on Instruction

- Positioning or Stance
- Equipment & Shooting Clothing
- Always Respectful
- Use Demonstrations
- Request Permission to touch
- In response to student’s need
- Avoid Breasts, Buttocks, and Groin

- Should Be Open & Not Secretive
- Governed by Age
- Always Appropriate When Safety of the Individual or Group is At Stake

Examples and Advice

Assisting with coats, shooting vests or shooting coat or jacket. There are several adjustments that can be made on a shooting jacket/coat that help the fit and performance of the individual. As we teach in instructor training there are appropriate methods and inappropriate ways of non-threatening hands on instruction or assistance. Utilizing same gender assistance or students helping students may be the most appropriate for the situation. Age of participants, gender, and individual permissions are also factors that must be considered. The one exclusion is when the immediate safety of the individual or others is at stake.

ARCHERY RANGE RULES

- 1) Know and obey all range commands.
- 2) Keep your arrows in your quiver until you are told to shoot.
- 3) Always wear your arm guard and finger tab.
- 4) Only use arrows the instructor gave you. Remember what they look like.
- 5) Always keep your arrows pointed down or towards the target. Shoot only at your target.
- 6) Only release a drawn bow with an arrow nocked on the string.
- 7) If you drop an arrow, leave it on the ground until you are told to pick it up.
- 8) Always walk at the archery range.

ARCHERY RANGE WHISTLE COMMANDS

- 1) Two Blasts – "Archers to be shooting line"
- 2) One Blast- "Begin shooting"
- 3) Three Blasts- "Walk forward and get your arrows"
- 4) Four or more Blasts (series of blasts)- "STOP SHOOTING IMMEDIATELY and put your arrows in your quiver"

ARCHERY RANGE PROCEDURES

- 1) Wait behind the waiting line until you hear 2 whistles and/or "Archer's to the shooting line". Pick up your bow and straddle the shooting line.
- 2) Keep your arrows in your quiver until you hear 1 whistle and/or "Begin shooting".
- 3) After you have shot all your arrows, step back from the shooting line, set your bow on the rack, and wait behind the waiting line.
- 4) After everyone is done shooting and behind the waiting line, the instructor will blow the whistle three times and/or tell you to "Walk forward and get your arrows and stop at the target line".

PULLING YOUR ARROWS

- 1) Two archers at a time, from each target, may go from the target line to pull their arrows.
- 2) Stand to the side of the target, and make sure no one is standing behind your arrows.
- 3) Pull your arrows out one at a time, and put them in your quiver.
- 4) When looking for an arrow beyond the target, set an arrow on top of the target to warn others that someone is behind the target.
- 5) After you have pulled all the arrows, wait behind the target line until the instructor tells everyone to walk together back behind the waiting line.

Securing Target Mats

Some of the target mats come with their own system for standing on the ground. Most of the round mats require some type of stand to hold the targets up. Target stands are available, but most are made of metal and do not hold up well or last very long.

The metal is also hard on the arrows when hit. Simple target stand tripods can be made with 2' X 4's.

Whatever you use, keep the targets as close to the ground as possible. Missed arrows won't go as far, and it will be easier for the kids to score and pull the arrows from the mat.

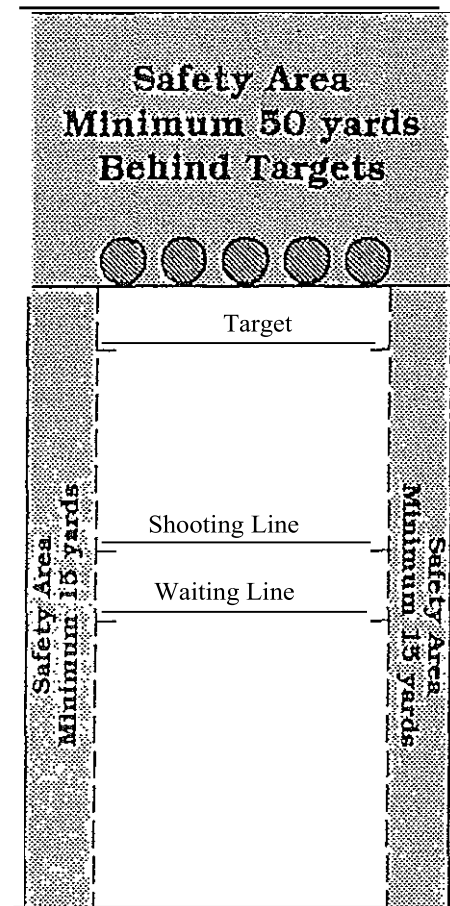
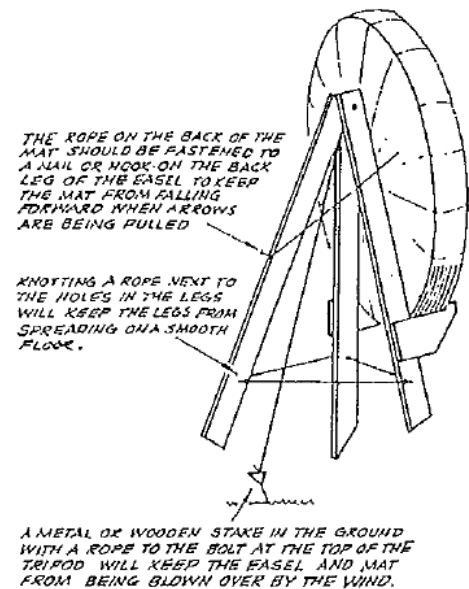
Target butts, mats and stands **must** be secured so they will not fall forward. A target mat with arrows in it could cause serious harm if it falls over on a child who is pulling arrows out. Also, if a target fails the arrows in the target will be bent or broken.

Archery range layout

A range should have a shooting line, waiting line, and a target line. These can be made with rope, tape or lime. Do not secure the ends, to prevent tripping. The shooting line should be at a distance close enough for the kids to hit the target every time. This will vary with the age and ability (or disability) of the archers, and the size of the target butts.

The waiting line should be 3 yards behind the shooting line. The waiting line allows the range director to have a clear view of the archers who are shooting, and a clear line so the whistle can be blown only after archers' finish shooting.

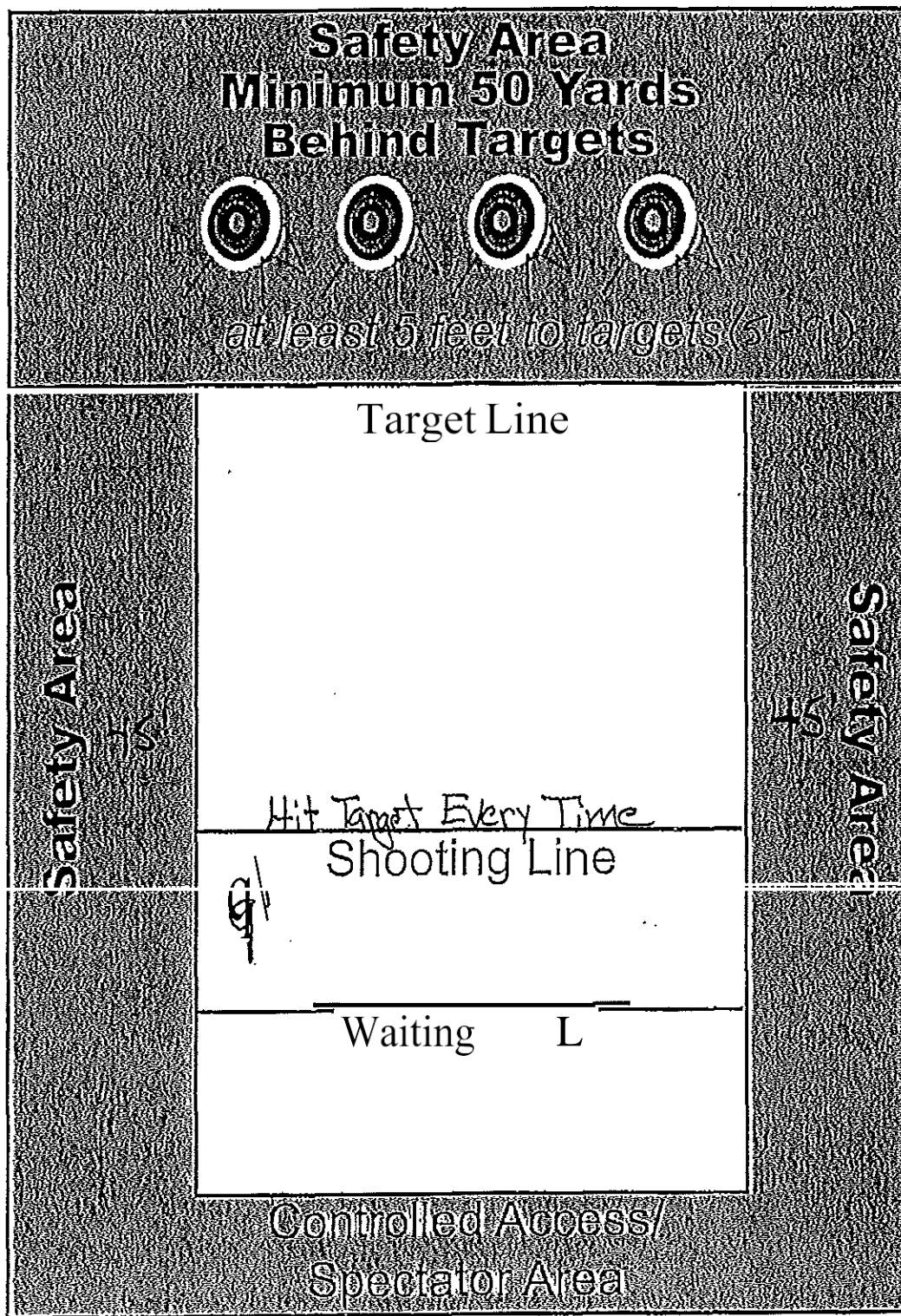
The target line should be 3 yards in front of the targets. This line acts as a 'speed bump', slowing the kids down so they won't run into the arrows sticking out of the target. It also keeps the kids that are waiting for their turn to pull arrows a safe distance in front of the targets.



Controlled Access /Spectator Area

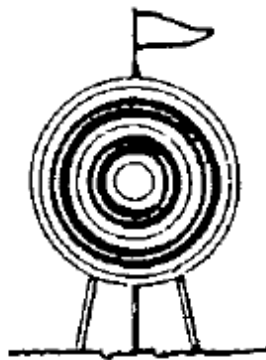
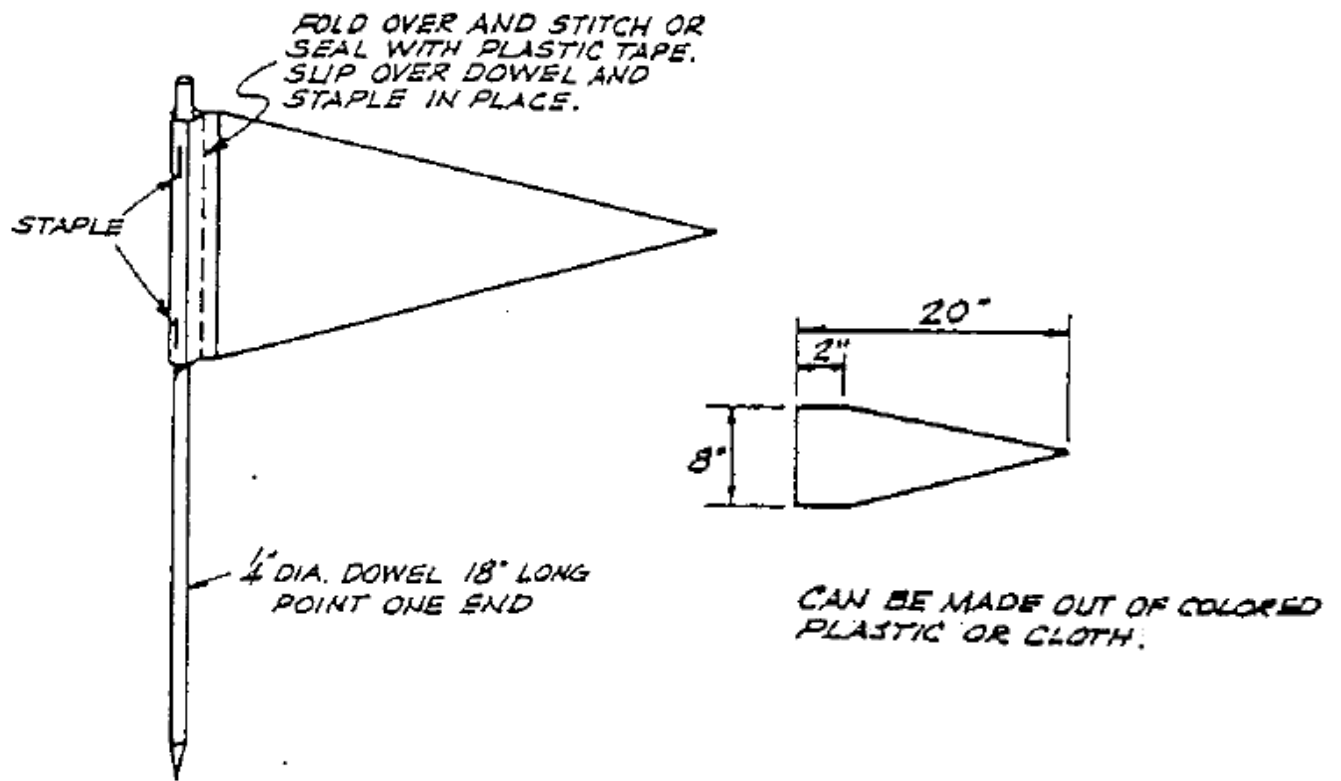
Equipment safety will be discussed in the chapter on Equipment

Outdoor Archery Range Layout

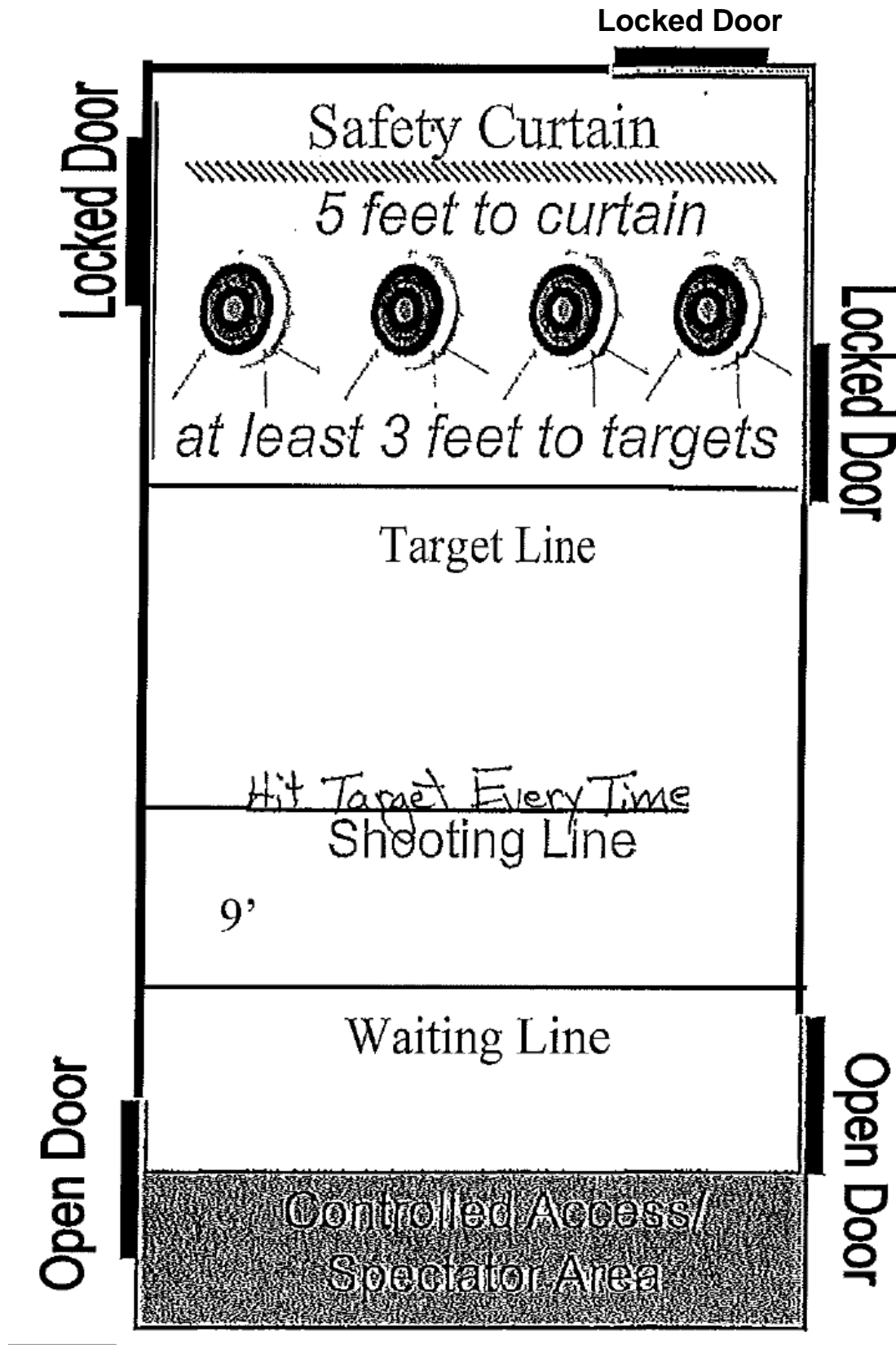


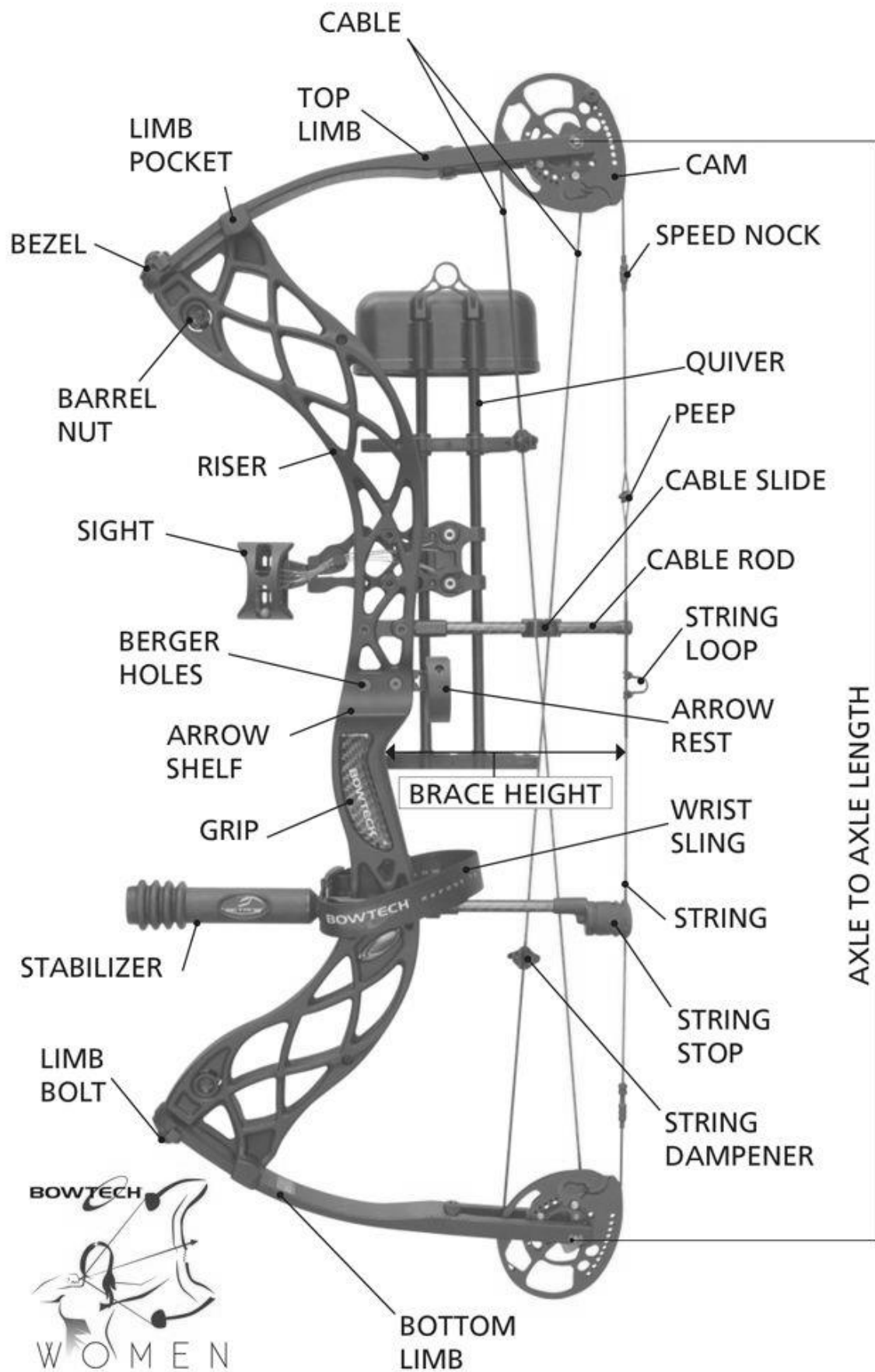
Appendix 6

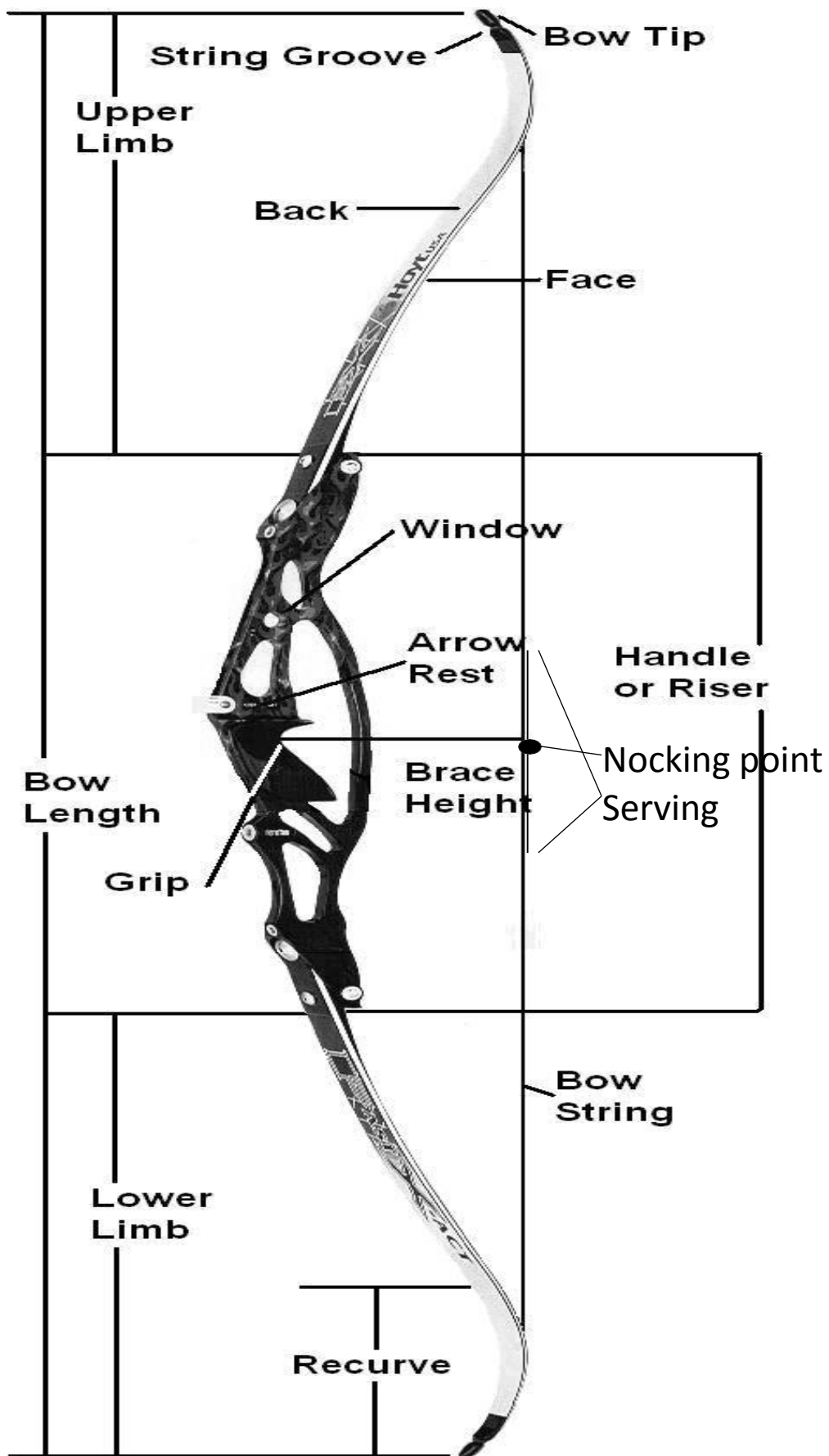
WIND FLAGS



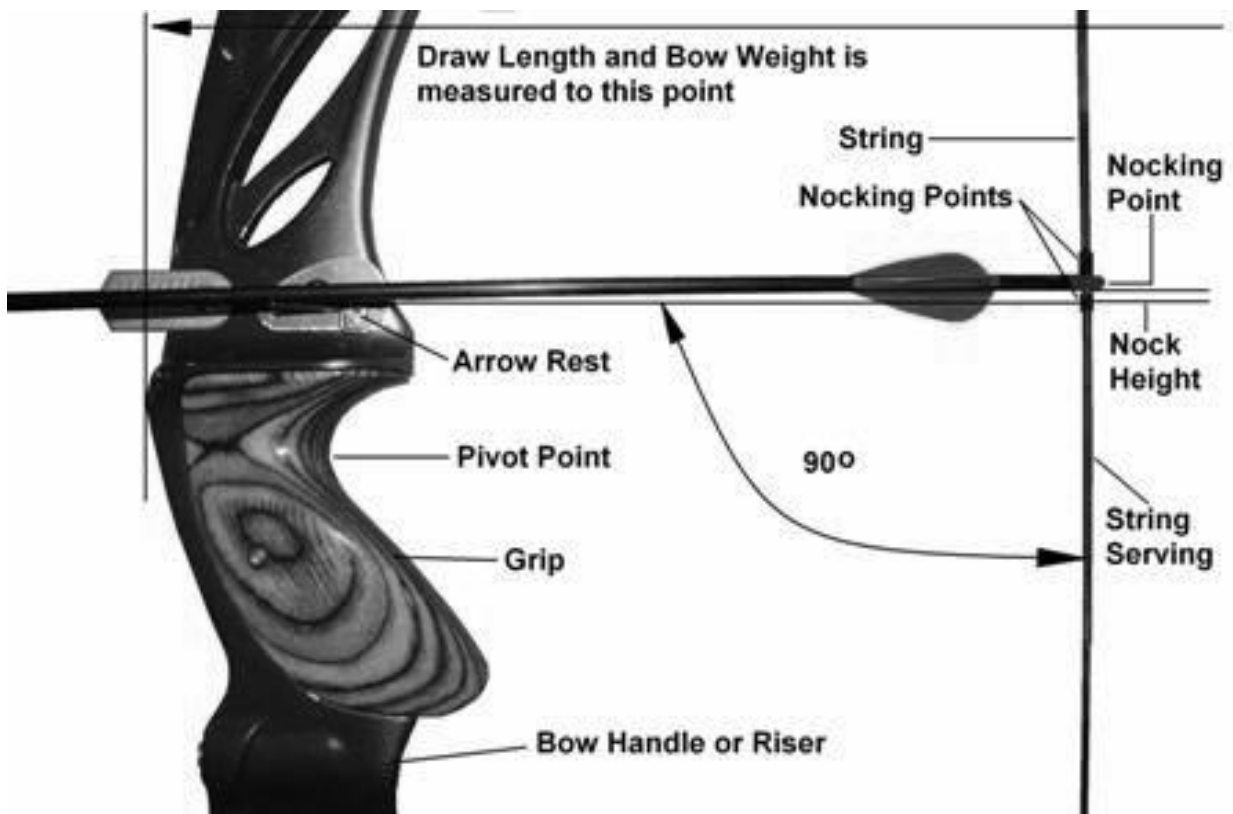
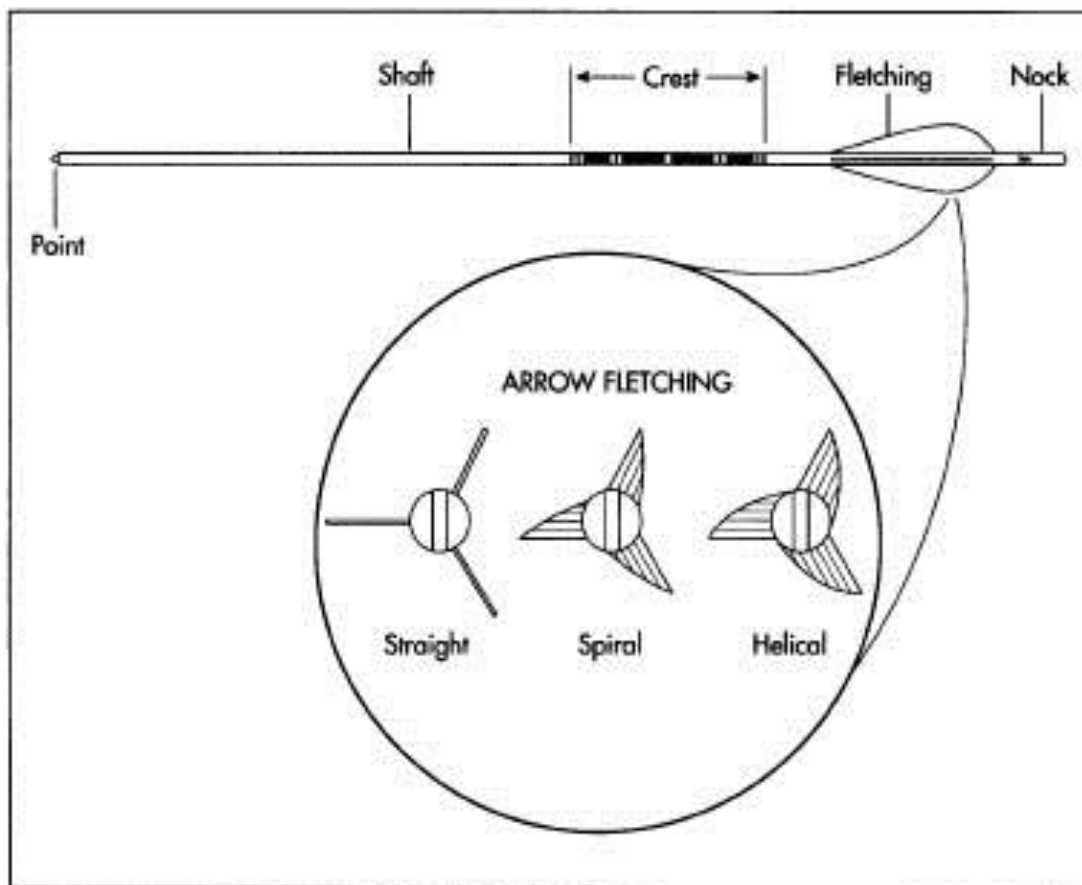
Indoor Archery Range Layout







Before purchasing equipment, it is necessary to know the nomenclature involved.



Bow Stringers

Ronald A. Howard Jr. *

Developing high standards of safety is one objective of the 4- H Shooting Sports Program. Using a bow stringer for bracing and unstringing recurve bows is an important safety practice. Many archers are comfortable stringing bows with a variety of methods. Some of them involve risk to the archer. Others are risky for the bow. Use of a bow stringer should be practiced by all archers using recurves and longbows. Numerous bow stringers are available from commercial suppliers, and others may be made inexpensively.

Cord stringers come in two primary styles. Single-pocket stringers have a cup or pocket made of leather or similar material. It attaches to the tip of the lower limb. A pad, bar or other structure fits over the upper limb of the bow. Double- pocket stringers have a long pocket that fits the lower limb tip and a shorter one that fits the tip of the upper limb. They are used in a similar fashion. The shooter attaches the ends to the bow, stands on the middle of the cord and pulls the handle of the bow upward with one hand while sliding the upper loop in the string into the upper string nock. The positioning of the loop is checked before the tension with the hand is relaxed.

Wall or box stringers allow the shooter to use more of their body or mass to help with stringing the bow. The box stringer allows the archer to press the bow into braced position using the weight of their bodies. Wall stringers allow the shooter to use the limbs of the bow as levers to give them a mechanical advantage in stringing the bow.

Plans for wall and box stringers are included in the appendices of the *National Archery Association Instructor Manual*. These stringers would be excellent woodworking projects for linking shooting sports with agricultural engineering, wood science or related project areas. They also may provide a benefit to the club or range sponsoring the 4-H shooting activities. Stringer projects could be used for method demonstrations or fair exhibits as well.

RECURVE BOW STRINGER

Making a Bow String

by spconlin

The kindest thing an archer can do for his bow is to use a bow stringer. Aside from making it easier to string the bow, the stringer allows for applying even pressure on the limbs during stringing so there is less chance of breaking or damaging the bow. This article will explain how to make a stringer that will work on most bows. The stringer is made up of three parts, the pocket, the saddle, and the cord. The function of each part is explained at the end of the article.

To make a simple stringer you will need the following:

- a length of cord 7-8' long (I use 8')
- a scrap of leather or suede at least 5 inches' square
- a hole punch
- a rivet (not a pop-rivet) or heavy waxed thread and needle

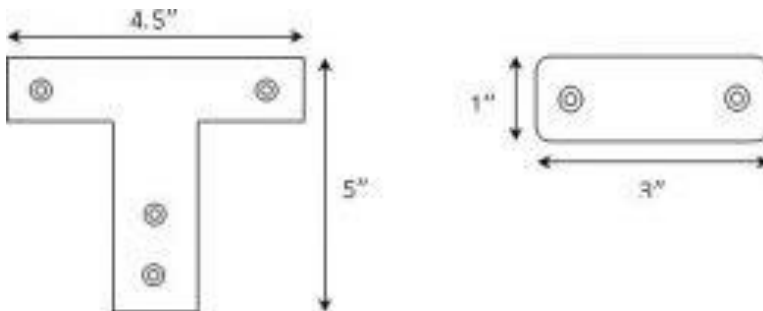


Figure 1: Leather Tab Patterns



Figure 2: How to fold the pocket tab



Figure 3: A completed bow stringer

You will need to cut two shapes for the leather (see diagrams). The first piece will be used to make the pocket. This piece is shaped like a “T” and measures 4.5” for the top and 5” for the body. The second piece should be 3” long and 1” wide. I usually round the short edges. Once these are cut you are ready to begin assembly.

You will need to punch holes in the $\frac{1}{4}$ ” from each of the sides of the saddle. The holes should be large enough to fit your cord through. The number holes required for the “T” depends on whether you use a rivet or thread. If using thread, you will only need one hole, large enough for the cord to pass through twice, punched $\frac{1}{4}$ ” from the bottom of the “T”. The diagram shows the single hole and the approximate holes for the rivet.

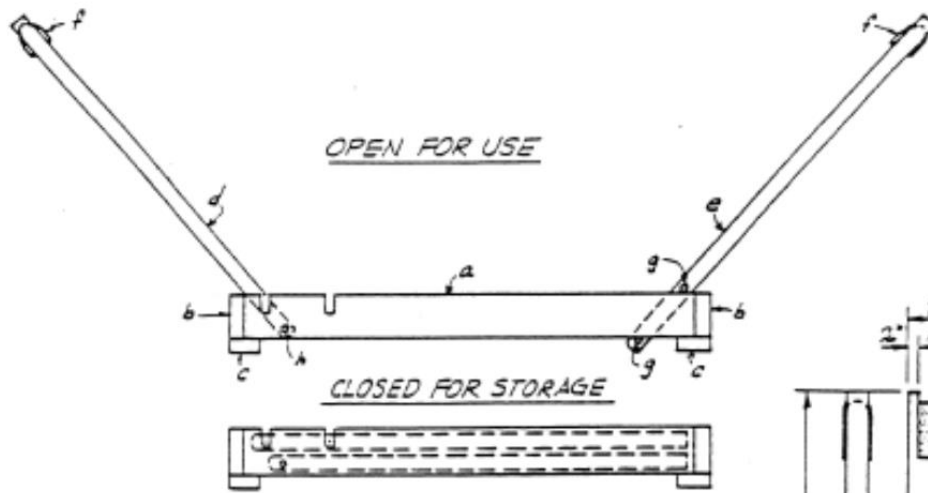
To make the pocket you will need to fold the top of the “T” over twice and then fold the flaps under so the overlap. You will then secure the bottom three layers; the two flaps and “T” body. You should now have a pocket with a loop above it (see diagram). You can now run your cord and complete the stringer

Start running the cord into the “T” with the pocket on top. The cord should pass through the hole from the top; then through the loop (pictured on the left above), and then back through the hole from the bottom. Once the cord is run, secure the strand together with a knot. The saddle is strung by running the cord up through the first hole, down through the second, and securing the cord together with a knot that will not slip. You should leave some room in the loop so it will slip over the bow without too much trouble.

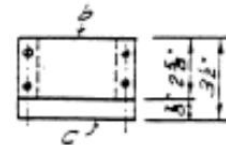
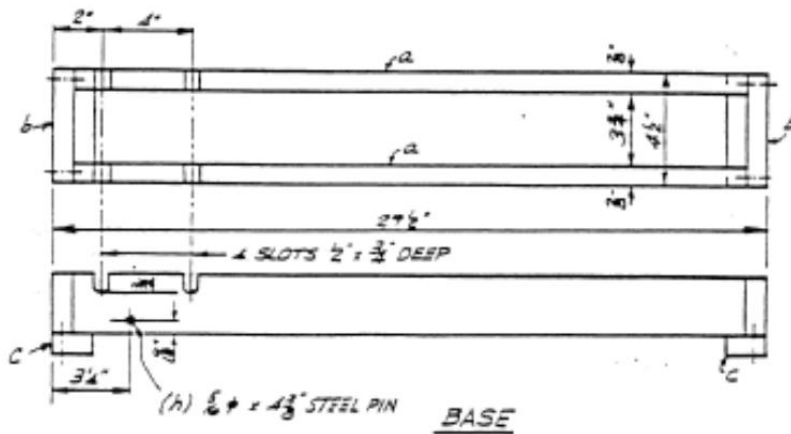
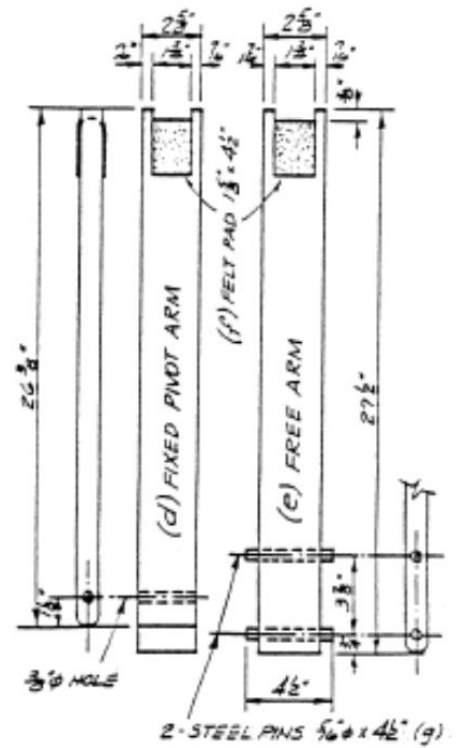
You now have a bow stringer, but do you know how to use it? If not read on and I will offer a quick lesson in stringing your bow. Hold the bow so the string hangs beneath it and slip the pocket of the stringer over the end that already has the string in place. Now slip the saddle over the other end and position it just behind the other loop in the bowstring. Place your foot on the stringer cord and pull up on the handle of the bow; the bow will bend into shape. While holding it in position, slip the loose loop down into position. Your bow is now strung. You should verify that both ends of the string are seated correctly before drawing the bow.

Appendix 4

BOX BOW STRINGER

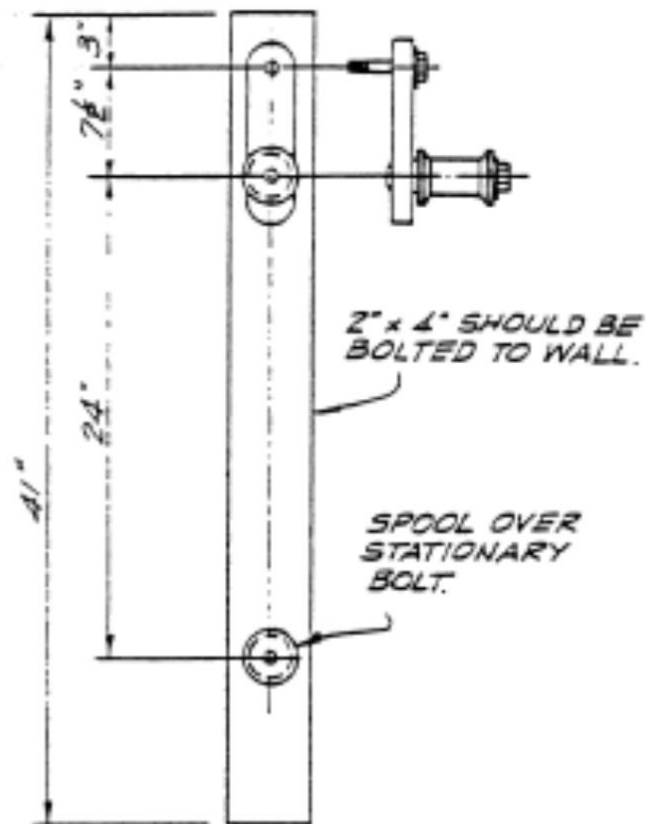


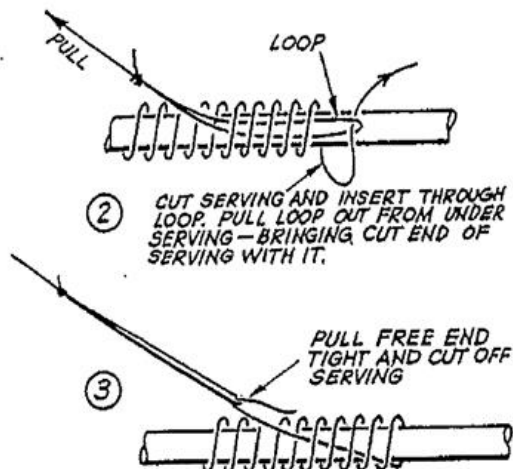
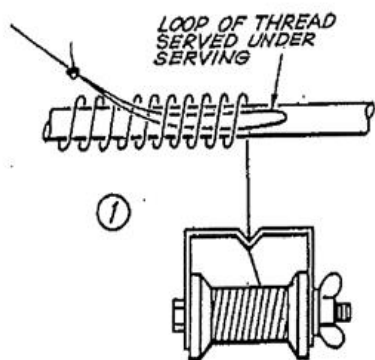
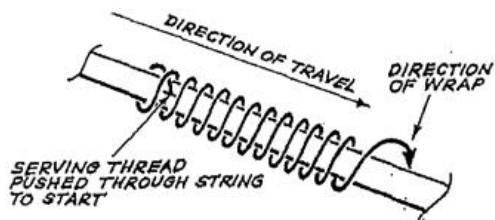
LIST OF MATERIALS				
a	2	2 3/8" x 2 9/16" x 3/8"	HARDWOOD	
b	2	2 3/8" x 4 1/2" x 3/8"	"	
c	2	2" x 4 1/2" x 3/8"	"	
d	1	2 3/8" x 26 3/8" x 3/8"	"	
e	1	2 1/2" x 27 1/2" x 3/8"	"	
f	2	FELT PADS 1 1/2" x 4 1/2" x 1/4"		
g	2	STEEL PINS 5/16" DIA. x 4 1/2"		
h	1	" " 5/16" DIA. x 4 3/8"		
	12	F.H. WOOD SCREWS #8 x 1 1/4"		



Appendix 9

WALL BOW STRINGER





Serving a Bow String

Beginning and finishing servings are not difficult, but it may be necessary to practice both before trying to serve the bow string. Wax the area to be served to keep the serving material from slipping.

Beginning a Serving

Slip the end of the serving material between the strands of the string and lay the end along the string. Wind the serving material so that it covers the end that has been laid along the string. Keep the strands of the serving material tightly wound and close together.

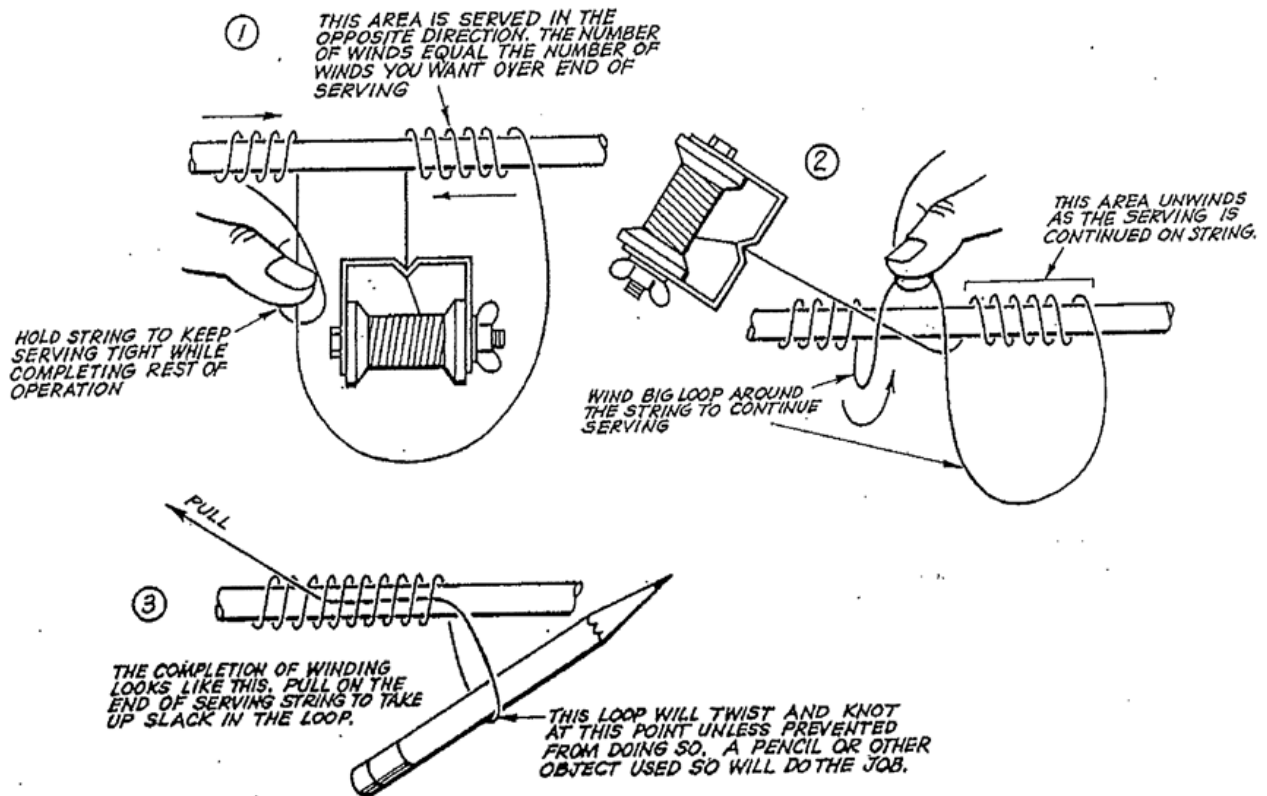
There is a definite relationship between the direction of travel and the direction of wrapping which *must* be maintained to keep from unwinding the individual filaments which make up each strand of string material. If the serving is to be *wound from left to right*, the server must come toward you *under* the string. If going from *right to left*, it must come toward you *over* the string.

Finishing a Serving

There are two methods commonly used to finish a serving. Each has advantages and disadvantages, and in most cases which one is used is a matter of preference. In either case, there should be five to eight wraps of serving thread over the cut end of the finished serving.

Method 1. This method involves laying a loop of serving thread alongside the string material and serving over it. When the desired number of wraps have been placed on the string, the serving thread is cut and the end inserted in the loop. The loop is then pulled from under the serving, pulling the end of the serving material through with it. The excess serving material is then cut off. Follow the diagrams.

Method 2 This method is difficult to describe. Follow the diagrams. The final loop that is pulled under the serving will tangle unless it is kept under tension by pulling against it with some pointed utensil such as a pencil.



Applying a Nocking Point

This is an easy method of serving a permanent nocking point on the bow string. The exact location of the nocking point must first be determined by either measuring with a bow square (see Chapter 5, FIRST LESSONS IN ARCHERY) or by shooting a bare shaft as described in Chapter 10, BASIC BOW TUNING.

The bow string diameter must be correct at the nocking point so when an arrow is nocked on the string and pulled to full draw, it will not be necessary to hold the nock with the fingers of the drawing hand. But it also must be loose enough to fall off when an arrow is nocked and the string is tapped (the bow is pointing downward). If the string is not thick enough, there are two solutions:

1. If the string already has the center serving on it, dental floss can be served on the area of the nocking point.
2. If the string is being made and does not have a center serving on it yet, or the center serving has been removed, one or more six inch pieces of string material may be placed along the strands of the string where the center serving is to be placed. Then the serving is wound, covering the extra pieces of string material.

3. The string is now ready to have the nocking point applied. Properly done, it is durable.
 - Mark the lower and upper edges of the nocking point on the bow string with a pencil.
 - Cut a 10-inch piece of dental floss and tie an overhand knot so that one end of the piece is seven inches long and the other is three inches long. Lay the three-inch end along the area to be served.
 - Winding in the same direction that the fingers leave the string upon release, serve a small area below the nocking point so that it is too thick for the arrow nock. Then serve the area under the nock, making the area wide enough for the nock and the correct thickness to hold the nock on the string properly. Above the nocking point, again serve an area that will be too thick to allow the nock to move. Finish the serving by Method 1 under Finishing a Serving.
 - Twirl the nocking point between the index finger and the thumb to melt the wax and seal the area served. Smear a layer of pliable glue on the nocking point. After it has dried, add four layers of glue alternating between pliable and hard glue. Allow each layer to dry before applying the next
4. Metal nock locators can be used instead of the dental floss serving, but while easier to apply, the hard metal causes more wear to nocks and tabs or gloves. These are clamped on the bow string above and below the nocking point. When using the metal nock locators, it is critical that there be extra room allowed between the locators so they will not pinch the arrow nock (See Chapter 10, BASIC BOW TUNING, for a discussion.)

Serving a Kisser Button

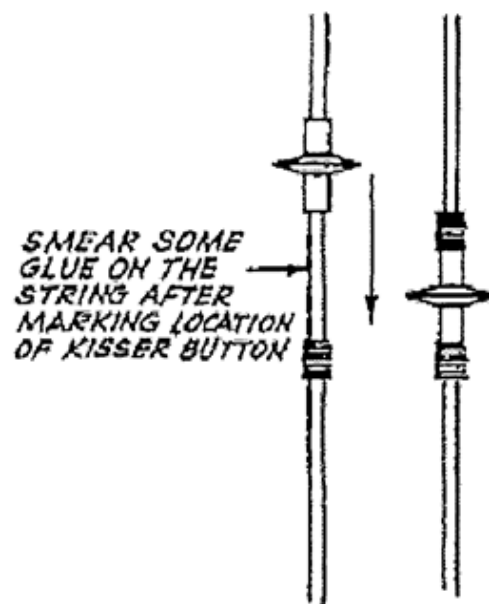
There are several types of kisser buttons on the market. Almost all have a slit on the sleeve that goes around the bow string. When the bow is unstrung, the strands of the bow string can be guided through this slit one at a time until all are within the sleeve.

To determine the correct location of the kisser, have the archer string the bow with the kisser button on the string, go to the shooting line, and come to full draw with a nocked arrow on the bow string. While the archer is at full draw, move the kisser on the string so it is positioned between the lips; mark the string with a pencil. Repeat this several times to be sure the location is consistent and comfortable for the archer.

When serving the kisser button, it is important that it is done in such a way that it cannot move or wobble. It is noisy if it wobbles and if it moves it defeats the purpose of using a kisser.

Clearly marked where the kisser button will be located. Put the kisser button on the string and move it above the area marked. Using the method described for beginning a serving, serve down the string for a small distance with standard serving thread. Depending upon the thickness of the string, the kisser will either slide onto this layer of serving, or will butt up against it. Continue serving downward until there is about one-half inch of serving on the string. Then begin to serve upward over the layer of serving just done until the serving butts against the kisser button. Take

the serving thread through the slit in the kisser and continue serving upward until there is, again, about one-half inch of serving on the string, this time above the kisser. Finish the serving downward over the layer just served by either of the methods of finishing a serving described in this chapter. Before doing this, count the number of wraps made upward, and do one more downward to insure the kisser button is held snugly by the serving.

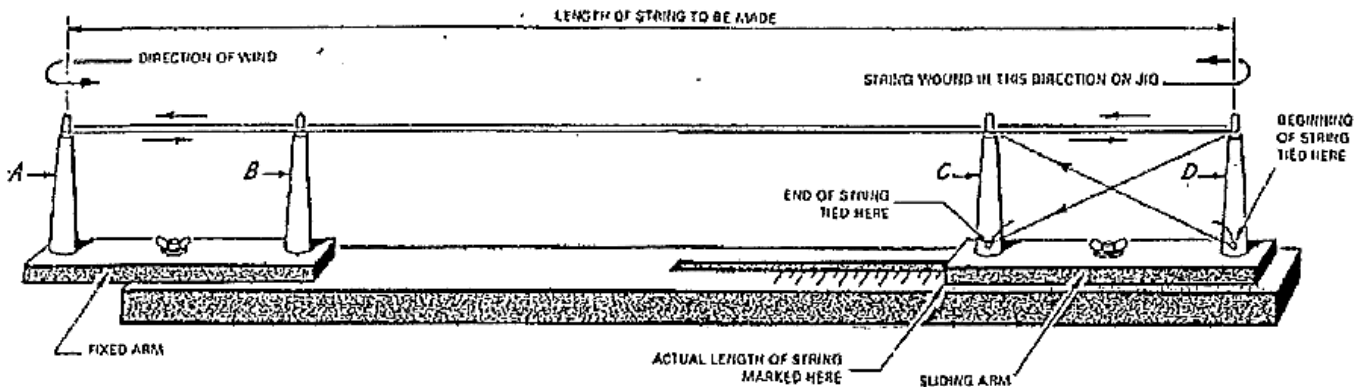


Cover the dental floss with a generous amount of pliable glue and then follow it with a hard glue such as that used for fletching. Allow the glue to dry thoroughly.

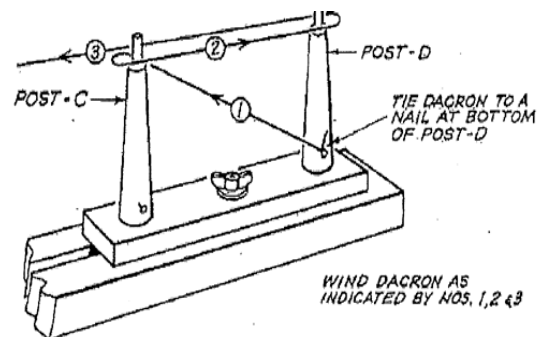
Making a Bow String

If an archery program has a limited budget, making bow strings can save money. Besides, it is an interesting activity, particularly for advanced students. The method described here uses the string jig shown on the following page. When making strings, Dacron bow string material is recommended for beginning students. Read completely through the instructions before proceeding.

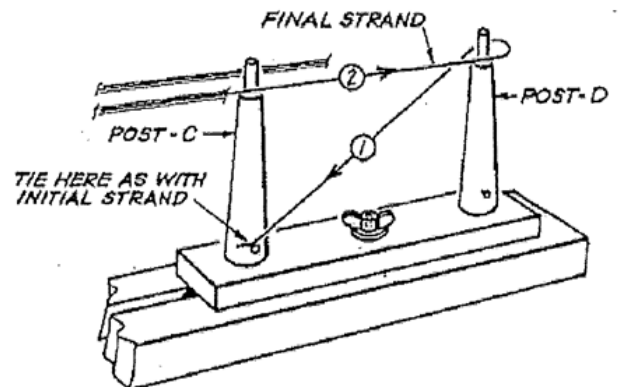
The length of the new string may be determined by placing an old string on the jig provided it is the proper length, and adjusting the sliding arm until the string is held under tension.



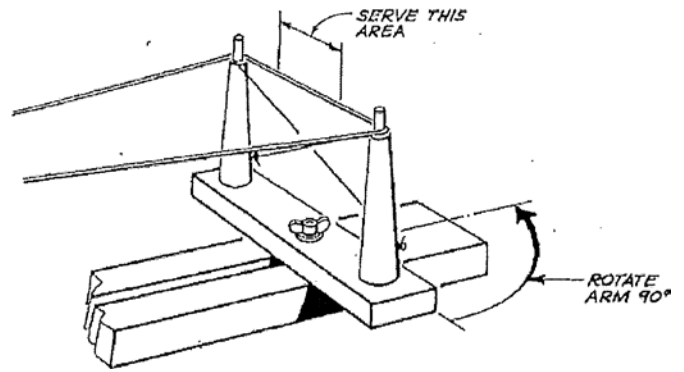
The beginning end of the string thread is then tied around a nail or the bottom of post D. The Dacron is wound around post C and then D, around post A, and back to D. The diagram illustrates the beginning of the string.



Continue to wind the string material around posts A and D in the same direction until the correct number of strands have been placed on the jig. (As the string material is wound around the posts, every complete turn creates two strands in the finished string; i.e., six complete turns make a 12-strand string. Use the guide in Chapter 2, EQUIPMENT SELECTION, for determining the correct number of strands needed for a draw weight.) When the required number of strands have been wound on the jig, tie and cut the string material.



Loosen the wing nut on the C-D arm of the jig and pivot it in the same direction as the strands of the string material were wound. Pull the arm taut and tighten the wing nut. The area between the posts will become the bottom loop of the finished string.



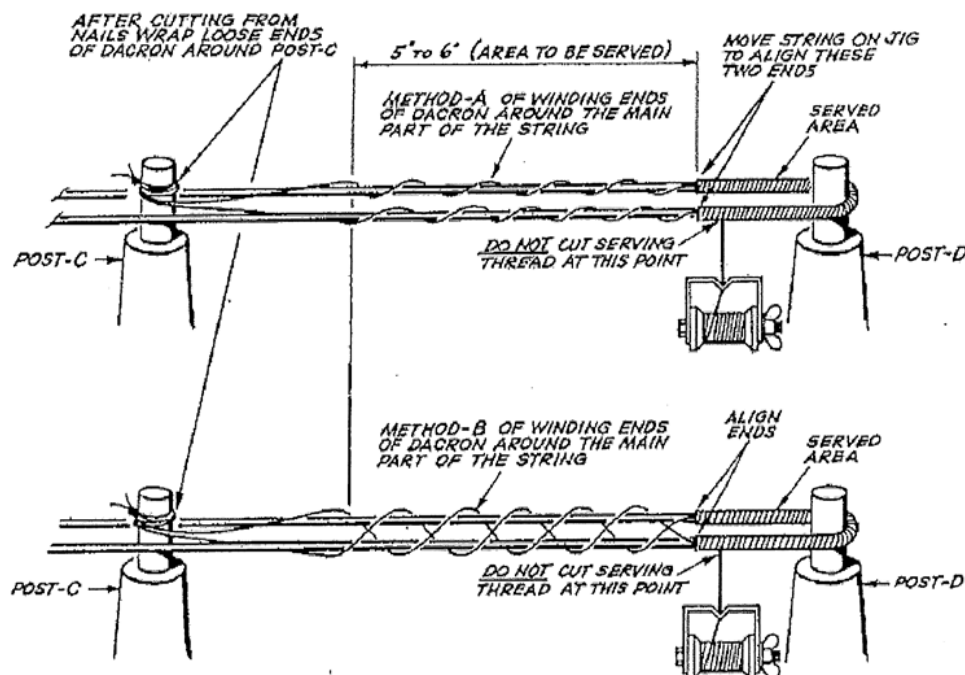
Mark the length to be served with chalk or pencil. Do not use a ball pen, as some inks destroy the Dacron. The loop of the old string can be used as a guide to judge the length to be served.

There is a definite relationship between the direction of travel and the direction of wrapping which must be maintained to keep from unwinding the individual filaments which make up each strand of string material. If the serving is to be wound from left to right, the server must come toward you under the string. If going from right to left, it must come toward you over the string.

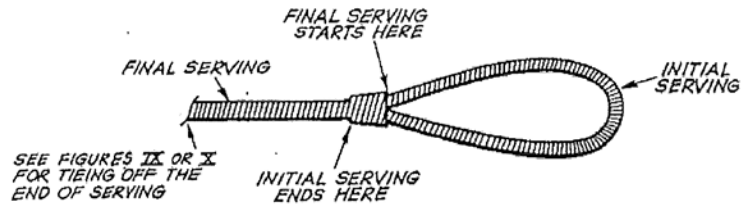
The cut ends must be served into the string so those strands will not stretch or come apart from the other strands. The ends are *not* secured by tying them together, as this greatly reduces the strength of the fiber. Instead, the tight serving is used to bind the strands so they will not slip.

It is better to put the loose ends in the bottom loop of the finished string. Since this loop does not slide up and down the limb during stringing and unstringing, it can be smaller. When the proper amount has been served, finish the serving by Method 2 under *Finishing a Serving*. *Do not cut the serving thread at this point.*

When this initial serving has been finished, the ends of the Dacron string material should be cut and the arm rotated to its original position. To strengthen the string, weave the ends of the string material around the main body of the string for five or six inches. Pull the loose ends tight and tie them to post C. Use either of the weaving patterns shown

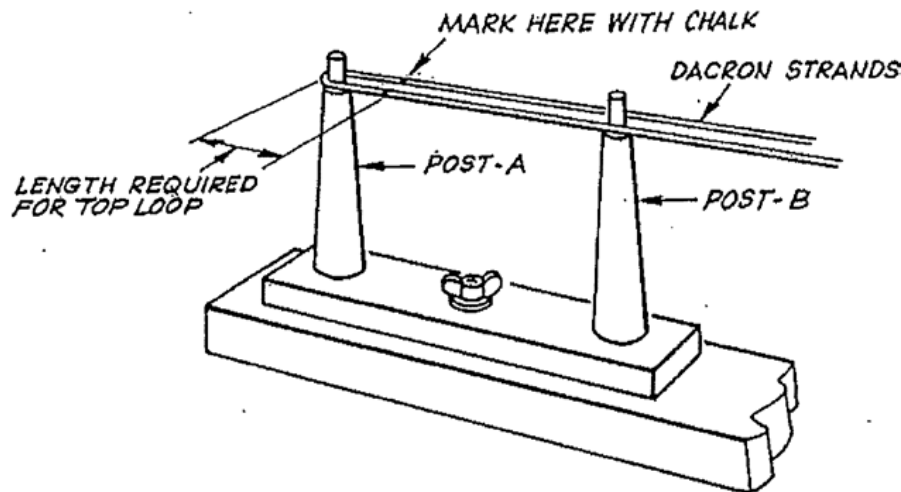


Serve the loop closed by serving over -the areas previously served, moving down the string for five or six inches. Finish the serving by either of the two methods presented earlier in this chapter.



This completes the lower loop. To finish the other loop of the string, repeat the procedures described for the bottom loop with the following exceptions:

1. This loop must be larger; the exact size depends upon the width of the bow limbs. An initial serving of three to three- and-one- half inches is usually necessary.
2. The loop serving must be centered when completed. To do this, mark the length of the string to be served before rotating the A-B arm as shown in the drawing.



If the final serving on both ends is not exactly even (one-eighth to one-quarter inch difference) don't worry, but try to avoid a difference of more than one-half inch.

Once the second loop has been served, the work on the jig has been completed and the string can be removed from the jig.

For maximum strength, the string must be twisted at least one turn every three inches when it is on the bow. The twists must be in the same direction the fibers in each strand is twisted. Using this method of string- making, always twist the string *clockwise* when looking at it from the end. Now place the string on the bow, properly twist it, and string the bow. Draw it several times to initially stretch the Dacron. Continue doing this until the string height is constant.

After the string has been stretched in this manner, the center serving should be completed. This serving should be long enough to protect the string from wear due to rubbing against the archer's arm guard and finger tab. While this can be determined best by the archer, as a rough guide, allow three inches above the center of the string and five inches below it.

When making a D-loop, the proper material must be used or the loop may fail and cause damage to the archer and/or bow. The material must have sufficient strength and be of a material that will allow for melting without weakening too much. There are several good suppliers of D-loop material and most pro shops should carry a stock of it.

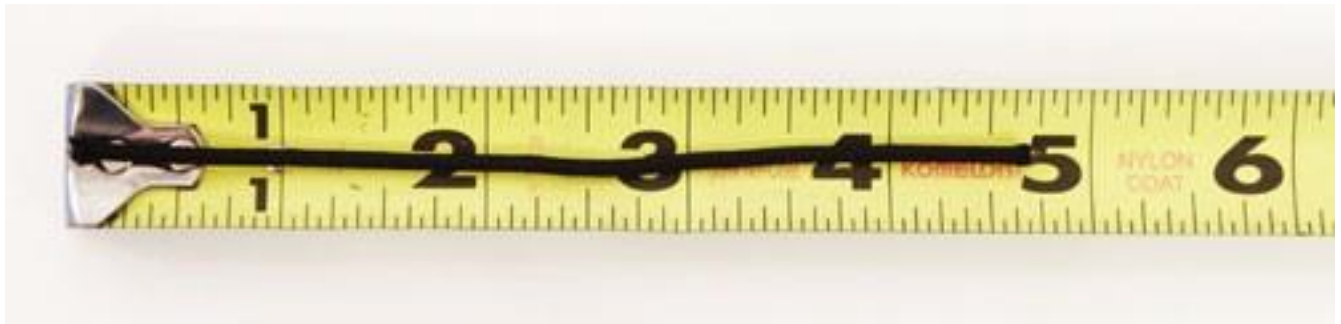
Material and tools needed for making and installing D-loops

- D-loop material
- lighter or other flame source
- needle nose or D-loop pliers
- wax

The total installed loop length and installation method will determine the starting length of material need for making a D-loop. For an average length without any nock points used (the D-loop serves as the nocking point itself), I start with 4 1/4" of loop material. If you want to use internal nock sets than 4 1/2-4 3/4" is a good starting length.

Preparing the d-loop

Cut the necessary length of material



Flare the ends of the material, a total flared length of about 1/8- 3/16" is best



Using the lighter, very carefully melt the flared ends into a nice ball. Do this by placing the flame to the side of the flared material and slowly bring it closer until the material starts to melt. Do NOT place the flame below the material. This is more likely to set the material on fire and weaken the final melted knot, not to mention blacken the material more than necessary due to the smoke. If you are using colored d-loop material, you don't want to mess it up with nasty smoke scarring!



A properly melted end will not have any charring, ash, bubbles or anything else that will weaken it. If you have any of these defects, throw the loop away and start again. It is not worth the risk of having an improperly melted loop pull free or break.



Repeat for the other end and measure the final product. You should have between 4 and 4 1/2 inches **BETWEEN** the finished melted ends.



Installing the d-loop

Secure your bow somehow to where you can work on it with both hands. Use a press, bow vise or set it on a flat surface. Lightly wax the non-melted portion of the loop. This will help with tying the knots, pulling the loop tight and keeping it tight once installed.

If you are going to use tied nock sets inside of the d-loop, I recommend tying them into the proper location before installing the d-loop. This makes it easier to tie the nock sets in place without having to thread through the d-loop while doing so.

Tie the first knot as shown, pulling it slightly tight. Do not cinch the knot down!



Repeat the same knot, but starting the opposite way. The final knots should end up opposite of each other with the top melted end facing away from the archer and the bottom towards. This will allow the final loop to twist per the type of release used while minimizing the torque induce to the bow string at full draw.



Once the knots are in place and satisfactory, move them into position, butting up against the tied nock sets if using them. Using the needle nose or d-loop pliers as shown, tighten the d-loop to where it just begins to cinch to the string. At this point the d-loop needs to be positioned to where it can pull the peep sight into position if necessary. I personally prefer to tighten the d-loop perfectly straight and adjust the peep (see the peep adjusting article, coming soon) rather than try to use the loop to force the peep into position.



If you are still tuning your bow and are not sure of exactly where arrow nock should be located, leave the knot a little loose so that it can be moved up and down the bow string. Moving it can be done by screwing it up or down as it will follow the winds of the bow string serving.

When doing the final cinching of the d-loop, do it **TIGHT!** Make sure the melted ends are seated well and that there is no slack anywhere in the knots.

The final knotted d-loop! Notice that on the top knot the melted end faces the archer and the bottom knot faces away from the archer. This will allow some twisting of the archer's release while minimizing the amount of torque induced on the bowstring.



Making Arrows

Ronald A. Howard Jr.*

Many archers enjoy making their own arrows because it allows them to exercise personal quality control, add special features, personalize the arrows in other ways or add to their shooting enjoyment. Making arrows involves several steps, but it is not difficult. High quality arrows can be made with care and attention to detail.

Shaft Selection

The first step is selecting the shaft type and size desired. Arrow shafts are available in wood, fiberglass, graphite, aluminum and graphite-aluminum combinations.

Wood shafts are traditional. Historically they have been inexpensive, but quality shafts may be difficult to find. Finding shafts that match in spine and weight can be a challenge, and keeping them straight can be an even greater one. American Indians used several hardwoods for shafts. The most common material is Port Orford cedar. Some wooden shafts, like Forgewood shafts, are compressed to reduce their diameter without sacrificing strength. Bow hunters seeking very large game sometimes insert a compressed wood shaft in another type of arrow shaft to increase arrow mass. Wooden shafts must be lacquered or painted full length to protect them from moisture.

Fiberglass shafts are lighter than wooden shafts of the same spine weight. They remain relatively straight, and they can be matched in spine and arrow mass much better than wooden shafts. Although fiberglass is a tough material, these shafts are subject to splitting on impact. They also tend to shatter or splinter if struck along their length. Shafts with internal damage may even shatter during a release. Fiberglass has been an excellent arrow material for beginning archers, combining toughness, durability and reasonable consistency with modest cost. However, fiberglass shaft material has become much more difficult to obtain.

Another composite material used in arrow production uses graphite fibers for its strength. Graphite (carbon) is much stiffer than fiberglass (silica) even though it is lighter in weight, which results in a thinner, lighter arrow for any given spine. Graphite fibers are also more expensive than glass fibers. Arrow manufacturers recently recommended that graphite not be used for hunting arrows unless care was taken to remove all meat that might have been exposed to the graphite fibers. Those fibers are hard, stiff and fine. They survive cooking well and can cause injury if swallowed. Many target archers, particularly those shooting bows equipped

with overdraws, prefer graphite shafts.

Aluminum shafts have been the standard of both target archers and bowhunters for many years. The shafts can be made to very close tolerances in a variety of alloys, offering easy matching in spine and weight. Aluminum shaft materials may be obtained in inexpensive soft alloys that are easily bent or straightened, or very hard ones that are durable but hard to straighten and expensive. The range of materials makes finding an optimum shaft material for your shooting application possible. Aluminum-graphite combinations combine features of both materials.

Arrows must be matched in mass and spine, and they must be straight to allow accurate and precise shooting. Shaft manufacturers and archery supply houses provide graphs or tables to assist the shooter in selecting the proper shafts for his or her bow and shooting purpose. In most cases, any given draw weight and length will have a range of sizes suggested. Most target archers can use the lightest shaft that will fly well in their bows. Bowhunters are often wiser to select a shaft on the stiff side. The heavier, more massive heads used in bowhunting tend to “soften” shaft behavior. Consider your personal experience with your bow and

tuning when selecting the proper shaft.

Cutting to Length

Once the shaft type is selected, the shafts must be cut to the appropriate length. Extra length may be helpful for young people, but it adds arrow mass and softens the spine of the shaft; this results in reduced arrow speed, greater drop at any given distance and higher trajectories. Errors in distance estimation become more critical with slower arrows. Missing high or low is a greater problem for archers using them. Wooden shafts may be manufactured full length, then cut to length and tapered just before the arrowhead is attached. Other types of shafts are cut to length before the arrow is made. Cutting requires use of an abrasive cutoff wheel. Home cutting is not recommended without proper tools, because some techniques alter the diameter, shape or character of the shaft around the cut end.

Target archers usually cut their shafts to true draw length. The base of the head reaches the rest at full draw. For young people and beginning archers, draw length changes over time. Cutting to true draw length gives maximum performance, but it may result in arrows that are “out-grown” in a short time span.

Hunting archers and many field archers cut their shafts a little longer. The broadhead needs to clear the back of the bow, the archer’s hand or the rest on the overdraw. Usually an

allowance of about two centimeters (3/4 inch) is added to the length. This compensates for overdrawing the shaft when the shooter is excited.

Specify the draw length or cut length of the arrows when ordering shafts. Draw length is measured from the bottom of the string notch in the nock. One of the best ways to measure draw length is with a draw-check arrow in a light bow. Draw to your anchor and have a friend note the true draw or the distance to the face of the bow or the rests on the overdraw. Once that distance is known, determine the length the shafts should be cut. Be sure the person cutting the shafts deburrs them when they are cut.

Attaching the Inserts

Wooden shafts are tapered with a cutting tool resembling a hand pencil sharpener to receive the nock and the point. Other shafts are tubular. They use inserts or built-in tapers for the nock and the point. Some types of inserts have screw-in adapters that accept several types of points.

The type of shaft material influences the way the inserts are fixed in place. Melt able adhesives, like ferrule cement, are usually used on aluminum shafts. The cement forms a solid bond that is slightly flexible and durable. It is applied by melting a small amount of adhesive on the insert, warming the end of the shaft and pushing the insert into the shaft with a twisting

motion. The insert needs to be held in place until the adhesive sets or cools. If screw-in adapters are used, a precaution should be sued to prevent glue from getting into the threads. Apply a liberal amount of petroleum jelly to the threads of a broadhead (without blades) or a field point. Screw the head into the adapter, being careful not to get the petroleum jelly on the outside of the adapter. Then attach the insert as described above. An added advantage of having the head screwed into the adapter is the ability to check the alignment of the adapter in the shaft. Spin the arrow on its point. If it wobbles, re-heat the adapter area and adjust it until it spins true.

Composite shafts may have adapters at both ends. Most archers prefer to use epoxy adhesives to attach the inserts. The epoxy is mixed per manufacturer’s instructions. It is applied to the body of the insert and inserted into the body of the shaft with a pushing and twisting motion. If screw-in adapters are used, the precautions outlined above to prevent fouling the threads with glue should be followed. Be sure to use the appropriate adapters in each end of the shaft.

Cleaning and Preparing the Shaft

Spending a little time and effort preparing the shaft before applying the fletching can pay great dividends in durability. Most adhesive manufacturers encourage applying a base of lacquer to aid in the bonding

process. A clean surface is essential for good adhesion by the lacquer base.

Lacquer manufacturers supply instructions on preparing the shafts for good adhesion. Metal shafts may be scrubbed with a milk cleanser, rinsed and dried. They can also be cleaned with a lacquer thinner or lacquer remover and rubbed dry. Composite shafts can be scrubbed with a cleanser and rinsed, washed with alcohol or otherwise prepared as instructed by the manufacturer. Care taken with the cleaning pays off over the life of the shaft.

If the shafts are going to be dipped full length, they may be dipped as soon as they are completely dry. If they are going to be dipped only partially, each shaft should be lightly marked with a pencil at the end of the dipped area. Lacquer is best applied by dipping the shafts one at a time into a tube filled with the desired lacquer. If you want to keep the natural color of the shafts, use a clear lacquer instead of a colored lacquer if you prefer. After the arrows, have been dipped, allow them to drip for a moment to remove the excess lacquer. Hang them by their tips in a clean, well-ventilated place to cure. The lacquer is extremely durable, so make sure the floor and other surfaces are protected. Once the arrows have dried completely, they are ready to finish.

Applying the Nock

Nocks come in several styles, and the choice is primarily a

matter of preference. The nocks may fit rather loosely, or they may snap onto the string. Snap-on nocks are available from several manufacturers in several styles. All nocks come in a variety of sizes. Shaft manufacturers specify the proper nock size for their shafts.

Before the nock is applied, the nock insert or nock taper must be cleaned thoroughly. Excess adhesive or lacquer should be removed by scraping or with a small piece of sandpaper. Use a rotating motion to avoid making flat spots or irregularities in the nock taper.

Place a drop of fletching cement on the tip of the nock taper. Turn the shaft to spread the glue around the taper. Attach the nock with a twisting motion, much like placing a nut on a bolt. The nock must be aligned with the shaft for best shooting results, so care in placing it is essential. Some serious hunters and target shooters use a jig to ensure proper nock alignment.

Set the shaft aside for a few minutes to let the adhesive set. By the time a dozen nocks have been applied, the first one will be set up firmly enough to allow the fletching to be applied.

Applying the Fletching

Selection of fletching material is a matter of both personal preference and use. Feathers offer more control. In archer's jargon, they are more forgiving. They hiss in flight, are affected by inclement weather and tend to slow the shaft's flight more

than the plastic vanes. Feathers are also the traditional fletching material. Soft plastic vanes yield more arrow speed but at the cost of some control. They are more durable and weather resistant than feathers. Several specialized types of vanes are available to the target shooter.

Many target shooters use feathers indoors and vanes outdoors.

The use of the arrow dictates the amount of fletching needed for stability. Light target arrows can be shot with only three small vanes for guidance. Heavy broadhead hunting arrows may require three or four much larger vanes to achieve the same amount of stability. Flight arrows have very small amounts of fletching. On the other end of the spectrum, there are arrows designed for limited flight. Flu-flu arrows use massive amounts of fletching, six full-length feathers for example, to slow the arrow rapidly after a short flight.

The fletching style represents a compromise. Straight fletching, with the vanes aligned with the shaft gives less control and more speed than those types that impart more spin to the shaft in flight. Some archers like to angle the vanes slightly to give the shaft additional spin. Others prefer a helical fletch to give the shaft a higher spinning rate, accepting the sacrifice in speed for the extra control. Whether three or four vanes are used is largely a matter of preference. Archers argue over the merits of fletching styles.

Experiment to determine your own preferences.

With plastic vanes, selecting a right or left helical or off-set fletching pattern is a matter of preference and string or cable clearance. When feathers are used, the direction of the offset or spiral must match the curvature of the wing. For example, left helical or left off-set fletch requires use of feathers from the left wing.

Plastic vanes are bought cut to shape. Feathers may be purchased in that condition, but they may be applied full height. Unless the height is desired to slow the arrow, those feathers must be die-cut or burned to length. Most are burned with a hot wire to the shape desired. Most feathers are cut or burned in shield or parabolic shapes. Availability, control, noise in flight and personal preference are involved in selecting a feather shaped. The best shape remains a matter of debate. The fletching should be applied using a properly set-up fletching jig. Each vane should be the same distance from the nock and they should be positioned precisely. The vane should be cleaned before it is used and be held firmly in place until the bead of fletching cement has dried. After all the fletching, has been applied to an arrow, a tiny spot of fletching cement should be applied to the leading and trailing edges of each vane.

Customizing Your Arrows

Many archers like to apply a crest or signature to their

arrows as a personal symbol. They identify their arrows when several people are shooting at the same target or in other situations where identification is needed. Sometimes archers add decals or individual markings to each arrow, so it can be distinguished from others in the set. That permits individual evaluation. If one shaft tends to give erratic flight or consistently poorer flight, it can be checked for alignment or straightness. Cresting is a series of lacquer bands. It is applied with brushes while the shaft rotates in a cresting lathe. The lather has a collet or receiver that holds the nock and one or more padded rests on which the arrow rotates. Usually it includes a series of pins or markers that can be set to ensure uniform application of the stripes. Lighter colors should be applied as a base coat, with darker ones covering them. Try several designs on a junked shaft before deciding on one that pleases you. A few archers go one step further and add a minute "crest" at the base of the nock. Many of today's archers dispense with the crest completely. You decide how you want to have your arrows look.

Attaching the Point

If screw-in adapters were used, the point of choice could simply be screwed into the adapter to finish the shaft. If other inserts were selected, the points need to be attached with ferrule cement. Those points are attached using the same procedure as in attaching the

inserts of aluminum shafts. Heat the insert and the point. Apply a small amount of ferrule cement to the insert and rotate the shaft while heating the insert to spread the cement evenly around the taper. Using a twisting motion, seat the point fully on the taper of the insert. Check it for alignment by spinning the shaft on the point and watching for any wobble in the spinning shaft. If the point is true, allow it to cool and remove any excess ferrule cement from the base of the ferrule. If it is not, re-heat the point and adjust it.

Making arrows takes some time and attention to detail. It can add to your enjoyment as an archer. Try making your own to see you want to be involved with this part of archery.

Ground Quivers

Ronald A. Howard Jr.*

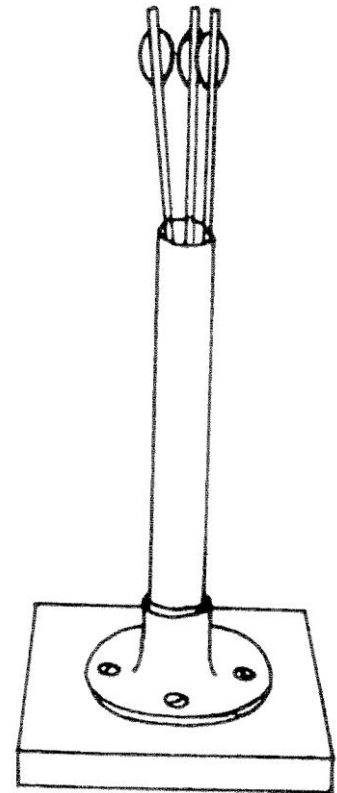
When archers are shooting from an established shooting line, a ground quiver can conveniently hold the arrows. Several manufacturers make ground quivers, but you can easily make one.

A ground quiver can be made from a short length of 4-inch PVC pipe and a flange or piece of wood. Cut the section of pipe about 35 to 50 centimeters (15 to 20 inches) long. Glue a closed flange over one end of the section. If you prefer, cut a hole in a piece of one-inch pipe or $\frac{3}{4}$ -inch plywood large enough to hold the pipe. Drill pilot holes in the pipe and attach it to the wood with small screws, brads or nails. Cut another piece of wood slightly larger than the first, and attach it to the bottom of the first one. Drill a couple of holes just inside the edge of the bottom piece to accept a dock spike or other anchoring device.

On level ground or indoors, these quivers may be used without support. On uneven ground or in windy conditions, anchor the quiver to keep it in place.

Ground quivers may also be made from heavy gauge wire, welding rod or light metal rods. Bend a ring on one end, then bend the ring to a right angle with the rod. Push the rod into the ground until the ring is about 35 to 50 centimeters (15 to 20 inches) above the ground.

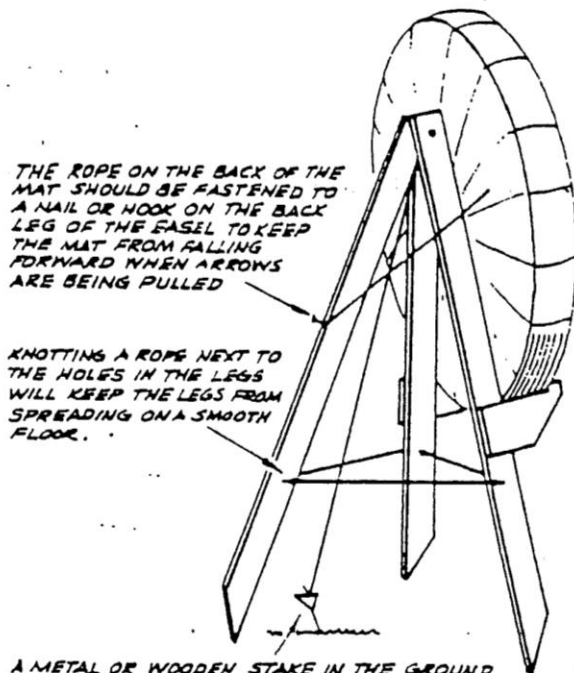
You can probably imagine other ways of holding arrows on the shooting line. Anything that is light, portable and stable is acceptable.



* 4-H and Youth Development Specialist, Texas Agricultural Extension Service

Appendix 1

TARGET STANDS

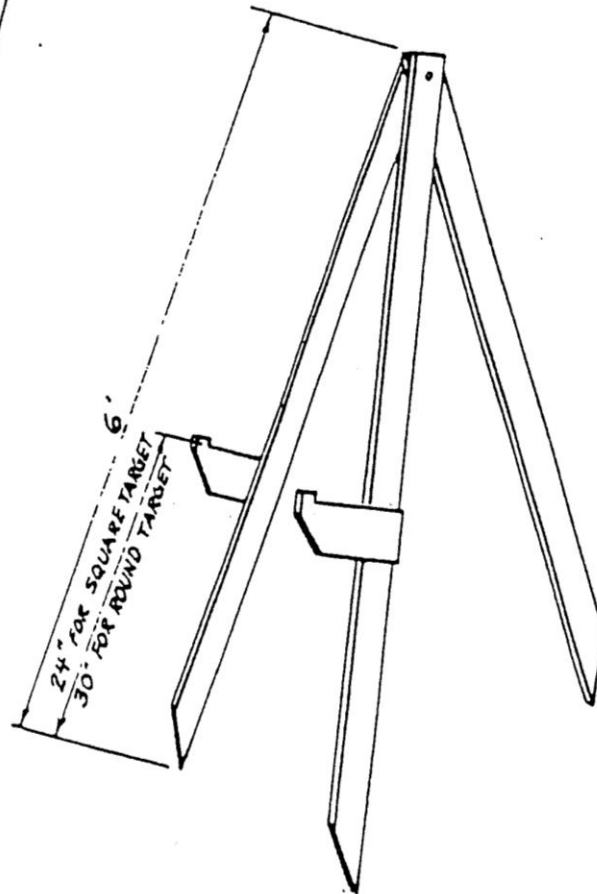


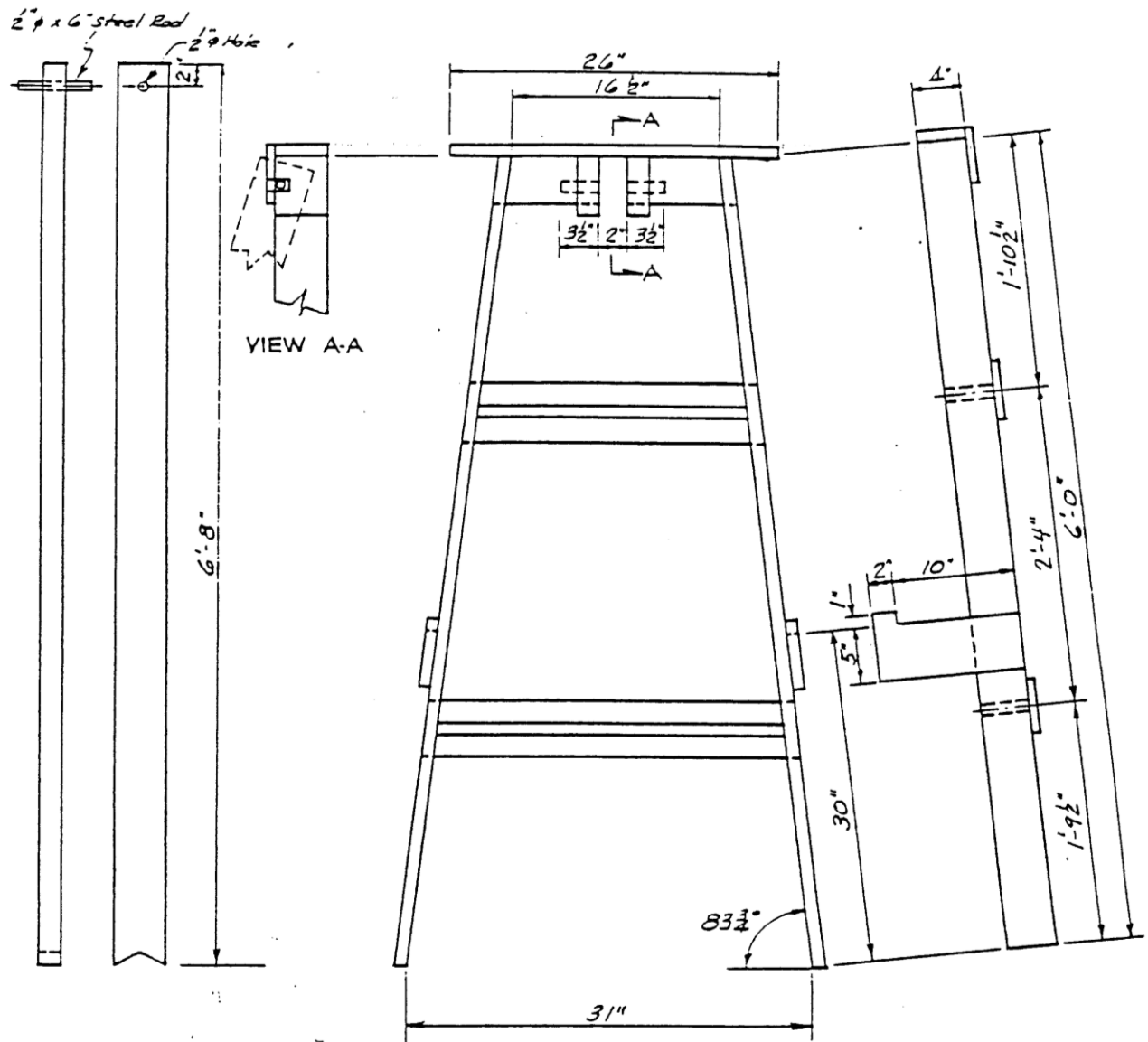
A METAL OR WOODEN STAKE IN THE GROUND WITH A ROPE TO THE BOLT AT THE TOP OF THE TRIPOD WILL KEEP THE EASEL AND MAT FROM BEING BLOWN OVER BY THE WIND.

Board size: $1\frac{1}{4}$ " x 4"

Prop size: 11" x 5"

Bolt size: $\frac{1}{2}$ " diameter 5" long with washers on each end





Folding Target Archery Stand

As the Director for Target Archery for the 2009 Huntsman World Senior Games in St. George, Utah, I took up the challenge to build target stands for the event. Having had experience the previous year with wobbly stands tied together with twine, I set out to design new stands that would be sturdy, light weight, easily moved for distance changes, easy to set up and take down, and would be compact for storage. After getting ideas from other stands I saw on the internet, in magazines, in the FITA Target Manual, and from personal experience, I designed and built the stand presented here.



I built 13 of these stands which were all used for a three-day tournament accommodating 31 archers. Because of venue limitations, all stands and target mats had to be set up and dismantled each day and stored on site in a truck. With this design, it took less than a minute for two people to unfold and secure the stand for use in the morning, and just as quickly fold and secure the stand each afternoon. With the wheels and short side arm extensions, it was very easy for one person to move the stand and mat forward to the next distance. We had several senior ladies that had no problem moving their targets. The stand, with wheels, weighs 25 pounds and is easily stacked, loaded, and unloaded.

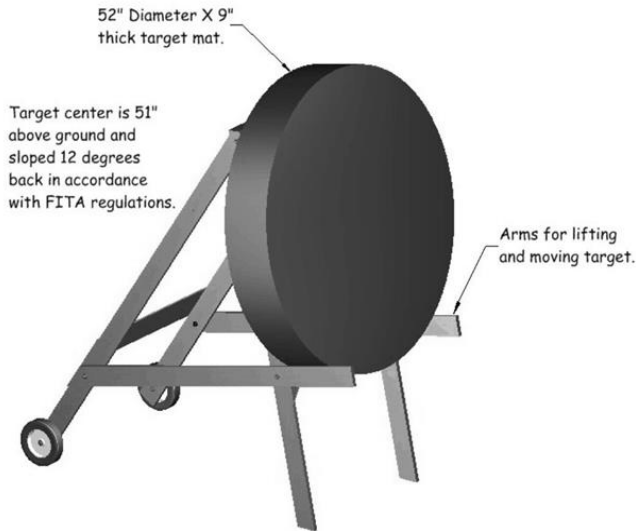


These stands met all my expectations and I plan to build more as the tournament grows (and paint the stands already built.) The only reservation I have at this point is the maintenance of the legs. After the first tournament, we had a few minor arrow holes in the lower edges of the legs but no major splintering. I anticipate some yearly maintenance of the legs.

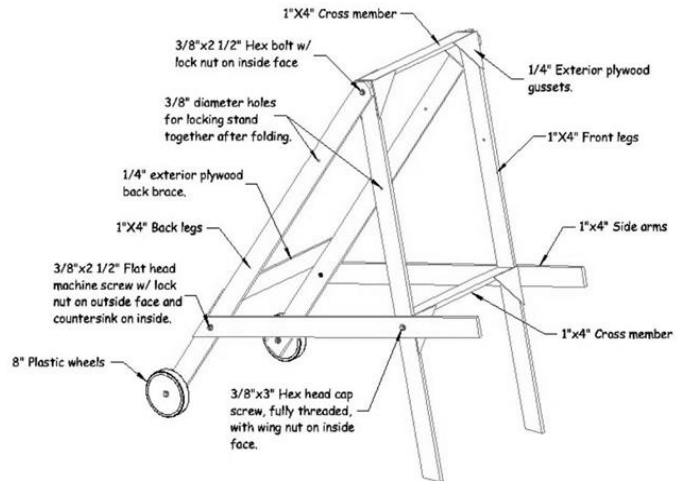
On the following pages are illustrations, dimensions, instructions, and a materials list for constructing these stands. Please note that there is an optional longer back leg shown that can be used without wheels. These drawings are not proprietary, so feel free to use them as you see fit.

Allen Floyd

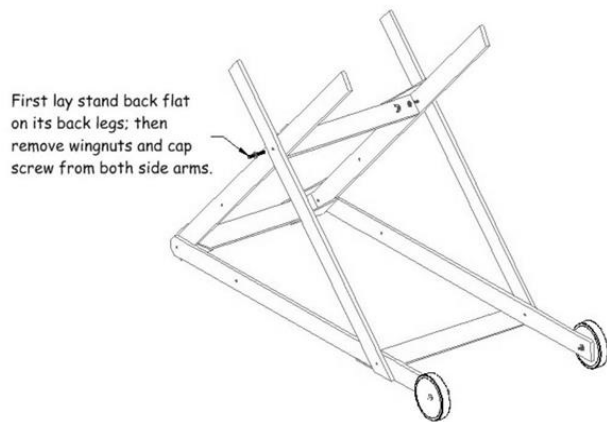
Folding Target Archery Stand



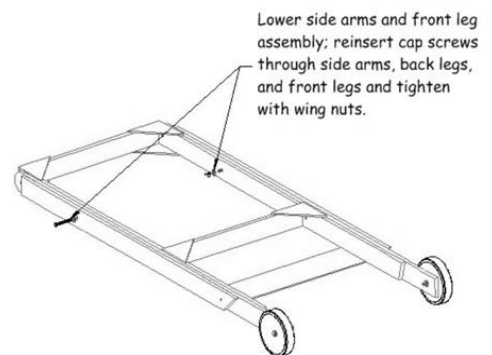
Wheeled Stand with Target Mat



Stand Components



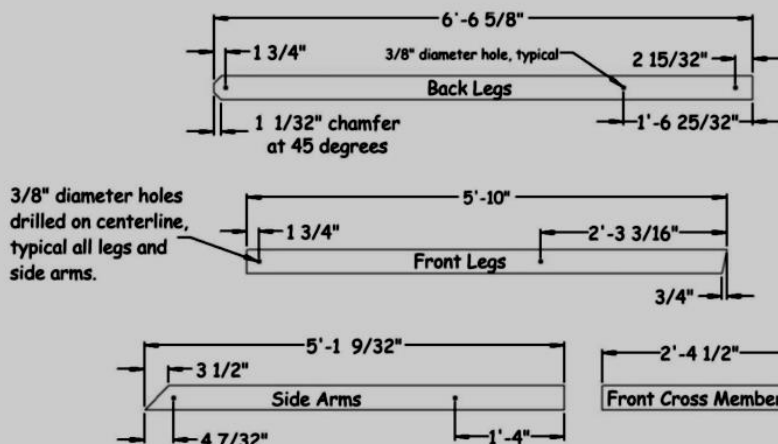
Step 1



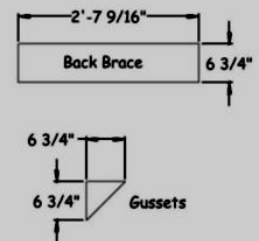
Step 2

To Fold Stand

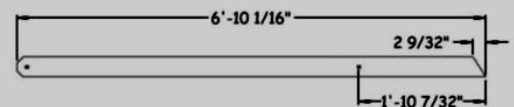
Folding the stand is performed most quickly with two people, one working on each side of the stand. To unfold, just reverse the procedure shown above. Note that both operations first requires that the stand be positioned on its back.



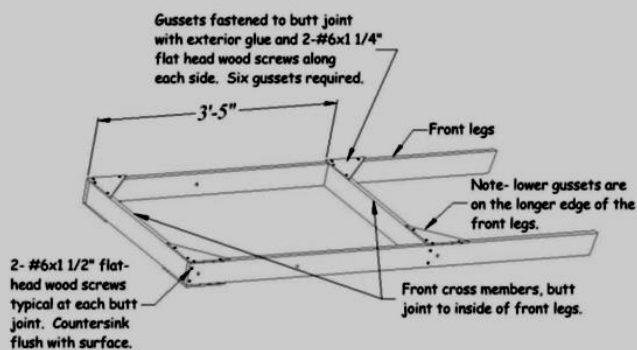
1"x4" Member Dimensions



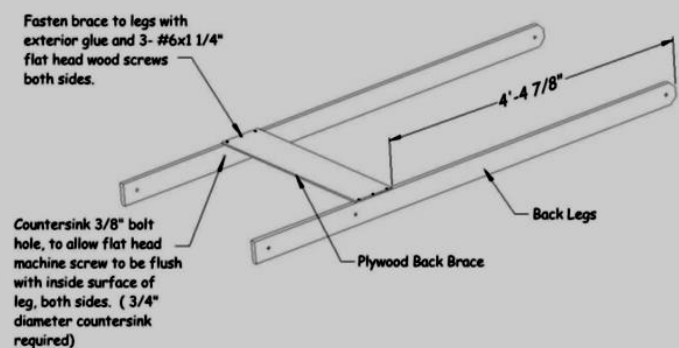
1/4" Plywood Member Dimensions



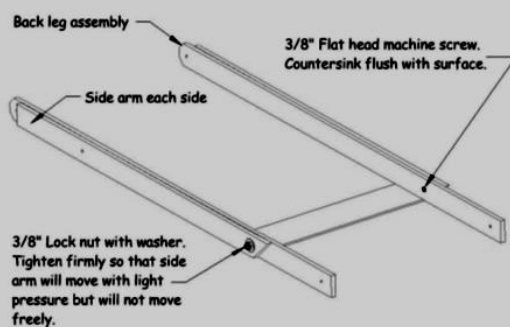
Optional Back Legs without Wheels



Front Leg Assembly



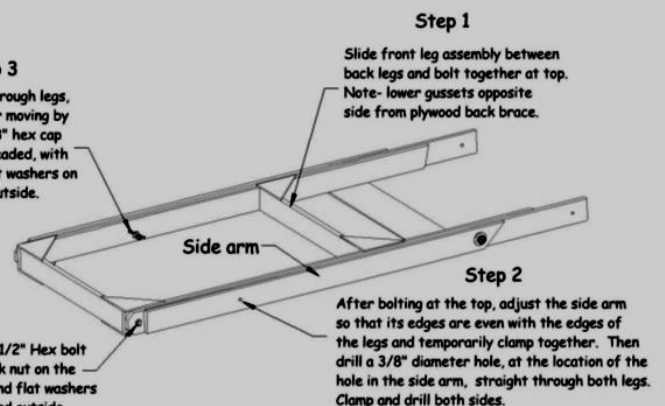
Back Leg Assembly



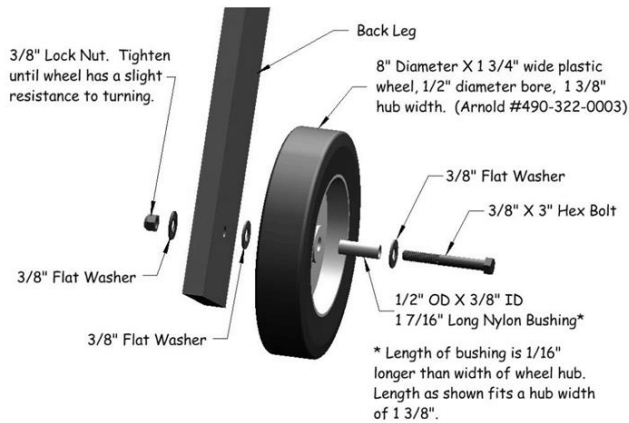
Side Arm Assembly

Step 3
After drilling through legs, secure stand for moving by installing 3/8"x3" hex cap screw, fully threaded, with wing nut and flat washers on the inside and outside. Bolt both sides.

3/8"x2 1/2" Hex bolt with lock nut on the inside and flat washers inside and outside.



Final Framing Assembly



Wheel Assembly

General Design and Building Notes

1. The actual dimensions of the nominal 1"x4" boards used in this design are 3/4" x 3 1/2". All boards are pine, as straight and warp free as possible.
2. The plywood is exterior grade with a minimum of C grade outside veneers.
3. Glue is waterproof "Titebond II" wood adhesive.
4. Fasteners:
 - a. 3/8"-16 X 3" Full thread hex cap or tap screw.



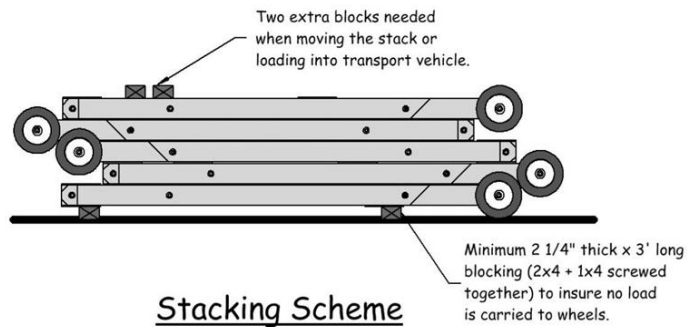
- b. 3/8"-16 X 2 1/2" Full thread flat head machine screw or stove bolt.



- c. 3/8"-16 X 2 1/2" and 3" Hex bolt.



- d. 3/8"-16 Lock nut.

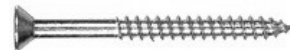


Stacking Scheme

- e. 3/8"-16 Wing nut.



- f. #6 X 1 1/2" and 1 1/4" Flat head wood screw.



5. Wheel bushings are cut to length from 1/2" OD (outside diameter) X 3/8" ID (inside diameter) nylon tubing. Metal tubing (aluminum, brass, or steel) can also be used. When metal tubing is used, reduce length by 1/32". The bushing can be omitted altogether by drilling a 1/2" diameter hole in the back leg and using a 1/2" diameter bolt. Without a bushing the wheels tend to wobble and wheel rotation is very sensitive to lock nut pressure.

Material List

<u>Item (Part#, Source)</u>	<u>Unit</u>	<u>Qty.</u>	<u>Cost</u>	<u>Total</u>
1"x4"x8' board (HD)*	Ea.	4	2.73	10.92
1"x4"x6' board (HD)Ea.	Ea.	2	2.55	5.10
1/4" Exterior Plywood (HD)	SF	2.5	0.56	1.40
#6x1½" Wood Screws (HD)	Ea.	8	0.05	0.40
#6x1 1/4" Wood Screws (HD)	Ea.	30	0.05	1.50
Fasteners are Hillman bolts from Ace Hardware Stores:				
3/8"x2½" Hex Bolts (#190183)	Ea.	2	0.43	0.86
3/8"x3" Hex Bolts (#190189)	Ea.	2	0.50	1.00
3/8"x3" Full Thread Hex Tap Bolt (#221027)	Ea.	2	0.59	1.18
3/8"x2½" Flat Head Stove Bolt (#1808-F)	Ea.	2	0.95	1.90
3/8" Lock Nuts (#180153)	Ea.	6	0.17	1.02
3/8" Wing Nuts (#180255)	Ea.	2	0.40	0.80
3/8" Flat Washers (#270061)	Ea.	16	0.10	1.60
Wheels (www.ronshomeandhardware.com) without shipping)	Ea.	2	3.00	6.00
Nylon Bushing (nylon tubing ordered at www.mcmaster.com #8628K28, \$5.12 + shipping for 5' section)	Ea.	2	0.27	0.54
Wood Glue (HD)	Oz.	0.7	0.38	0.27
Subtotal				\$34.49
Tax 6.25%				2.16
*(HD)- Home Depot			Total	\$36.65

Equipment for Beginning Archery Club Programs

Archery Range Facility - Can be outdoor or indoor- adequate safety zone beyond targets or appropriate backstop is needed. Indoors -an archery arrow backstop net needs to be used. Nets available in 10', 30' & 50' lengths and cost \$115 / \$345 / \$575 (See information on range layout is included)

Targets & Target Butts- Best for beginner programs to have a target & target butt for each archer on the shooting line, however 2 archers can safely shoot at a single target at the same time.

Bows- Beginner programs should focus on the use of recurve bows. (compound bows can be introduced after archery basics are learned and practiced by the youth). It is recommended that a beginning program have a variety of recurve bows, varying in bow length, bow pull weight and right & left hand (eye dominance).

Example: The 10 Ring 4-H Archery Club is about to organize. It is anticipated that 10 to 12 youth ages 8 to 13 will enroll.

Recurve Bows - can be purchased between \$60 & \$80 each

3 - 48" bows with pull wt. Of 15 to 16# (2-Right hand & 1-Left hand) 3 - 54" bows with pull wt. Of 20# (2 Right hand & 1 Left hand) 3 - 62" bows with pull wt. of 20# or 25# (2 Right hand & 1 Left hand)

Arrows - 1 dz. Of each 24", 26" & 28" arrows. These could be either fiberglass or aluminum. Fiberglass will cost approx. \$23.00 per dz. While aluminum will cost approx.

\$45 - \$55 per dz. Arrows should be matched to bow wt. As well as individual youth draw length.

Aluminum arrows will last longer and shoot better. Aluminum arrows come in different thickness/diameter for matching to bows and youth-1516; 1616; 1716

Targets and Target Butts-

Targets - can use tag paper targets that are available in a variety of diameters from 16"to 36" and cost under \$3.00 each.

Target Butts - can use straw bales or purchase commercially made butts made of foam, or grass mats. Inexpensive foam target butts can often be purchased locally and cost around \$15. Grass Mats will cost between \$125 and \$150 each.

Target Stands - depending on the type of target butts you use, these can be constructed or purchased.

Safety Equipment - you should plan on 1 arm guard and 1 finger tab per youth participant. (youth can share, but switching equipment can take valuable teaching time)

Finger Tabs will cost from \$1.35 to \$5.25 *Arm Guards* will cost \$4.50 to \$7.00 *Bow Stringer*- at a minimum you will need one of these for use in properly stringing recurve bows \$7.00

Other items to consider: nock sets, nock pliers, bow square, extra arrow nocks and points. Plans for ground quivers, floor quivers and other items can be found in the instructor notebook. Other items can be added as your program progresses.

Instructor Workshop Archery Equipment List

Equipment	Number of Participants in Class		
	6	12	18
*20# Recurve Bow	2LH	3LH	4LH
	5RH	6RH	9RH
*Standard Genesis	2LH	3LH	4LH
Compound Bow	5RH	6RH	9RH
**Arrows	25	50	75
Adult Plastic Tabs	6	12	18
Adult Long Arm Guard	6	12	18
Hip/Side Quiver	6	12	18
34"- 48" Target Mats w/Stands	3	6	9
Cord Bow Stringers	2	4	6
Whistles	6	12	18

*With rest and nock locator.

**The arrows can be aluminum or carbon. For the total number of arrows recommended per class size, there needs to be a collection of full length arrows. The class of 6 could require 25, the class of 12 would require 50, and the class of 18 would require 75. Three Flu-Flu arrows with target points will also be needed.

Accessories for Bow

- 3 – LH Rubber Stick on Rests
- 10 – RH Rubber Stick on Rests
- 20 – Nock Locator Sets
- 2 – Tubes of Bow Wax
- 2 – Packages of PVC Foam Weather Stripping
3/8” Thick x 3/4” Wide
- 50 – 1.5” Long Straight Pins with Colored Heads

Bow Tuning, Nock & Fletching Repairs

- 2 – Bow Squares
- 2 – Nock Set Pliers
- 2 – 1 oz. Bottles of “All Fletch”
- 2 – Tubes of Fletch Tile Cement
- 2 – 5 Minute Epoxy for All Points
- 1 – Bowstring Serving Tool
- 1 – Spool of Serving Thread

Range Set-Up

- 640’ of Orange Nylon Twine
- 6 – Rolls of Orange Surveyors Tape
- 12 – 1.5” Wide x 48” Long x .75” Thick Wooden Stakes
with Points
- 24 – 20 D Nails

10 – 48” 122 cm Official 5 Color FITA Target Faces
10 – 32” 80 cm Official 5 Color FITA Target Faces
10 – 24” 60 cm Official 5 Color FITA Target Faces
10 – 16” 40 cm Official 5 Color FITA Target Faces
Various Animal Targets Such as Deer, Elk, Bear, Squirrel,
Raccoon, Javelina, Turkey
75 – Plastic Target Pins
1 – 10’ x 50’ Archery Back-Stop Netting (If Range Indoors)

Other

12 – Tennis Balls
2 – Different Color 9” Round Rubber Balls such as Red &
Green
100 – 9” Balloons
100 – 12” Balloons
100 – Assorted Size Balloons Less Than 9” 15 – Full Size
Poster Sheets
1 – Large Permanent Black Marker 1 – Large Permanent
Red Marker 1 – Large Roll of Duct Tape
10 – 39 Gallon Size Trash Bags

NOTE: The archery equipment can be purchased from
Hall’s Arrow Archery; (888) 808-1801,
www.hallsarrow.com

Site

- Classroom large enough for 1/7 the total number of participants
- Tables and chairs for participants
- Archery target range or open field with archery target butts (mats) or hay bales
- Tent or shelter near range with three, 6-8 feet tables & folding chairs for number of participants
- Digital Projector & Laptop (dvd) can be shared
- Flip chart & markers
- Masking tape

Archery Level 1 Training Outline

State Workshop Training Outline

SESSION 1 – RANGE (4HR.)

HAVE RANGE SET-UP BEFORE STUDENTS ARRIVE, POST RANGE RULES, HAVE EQUIPMENT READY, BLANK TARGET

I. ARCHERY ESSENTIALS: SAFETY ORIENTATION CLASS

- A. **LIFE SKILL TO BE LEARNED:** Personal Safety
- B. Pair up pupil coach and determine eye dominance outside of range (safety glasses recommended but not required in archery yet. Some states require them.)
- C. Remove jewelry; tie back long hair, etc.
- D. Enter Range: Range Officer (**ORANGE CAP & ORANGE VETS**)
- E. Hand out equipment (except for bows)
 - 1. Arm Guard, Finger Tab or Glove
 - 2. Quiver
 - 3. Measure archers for arrows (3 **ARROWS** in Quiver)
- F. Range Officer explains **RANGE PROCEDURES & WHISTLE COMMANDS** as a group on waiting line
- G. Demonstration (group on waiting line)
 - 1. Shooting Arrow
 - 2. Dropping Arrow
 - 3. Retrieving Arrow
 - 4. Pulling Arrow
 - 5. Lost Arrow (Arrow top of target butt)
 - 6. Carrying Arrows (either in quiver or by tips with fletching behind shoulder)
- H. **SAFETY** Reminders
 - 1. Keep your arrows in your quiver until you are told to shoot
 - 2. Always keep your arrows pointed down or towards the target
 - 3. Only shoot target in front of you
 - 4. Only release a drawn bow with an arrow nocked on the string i.)
- I. Select Bow
 - 1. Flight 1 - Select Bows
 - Archers shoot first end of 3 arrows (1st arrow with instructor)
 - Pull arrows (range officer last to walk back)
 - Flight 2 - Select Bows, Shoot, Pull Arrows
 - Etc.
- J. 4-H Lesson Plans pp. 8-10, 15-16, 24-25, 30-31; 4-H Fact Sheet 3

II. DEBRIEF: Explain Each Rule or Procedure as the Archer Needs to Know It

III. THE TEN COMMANDMENTS OF ARCHERY SAFETY

- A. 4-H Lesson Plans pp.12-13; Handout: The Ten Commandments of Archery Safety

IV. ARCHERY RANGE SAFETY: Posted Poster

- A. Range Rules
- B. Range Whistle Commands
- C. Range Procedures
- D. Pulling Arrows
- E. 4-H Lesson Plans pp. 5-6, 12-13; Handout: Archery Range Rules

V. SHOOT

VI. DEBRIEF

VII. RANGE LAYOUT

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety, Planning/Organizing, Critical Thinking
- B. Outdoor Range
 - 1. Location of Targets
 - 2. Target line
 - 3. Shooting Line
 - 4. Waiting Line
 - 5. Safety Areas
 - 6. Safety Signs
 - 7. Controlled Access/Spectator Area
- C. Indoor Range
 - Location of Targets
 - Safety Curtain
 - Target Line
 - Shooting Line
 - Waiting line
 - Safety Areas
 - Locked Doors
 - Safety Signs
 - Controlled Access/Spectator Area
- D. Field Layout
 - Footpaths
 - Shooting Line
 - Shooting Lane
 - Safety Lanes
 - Safety Signs
 - Controlled Access
- E. Handout: Outdoor & Indoor Range Layout

VIII. STEPS OF SHOOTING

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety, Self-Discipline, Self-Responsibility, Goal Setting
- B. **Eleven** Steps to 10 Ring
 - 1. Stance & Posture
 - 2. Place one foot on each side of the shooting line.
 - 3. Find a comfortable balanced stance with feet shoulder width apart.
 - 4. Stand straight, keeping ribs and chest down, and bottom tucked under. Keep shoulders down and relaxed.

- C. Nock Arrow
 - 1. Place arrow on arrow rest, holding arrow close to nock.
 - 2. Keep index fletching pointing away from bow.
 - 3. Snap nock of arrow onto bowstring under nock locator
- D. Set Hook
 - 1. Set first groove of first three fingers around the bowstring under the arrow nock creating a hook.
 - 2. Keep back of drawing hand flat and relaxed.
 - 3. The thumb and pinkie should be tucked away
- E. Set Bow-Hand Grip
 - 1. Position the bow-hand on the bow grip by making a Y with the fingers and thumb.
 - 2. The knuckles of the fingers should be positioned at a 45-degree angle and the thumb pointed towards the target.
- F. Raise & Extend Bow
 - 1. Raise bow arm and string hand together towards the target, while keeping shoulder down and aligning chest perpendicular to target.
 - 2. Drawing arm should be near level of nose.
 - 3. Bow arm should be rotated so it is straight up and down.
- G. Draw
 - 1. Draw the string back in a straight line from raising and extending bow (step 5) to the side of the face anchor point.
 - 2. Set drawing arm shoulder back and down until elbow is directly behind or a bit higher than arrow.
- H. Anchor
 - 1. Draw string to side of face placing tip of first finger on corner of mouth.
 - 2. Keep hand snug against face folding thumb down and little finger towards palm.
- I. Aim
 - 1. Look at target or through sight, keeping focus on form.
 - 2. Focus on the point of aim if not using sight.
 - 3. If using sight, then focus on the point you want to hit.
 - 4. Keep string lined up with center of bow.
- J. Release
 - 1. Release all tension in fingers and drawing hand, all at once, while continuing to draw bowstring back without stopping.
 - 2. Continue bow arm towards target.
- K. Continue focusing on target. Follow Through
 - 1. The drawing hand should continue back beside neck with fingers relaxed and ending up behind the ear.
 - 2. Keep bow arm up
 - 3. Maintain follow through until arrow hits target.
- L. Relax & Evaluate
 - 1. Relax after each shot.
 - 2. Evaluate the feeling of each shot to determine if you accomplished the goal you were trying to achieve.
 - 3. If not, you should refocus your efforts on the feeling of the proper shot and try again.
 - 4-H Lesson Plans pp. 19-24, 26-30

IX. CALLING OUT STEPS & SHOOTING

- A. Mimetics without Tackle
- B. Mimetics with Tackle
- C. Shoot

X. DEBRIEF

XI. HISTORY OF ARCHERY

- A. **LIFE SKILL TO BE LEARNED:** Responsible Citizenship
- B. Hunters and warriors since prehistoric times
- C. Projectile points have been found from 5-6 thousand years ago
- D. The Egyptians developed the bow from plant fibers
- E. The Turks developed the laminated recurve bow
- F. The NAA was founded in 1879 by Maurice Thompson; Will Thompson won the first sponsored tournament that year
- G. Dr. Saxton Pope and Art Young were great bowhunters
- H. 1931- The Federation Internationals de Tir a l'Arc (FITA) was formed
- I. 1939 - National Field Archery Association formed
- J. 1957- Pope and Young Club formed
- K. 1961 -Professional Archers' Association formed
- L. 1966- H. W. Allen invented the compound bow
- M. 1984- International Bowhunting Organization formed
- N. 4-H Lesson Plans pp. 5, 11

XII. SHOOT

XIII. DEBRIEF

XIV. BOW & ARROW PARTS

- A. **LIFE SKILL TO BE LEARNED:** Personal Safety
- B. Bow
 - 1. Tip
 - 2. String Notch
 - 3. Upper Limb
 - 4. Face
 - 5. Back
 - 6. Window
 - 7. Shelf
 - 8. Arrow Rest
 - 9. String Height (Brace Height)
 - 10. Grip (Pivot Point)
 - 11. Lower Limb
 - 12. Recurve
 - 13. String
 - 14. Nock Locator
 - 15. Serving
 - 16. Cable
 - 17. Wheel or Cam

- C. Arrow
 - 1. Point
 - 2. Shaft
 - 3. Crest
 - 4. Fletch or Vane
 - 5. Index Fletch or Vane
 - 6. Nock
- D. 4-H Lesson Plans pp. 6-8, 13-14

XV. ARCHERY ACCESSORIES

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety
- B. Arm Guard
- C. Finger Protection
 - 1. Tab
 - 2. Glove
 - 3. Rubber Finger Guard
- D. Quiver
 - 1. Side Quiver
 - 2. Ground Quiver
- E. Miscellaneous
 - 1. Silencers
 - 2. Sights
 - 3. Stabilizer
 - 4. Clicker
 - 5. Kisser Button
 - 6. Mechanical Release
 - 7. Torque Compensator
 - 8. Spirit Level
 - 9. Peep Site Eliminator
- F. 4-H Lesson Plans pp. 8, 14

XVI.SHOOT: INSTINCTIVE SHOOTING (High Anchor & Point of Aim)

- A. **LIFE SKILLS TO BE LEARNED:** Self Discipline, Self-Responsibility, Self-Motivation, Leadership, Communication, Goal Setting, Healthy Lifestyle Choices b.) Shoot at FITA Target Face
- B. Shoot at Balloons
- C. 4-H Lesson Plans pp. 32-37

XVII. DEBRIEF

- A. Have students leave range on a **HIGH**
 - 1. Example: Give all participants a **BLUE** ribbon for being **FIRST CLASS** students in the session

SESSION 2 – RANGE (4HRS.)

I. STRINGING A BOW

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety, Concern for Others
- B. Cord Stringer
- C. Wall Stringer
- D. Box Stringer
- E. Do Not Use Push-Pull Method and Step -Through Method
- F. Practice stringing recurve bow using cord stringer
- G. 4-H Lesson Plans pp. 8-9, 15; 4-H Fact Sheet 8

II. SHOOT USING SIGHTS

- A. **LIFE SKILLS TO BE LEARNED:** Decision Making, Learning to Learn, Self-Discipline, Self-Responsibility, Self-Motivation, Leadership, Communication, Goal Setting
- B. Make a Pin Sight
 - 1. Put duct tape and/or weather stripping foam on back of bow at the sight window
 - 2. Use dressmaker's enamel head pins (white, yellow, orange, or red) for sight
 - 3. Stick pin under tape or in foam, leaving enamel pin in the sight window
 - Place pin about the same distance above the arrow rest as the eye is above the anchor point
 - The head of the pin should stick out the sight window about as far as the edge of the arrow is from the dominant eye (about 3/4 inches)
- C. Shooting with Sights
 - 1. Use low anchor point below the chin. This raises the rear sight (the eye), giving the shooter more room in the sight window to adjust the front sight
 - 2. Shoot 3 arrows to establish point of impact or grouping
 - Use consistent aiming point to anchor
 - Chase group center with pin
 - Low arrow: lower pin
 - High arrow: raise pin
 - Left arrow: move pin left
 - Right arrow: move pin right
 - Repeat trial and error method until arrows hit where aimed d.) 4-H Lesson Plans pp. 38-43

III. DEBRIEF

IV. SHOOT USING COMPOUND BOWS

- A. **LIFE SKILLS TO BE LEARNED:** Wise Use of Resources, Goal Setting, Self-Motivation, Self-Discipline, Self-Responsibility, Leadership, Communication
- B. Definition: Any bow that uses pulleys or cams is deemed a compound
- C. Basic Parts
 - 1. Riser or Handle
 - 2. Limbs
 - 3. Wheels or Cams
 - 4. Cables
 - 5. String

D. Advantages

1. Mechanical
 - Relaxation at full draw
 - Ease of holding anchor
 - Redistributing draw force
2. Increased Energy Transfer
 - Greater energy recovery
 - Higher arrow speed
 - Reduced arrow stress

E. Disadvantages

1. More moving parts
 - Noise
 - Complex tuning
 - Possible damage

F. Types

1. Wheels
2. Single Cam
3. Dual Cam
4. Universal Draw-Length

G. Shoot Compound Bow

H. 4-H Lesson Plans pp. 44-49

V. DEBRIEF

VI. TEACHING TECHNIQUES

A. **LIFE SKILLS TO BE LEARNED:** Leadership, Communication, Cooperation, Nurturing Relationships, Self Esteem, Social Skills

B. Flexible Gumby Technique

1. Ask for archer's permission, then mold archer into the proper form as you would a flexible "Gumby"
2. Use hands-on to get the body into the proper "T" position
3. Never take a bow out of a child's hand to show them how it is done

C. **NON-THREATENING** Hands-On Instruction

1. Use an assistant or child you know to demonstrate how you will handle them
2. Tell archer what you are going to do
3. Ask permission before touching
4. When touching them use:
 - Heel of your hand: hold your hands flat and firm with your fingers straight out and your thumbs on the side
 - Have them move their feet to touch your feet in proper position
 - Back of hand with hand relaxed

D. **OREO Technique: PUPIL COACH Relationship**

1. **COOKIE:** Find something the archer is doing right and compliment. This reinforces correct behavior and opens them up to your ideas for improvement. "Your release looks real smooth."
2. **CREAM:** Give the archer positive instruction on how to perform a skill correctly without telling them they are doing something wrong. "Keep your bow arm up until the arrow hits the target."
3. **COOKIE:** Follow-up with a compliment specific to the skill you have just taught them. "Your bow arm looks much more solid now. Good Shot."

E. **COACHING STYLES**

1. **COMMAND** - Coach makes all the decisions. Athlete's role is to listen, absorb, and comply.
2. **SUBMISSIVE**- Coach makes as few decisions as possible. Allowing archer to make most decisions. For example, throw out the balls and tell the athletes to have a good time.
3. **COOPERATIVE**- Coach shares decision making with athlete. They recognize their responsibility to provide leadership and guide your people toward achieving their goals. Spend most time with this style.

F. **COACHING POSITIONS**

1. **FRONT** - Look for:
 - Proper stance: feet shoulder width apart, hips aligned with feet
 - Straight body alignment
 - Shoulders level and relaxed
 - Relaxed bow hand
 - String hand flat and relaxed.
 - Drawing arm and elbow even or slightly elevated
2. **BACK**- Look for:
 - Correct arrow length for archer
 - Shoulders even and level across
 - Head straight over body
3. **Elbow**- Look for:
 - Posture- bottom tucked under, ribs and chest down
 - Bow straight up and down
 - Head straight
 - Body stable
 - Proper release motion
4. **Far back**- look for
 - Whole archer
 - Complete shot sequence

G. 4-H Fact Sheet 4

VII. **SHOOT**

- A. Shooters pair up and practice Oreo Technique and Coaching Positions
- B. Developing Archery Skills: What are shooters doing wrong? Form Faults/Effect on Shot or Arrow/Correction

VIII. **DEBRIEF**

IX. ARCHERY GAMES

- A. **LIFE SKILLS TO BE LEARNED:** Healthy Lifestyle Choices, Stress Management, Self-Motivation, Teamwork, Social Skills, Contributing to Group Effort, Sharing, Cooperation
- B. Relay: 2 teams using equipment and FITA Target
- C. Balloons
- D. Other
 - 1. Skeet
 - 2. Clout
 - 3. Flight
 - 4. Tick Tack Toe
 - 5. Scavenger Hunt
 - 6. Wand

X. 4-H LESSON PLANS PP. 71-76

XI. DEBRIEF

XII. DEMONSTRATION: WHAT IS WRONG WITH SHOOTING THIS?

- A. Dollar bill where you only see the President's face
- B. Firing squad where people shoot center of target
- C. Animal target

XIII. DEBRIEF

SESSION 3 – CLASSROOM (4HRS.)

I. PROPER SUPERVISION

- A. **LIFE SKILLS TO BE LEARNED:** Concern for Others, Personal Safety, Managing Feelings, Nurturing Relationships
- B. Instructor immediately accessible and able to oversee the entire program
- C. Instructor alert to dangerous conditions and takes preventative action
- D. Qualified supervision is required while archers are retrieving arrows as well as while shooting
- E. Number of archers an instructor can manage depends on the experience of the instructor, the age and maturity of the archers, and the abilities or disabilities of the archers
- F. Developmentally disabled children may need one instructor per archer
- G. **Number and age of children per instructor: (not including range officer)**
 - 1. 6-7 years old: 2 or 3 children per instructor
 - 2. 8-9 years old: 4 to 6 children per instructor
 - 3. 10-11 years old: 6 to 10 children per instructor
 - 4. 12-15 years old: up to 10 children per instructor
 - 5. 15 years and older: up to 10 children per instructor

II. TEACHING CHILDREN WITH SPECIAL NEEDS

- A. **LIFE SKILLS TO BE LEARNED:** Accepting Differences, Concern for Others, Managing Feelings, Personal Safety
- B. Identify children's abilities and disabilities and plan to accommodate
 - 1. May require additional class time or need space for wheelchair, or need an interpreter who knows sign language
 - 2. Plan for needs
- C. **TIPS**
 - 1. Identify the children's abilities (moving their arms, gripping and holding a bow, pulling a string back) rather than their disabilities
 - 2. Find out what they can do and assist them where they need help
 - 3. Use adaptive aids
 - 4. Talk to children, parents, or caregivers to understand the children's abilities and what they might need
 - 5. Patience plus persistence equals progress for all children
 - 6. Be creative, modify equipment and procedures to allow children to reach their highest level of performance
 - 7. Encourage children to do things independently using as little adaptive equipment as possible
 - 8. Provide positive feedback whenever something goes right, regardless of the level of success
 - 9. Specific archery guidelines
 - a) Wheelchair wheels straddle the line
 - b) Keep arrows in some form of quiver
 - c) The archer may have someone else retrieve and score arrows
 - d) Select bows short enough and light weight enough to draw back
 - e) Keep comments positive to reinforce the experience
 - f) Reference: Teaching Shooting Sports to Persons with Disabilities by Robin Taylor, Dennis Carpenter, at www.amazon.com

III. DEALING WITH PROBLEM ARCHERS, PARENTS AND OTHER ADULTS

- A. **LIFE SKILLS TO BE LEARNED:** Problem Solving, Conflict Resolution, Planning/Organizing, Stress Management
- B. Archer **Not** Following Rules and Procedures
 - 1. Remind the entire group of the rules or procedures. Don't single out individual now.
 - 2. Walk up to the individual and remind them of the rule or procedure they are not following.
 - 3. Put the individual in charge of monitoring themselves and others for the rule they are not following.
 - 4. Tell the archer they will need to follow the rules or they will not be allowed to participate.
 - 5. Take the arrows from the archer's quiver. Tell them to sit down behind the waiting line and watch the rest of the group until they feel they understand and can follow the rules and procedures of the archery range.
 - 6. Talk to archer to determine the reason for their disruptive behavior.
 - 7. Talk to parents about archers' disruptive behavior.

- C. Parents and Adult Participants
 - 1. Have parents and adults in designated area
 - 2. Assign parents and adults duties and responsibilities

IV. BOW SET-UP AND TUNING

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety, Learning to Learn, Resiliency, Critical Thinking, Problem Solving, Sharing
- B. 4-H Lesson Plans pp. 62-70
- C. Reference: Easton Arrow Tuning and Maintenance Guide
<http://www.eastonarchery.com/software>

V. EQUIPMENT SELECTION AND CARE

- A. **LIFE SKILLS TO BE LEARNED:** Personal Safety, Sharing, Wise Use of Resources, Contribution to Group Effort
- B. Selection Depends on the Archery Program
 - 1. More time archers spend at the range, the better equipment you should provide
 - Laminated wood/fiberglass recurve bows, properly sized compound bows and aluminum or carbon arrows
 - 2. No matter which equipment you buy, the key to cost savings is in equipment care. Bows will last for years.
 - Hang unstrung bows vertically or horizontally with strings attached on wooden pegs (dowels) or nails wrapped with tape
 - Protect arrows and leather goods from mold
 - Equipment must be stored in a protected location
- C. Bow and Arrow Recommendations
 - 1. 15-20 lb. Recurve Bows (about the same length as the height of the archer using them, with a range of plus or minus 6 inches)
 - 2. White limbs recommended; black absorbs heat from the sun
 - 3. 5 left-hand bows to 10 right-hand bows
 - 4. Arrows: Aluminum, Carbon
 - Feathers more forgiving (for bows with a side rest)
 - Vanes: durability and use in wet conditions
 - Recommend using full length arrows
 - 5. Factors When Purchasing a Bow
 - Determine eye dominance
 - Draw weight
 - Draw length
 - What the child wants to do: target, hunting, 3-D.
 - Cost
 - How often is it going to be used
 - Size of the kid
 - Color
 - Weight of bow (physical)
 - Size of bow (bow length)
 - Grip of bow
 - Whether shooting a recurve or compound
 - Using fingers or release
 - If possible, try bow first
 - 6. Arrows designed to match bow

- Spine weight
- Fletching type and style
- Length

D. 4-H Lesson Plans pp. 6-8, 13-14

E. Handout: Equipment for Beginning Archery Club Program

VI. RECORD BOOKS

- LIFE SKILLS TO BE LEARNED:** Keeping Records, Goal Setting, Planning/Organizing
- Examples of Records Books
- Time to do records

VII. RECREATIONAL SHOOTING, ACHIEVEMENT, HIGHER ACHIEVEMENT

- LIFE SKILLS/Values TO BE LEARNED:** Honesty, Integrity, Sportsmanship, Respect, Confidence, Responsibility, Perseverance, Courtesy, Judgment, Humility, Planning, Goal setting
- USA Archery, NFAA, IBO, FITA, JOAD, NADA
- Local, State, National Matches

VIII. SIGN CODE OF ETHICS

IX. WRITTEN TEST

X. COURSE EVALUATION

XI. PRACTICUM PREPARATION

SESSION 4 – RANGE (4HRS.)

I. PRACTICUM PREPARATION

- Range Set-Up
- Dry Run

II. PRACTICUM AND DEBRIEFING

ARCHERY PROGRAM DEVELOPMENT

Class Instruction/Planning

Class plans depend on your program and how long the archers get to shoot each day, and how many days.

There are three simple steps in organizing your class plans:

1. Review past skills learned.
2. Teach new skills.
3. Give the archers an opportunity to practice their new skills by shooting for score or a game.

Try to finish all sessions with an archery game.

Variety and Fun

Variety in youth archery programs can keep you, as well as your students, excited about the sport of archery.

Be creative in finding ways to help the kids enjoy and have fun with archery. You can make the archery range a favorite spot in camp.

Scoring Rounds

Archery is a target sport with a system of scoring. You can use this scoring for Achievement programs, Tournaments or Games.

Targets with 10-ring scoring have each of the five colors divided into two areas for 10 scoring areas. The center of the gold, or inner ring, is worth 10 points. The outer gold is worth 9 points. The inner red is 8 points, and the outer red 7 points. Each ring out has 1 less point with the outer white ring scoring 1 point.

The old system used 9,7,5,3,1 scoring in the five colors only. Some newer targets may have 2 rings in the gold. The smaller ring is used for scoring 10's when shooting competitions with a compound bow. You can ignore it for camp purposes or make a special award for campers hitting in this area.

Tournaments

Archery is an Olympic sport, and competition is a fun part of any archery program. Competition should be kept in perspective, and some camps may feel that competition is not a good experience for kids. One major tournament per week or session is plenty. You can really play it up to make it a fun event for all the kids. Some camps also compete against other camps.

You can customize any competition to meet the needs of your group and to fit the amount of time available. Choose the number of arrows for the entire round based on time. Then decide how many arrows per distance (if more than one distance is shot), the size of target face, and how many arrows per end. An "end" is the number of arrows shot before scoring.

Example:

Shot at 122 cm. (48 inch) target face.

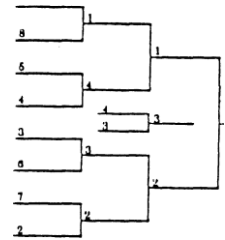
3 Ends of 5 Arrows - 15 arrows at 10 meters

3 Ends of 5 Arrows - 15 arrows at 5 meters TOTAL 30 Arrows/300 points possible

Traditionally, the archer with the highest score at the end wins. Ties are broken by taking the archer with the most "hits" or scoring arrows. If they both have the same number of hits, then the archer with the highest number of "10's" wins. If still tied, then the archer with the most "9's" wins. If still tied, the archers are declared equal.

Olympic Style Elimination Round

Many young archers have found the New Olympic Round format to be more exciting to play. After shooting a set number of arrows for qualification, the competitors are seeded in an elimination bracket. Then they shoot head to head, with the winner advancing to the next round, while the loser is eliminated.



Team Events

The New Olympic Round team event is exciting as well. This works best with 3 members on a team. The archers line up in a relay and shoot an elimination round using the same seeding diagram as in the individual round. Start in the second bracket for 4 teams.

The 3 archers have 3 minutes to shoot 3 arrows each, for a total of 9 arrows for the whole team. Only one archer can be ahead of the 1 meter waiting line and on the shooting line at a time. A penalty of 5 points is given for the second violation of this rule, after a warning for the first violation. The archers must be on the shooting line before they can nock an arrow. Vary the number of ends shot per time limitations.

*Sample Elimination
Round
Seeding diagram
{for 8 archers}*

The team round is a lot of fun provided the teams are balanced so that all archers feel they are contributing. The better archers often try to help others on their team, and as a result they learn more completely and become better archers because of it. The poorer archers are encouraged by the better shooters, and often show improvement, too. The distance and number of ends to be shot can be adapted for the conditions.

Achievement Programs

In achievement programs, the archers are competing against themselves for a score goal. There are formal systems, such as JOAD and CAA, but neither of these works well in all camp situations. You can create your own achievement program designed specifically for the camp. This can be as simple as winning a blue ribbon for shooting all their arrows with in the blue scoring areas, red for red, and gold for all gold.

Here is another example of a camp's own achievement award program. The system described below has been successful. The round is a test given to young beginning archers.

Eighteen arrows are shot from 15 meters at a regulation 80cm five-color target face. 10-ring scoring is used.

At the completion of the shooting and scoring, awards are made for the score shot. In this case a different bird represents the different scoring brackets.

The archer is awarded a GOLDEN EAGLE for a score of 130 or more, a CARDINAL for a score between 110 and 129, a BLUEJAY for a score between 90 and 109, a BLACK BIRD for a score between 70 and 89, and a BOB WHITE for a score between 50 and 69.

The archer is given a card with his name, score, date, and colored cut-out of the bird. The archer is also allowed to put his autograph on the target in the dining hall on the appropriate color indicated by the name of the bird.

This is meant to be an example of what can be developed for an achievement award system. It is important to use imagination and try to fit the rounds and awards to the situation.

Games

Games are fun to create and fun to play. As an Instructor, you can get involved and shoot in the games with the kids. If your camp has a week or summer theme, try to design games to go along with that theme.

Here are a few key items that must be remembered when playing archery games.

- The games must match the ability of the shooters. Many games may look easy (like lots of small targets) but are actually very difficult. This is how carnival games make so much money. The kids can not shoot well enough to intentionally hit a small target, so it becomes a game of luck. If the targets only cover 5% of the area, you can only expect them to hit it 1 out of 20 times.
- If a game is too difficult, move the archers closer to the target. If it is too easy, or as their skills improve, move them farther from the target.
- Always follow the Archery Range Rules and Procedures when teaching games. Always enforce all of the rules.
- When putting balloons or other items on a target, keep them in the middle 50% of the target butt. If you place items near the edge of the target, the arrows will miss, and time will be wasted searching for arrows.
- Where will the missed arrows go? Make sure that there is a safe area behind the targets, so the arrows can be easily found.
- End a game while the kids are still enjoying it. Let them know when it will be the last end. Always leave them wanting more.

Sample Games and Activities

Tic-Tac-Toe

Cover the target with a tic-tac-toe target about three feet square: Shoot 3 arrows trying to get three in a row. Score three points for each. You can also play this head to head with another archer.

Color Shoot

First person shoots one arrow and goes to the target to score. This archer and all that team will aim for that color. Each team may be aiming for a different color. Score one point for each arrow in the right color area. Instructor may select color and archers shoot and score only the hits within that color.

Musical Arrows

When the music starts, each archer shoots until the music stops. Score and retrieve arrows and move to the next target.

Wand Shoot

Target: a three- inch strip of masking tape placed vertically on the target mat Distance: 10 meters

Number of arrows: twelve Scoring: five points for each hit

(Note: In the standard Wand Round, 36 arrows are shot from 60 yards at a two inch by six-foot piece of balsa wood or soft pine. Standard target rules apply.)

Battle Ship

Use index cards sized per the ability of the archers. Draw different ships on the cards and assign points from 1 to 5. You can also include blank cards. Each individual or team will pin the cards up with the blank side showing on the target of their competitor. Archers shoot 3-6 arrows each or 12-15 as a team. Points are scored by the value of the ships they hit.

Shoot the Instructor's Hat

Hang your hat on the target for the archers to shoot at.

Balloon Elimination Shoot

After a scoring round, rank the archers from lowest to highest. Hang a balloon in the center of the target. Starting with the lowest scoring archer, each archer shoots one arrow at the balloon. If the archer pops the balloon, they move to the winner's circle until all archers in turn have shot 3 arrows. Prizes are awarded to the balloon breakers.

Holidays

If classes are taught as the different holidays approach, it is fun to make special targets in the shape of an item that represents the holiday. For example, the students can shoot at pumpkins, and cats at Halloween; a turkey at Thanksgiving; a bell at New Year's; shamrock on St. Patrick's Day; eggs at Easter; and flowers at May Day; for the 4th of July, archers can shoot at balloons filled with flour or confetti to simulate fireworks. As appropriate, the scoring areas can follow the outline of the target, giving higher values as the arrows come nearer whatever "center" there may be for that shape. At the completion of the event, it might be fun to award silly prizes appropriate to the holiday.

From National Archery Association Level I Basic Instructor Course manual. 2nd Edition, pp. 51-58.

Score Musical Arrows as follows:

Target #1	All arrows that hit the red count 1 point.
Target #2	All arrows that touch any part of the animal count one point. The black dot counts three.
Target #3	Arrows which hit the gold count 1 point.
Target #4	Arrows which hit the black count 1 point.
Target #5	Arrows which hit the blue count 1 point.

Bingo

Make target face to represent a Bingo card on a brown paper bag or wrapping paper. A score card can be made by having the students fill in numbers in the squares before shooting begins.

Shoot six arrows; and as they are removed from the target, the corresponding number is crossed off the score card. Winner is first to get any combination of numbers crossed off.

Bottle Shoot

Target: A half-gallon plastic bottle hung by the neck or handle

Distance: 10 meters

Number of arrows: Four

Scoring: 15 if the arrow sticks in the bottle, 10 if it strikes the bottle and rebounds

Hunting

Target: four-foot painting of a deer on the ground Distance: 15 meters

Number of arrows: Two arrows at each distance Scoring: as marked on the deer

Archery Golf

Target: A rubber ball four inches in diameter on a wire stand

Distance: 10 meters

Number of arrows: four Scoring: five points for each hit

Tablecloth Shoot

Target: a regular target covered with a checkered oilcloth with two-inch squares; squares randomly numbered one to nine

Distance: 15 meters

Number of arrows: four

Scoring: as marked

Arrow Patterns

Sometimes it is difficult to tell what archers are doing wrong just by watching them shoot. Watching where the arrows land on the target face can help you identify shooting form errors. Archers with good shooting form should shoot their arrows in a 'group'. Arrows are said to be 'grouping' when they are close to each other, even if the group is not in the center. Archers should be complimented for good groups. If the groups are not in the center, a sight adjustment or aiming change will solve the problem.

Here are some arrow patterns and common errors that cause the patterns. (Remember to use the "Oreo Technique" after you identify the form correction.)

High and Low Arrow Patterns

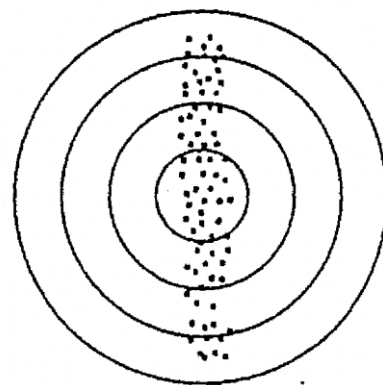
- Inconsistent anchor, moving up and down.
- Mouth open, teeth apart, chewing gum.
- Nocking arrow incorrectly, above, below or not touching nock locator.
- Holding the bow too high or low on the handle.

High Arrows

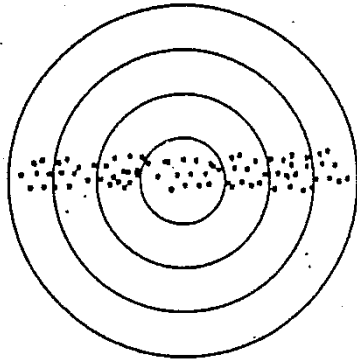
- Heeling the bow.
- Pulling the bowstring back too far.
- Raising the bow arm during the release.
- Pulling string hand down during release.
- Low drawing elbow.

Low Arrows

- Dropping the bow arm on release.
- Moving head forward to meet string when anchoring.
- Collapsing.
- Creeping.
- Leaning towards the target.
- Arrow necked above nock locator.
- Arrow placed on shelf instead of arrow rest.



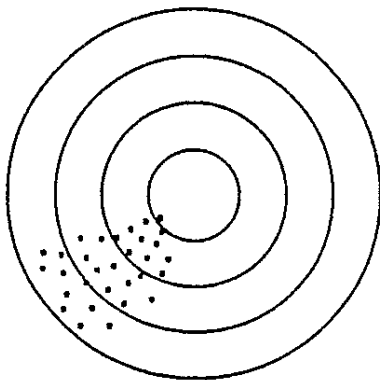
**High and Low
Arrow Pattern**



**Left and Right
Arrow Pattern**

Left and Right Arrow Patterns

- Gripping bow too tightly.
- Not watching string alignment.
- Canting bow to the left or right.
- Peeking



Low Left Arrows

Left Arrows (right arrows for left hand shooter)

- Pulling string hand away from the face during release.

Extremely Left Arrows (off the target)

- Aiming with the left eye for a right-handed shooter. (Opposite for a left-handed shooter)

Low Left Arrows (low right for left hand shooter)

- Most often caused by the string hitting the chest or bow arm, or being caught by loose clothing.

3D Archery, What is it?

The sport of 3D Archery is a form of Target Archery. It is also known as a very addicting and fun Archery sport. 3D Archery can be participated by anyone at any skill level.

3D Archery can be set in the woods, fields and sometime even indoor ranges. The goal of 3D Archery is having the ability to guess how far away the target is and know where to shoot to achieve the highest possible score.

3D Archery is a lot like golf

In golf, you generally need to know of far the hole is to choose the right club. In 3D, you have to guess the distance and shoot to get the highest score. As in golf if you guess the distance wrong you will probably not score as well. In golf the lowest score wins, in 3D the highest score wins.

Marked 3D vs. Unmarked 3D Archery

There are two types of archery events, marked yardage and unmarked yardage. Most the shoots are unmarked yardage. This means you stand at your designated stake and try to guess how far the target is. You then take your shot trying to score the highest possible points.

In Marked 3D Archery, they will tell you at each stake, how far the target is. Some clubs will even put a small dot on the highest scoring ring. Your object is to hit the highest scoring ring.

Target Scoring in 3D Archery

Each 3D Target will have a set of scoring rings on it. The scoring is normally Club dependent or association dependent. Many Archery Clubs use the following scoring. The smallest circle scores and 11 or 12 points, the next ring is the heart, 10 points, the lung is 8 points, the body is 5 points. The hoof or antlers on deer score a zero.

Types of Archery Targets

Generally, the 3D Archery will shoot at various animal shaped targets. These are close to life sized animals. The types of animals will vary depending on the club. You may see everything from Antelope, Deer, Sheep, Snakes, Beaver, Skunk, Moose, Elk, Cougar, Bobcat and much more.

Archery Skill Levels Required

3D Archery has many classes for different skill levels and equipment. Even beginners and children can have a lot of fun in this sport. The Archery equipment you use, is the deciding factor on how far away your targets will be. An example for bowhunter class it 35 yards and under.

Which 3D Archery Class do I belong in?

Each club will have their own requirements so please check with them. However, here are some general classes. The closest stake to the target is for the Cub Class (usually under 11 yrs.). The next will be the Youth stake (16 and under) followed by the traditional archer's stake and then bowhunter, open and competition stakes. Competition and Open classes are generally 45 or 50 yards as a maximum distance. This does not mean they are all that far.

What about guessing yardage in 3D Archery

Guessing the distance is probably the number one skill in 3D Archery. In unmarked 3D Archery, you must guess how far the target is to make a high scoring shot.

General Rules of 2016 4-H National Championships - Archery

1. Arrows---Minimum arrow weight of 5 grains/pound of bow draw weight. No larger than 27/64 (.422 inches diameter for arrows and .425 inches diameter for points maximum). Make sure arrows are marked in some fashion, to be told apart from others.
2. Bows---Peak draw weight cannot exceed 60 pounds. No electronic sights. Illumination of pins is allowed.
3. NO communication devices allowed on ranges. This includes archers, coaches, parents or spectators.
4. **ALL** archers **SHALL** remain with their group during shooting and until all score cards are signed and turned in. Archers must turn in all score cards as a group. Archers **MAY NOT** leave range until score cards are turned in. Archers must add their scores on their own (no parental/coach help). If archers need help they can ask range crew for assistance.
5. Score Cards must be signed by scorekeepers and the archer before turned in or they are not legal.
6. Be prepared for anything and everything including weather, mud, mosquitoes.
7. NO SMOKING ON ANY RANGES.
8. Dress Code: Appropriate for weather, but modest and acceptable. 4-H emblem is required, and club shirts are encouraged.
9. Coaches may use spotting equipment.
10. Archers shooting extra arrows will have highest arrow not scored plus one penalty point per extra arrow shot.
11. Range Finders may be used in the Field and FITA round only. Range Finders will **NOT** be allowed on the 3D range. This includes archers, coaches, parents, and spectators.
12. NO COACHING by coaches or parents is allowed during the firing of the matches. Encouragement offered to archers is welcomed as long as it is not directing their shooting. In case of a breakdown or problem above the level of the archer to handle coaches may assist, with the permission of the range officers.
13. Participants, coaches, spectators, or parents are **NOT** allowed on the official archery ranges used for the competition, unless permission has been granted by the Compound **AND** Recurve archery Chief Range Officer. Practice or warm up shots are **NOT** allowed in the parking areas of the official archery ranges.
14. Deliberate shooting or attempting to shoot any living animal while on competitive ranges is grounds for ejection from the event or from the match. Under no circumstances is "sky-drawing" permitted.
15. Scorecards must stay in possession of the archers at all times until turned in. At no time shall coaches, parents, spectators, or volunteers have access to scorecards.

FITA Round - 2016 National 4-H Championships

1. DISTANCE: 60-50-40-30 meters in that order
2. COURSE OF FIRE: 60/50 meters = 3 ends of 6 arrows
40/30 meters = 6 ends of 3 arrows
3. TIME: 6 arrows in 4 minutes,
3 arrows in 2 ½ minutes
4. SCORING: 10 pts. minus 1 pt. from the center outward. Inner 10's scored as X's
5. TIE BREAK: Total #10's first (10's and X's), then #X's, #9's, #8's etc. until tie is broken
6. WHISTLE COMMANDS: 2 Blasts=Get your bow and come to firing line.
1 Blast= Nock and shoot arrows.
3 Blasts=Score and Pull arrows
4 or more Blasts=CEASE FIRE
7. SHOOTING LINE ROTATIONS:

3 on a mat 60M=AB/C 50M=BC/A 40M=CA/B 30M=AB/C, BC/A, CA/B	4 on a mat 60M=AB/CD 50M=CD/AB 40M=AB/CD 30M=Rotate
--	---
8. Witnessed bounce-outs or pass-through by archer or coach must contact the Range Officer. Visual non-marked holes will be verified and scored accordingly. No re-shoots. Score must be agreed by all archers and range official and signed by CRO.
9. Robin Hoods - if it sticks in the arrow or hits the arrow and falls out, and the arrow it hit can be determined it will score the value of the arrow it is stuck in or damaged. If the arrow deflects off another arrow then sticks in the target it will score the value of where it sticks in the target. No re-shoots. Score must be agreed by all shooters and range official and signed by CRO.
10. Dropped or shot arrows going beyond the 3 meter line will count as a shot arrow.
11. Targets will not be moved. Parents, spectators, and coaches must stay at least 20 meters behind archers
12. PRACTICE: 2 practice ends at first distance, 1 practice end when changing targets at 40M.

Field Round 2016 National 4-H Championships

1. **DISTANCE:** Marked distance of 5 to 60 yards, with proper sized targets for the distance shot.
2. **COURSE OF FIRE:** Target lanes, shooting 4 arrows per lane.
3. **TIME:** Move through course in a timely manner. Avoid excessive glassing of targets. A (3) three let down rule, per arrow, will be enforced. A (4th) fourth letdown will be considered a shot arrow.
4. **SCORING:** 5, 4, 3 from center out marking center X's.
5. **TIE BREAKER:** Greatest number of X's, 5's, 4's, 3's in order

Target by target comparison starting with #1 until broken
6. **SHOOTING:** Archers will be designated A, B, C, D. On targets 1-7 shooters A & B will shoot first. On targets 8-14 shooters C & D will shoot first. For 3 member squads, A&B will shoot first at targets 1-4, B&C will shoot first at targets 5-10, C&A will shoot first at targets 11-14.
 - **ONE target -** All archers shoot all 4 arrows in the one center.
 - **TWO targets -** Archers on the left shoot the left target and archers on the right shoot the right target.
 - **FOUR targets -** Each archer shoots all 4 arrows in his/her own target. First 2 archers shoot bottom targets on left or right side. The other 2 archers shoot top targets on left or right.
 - **35,30,25,20 FEET WALKUP -** shot may not be #14. Archer will pick one column and will shoot all 4 arrows in that column with one arrow in each target. You must shoot from top to bottom or bottom to top in that order.
 - **WALK-UP -** All archers will shoot 1 or two arrows from each of the markers then move forward, as group, to shoot the next.
 - **FAN -** Archers will shoot 1 arrow from each marker, moving around the fan to the right. All 4 archers can shoot at the same time. If there are two targets then you will shoot the two left arrows in the left target and the two right arrows in the right target.
7. **BOUNCE OUTS / PASS THROUGH:** Witnessed bounce-outs or pass-through will be re-shot. Contact the Range Officer.
8. **ROBIN HOOD:** If a shot arrow sticks in an arrow already in the target, or hits an arrow and falls out, and the arrow it hit can be determined it will score the value of the arrow it is stuck in or damaged, if not then it will be re-shot before moving to next target. If the arrow deflects off another arrow then sticks in the target it will score the value of where it sticks in the target.
9. **PRACTICE:** Practice, 1st target (you can not score this target), score 2nd and consecutive targets.

3-D Round 2016 National 4-H Championships

******NO RANGE FINDERS ALLOWED ON RANGE!!******

****NO Practice at range before shooting****

1. **DISTANCE:** Unmarked from 5-50 yards for compound archers and 5-40 yards for recurve archers.
2. **COURSE OF FIRE:** 1 arrow at each of 30 3D targets.
3. **TIME:** Two minutes to shoot your arrow from when you step up to the stake, or after the archer ahead of you leaves the stake.

You **MAY NOT** glass the target from the stake after your shot. You **MAY NOT** adjust your sight after you have drawn and let down. You **MAY NOT** adjust your sight after glassing the target **AT** the stake.

In the case of a lost arrow you have two minutes to look then move on to the next target. Mark where the arrow was lost and you may return to find it later.

4. **SCORING:**
Center X-----listed as X counts + 11
Center Vitals-----+10
Outer Vitals-----+8
Any non-vital hit in the target-----+5
Complete Miss---0
5. **TIE BREAKERS:** Number of X's, 10's, 8's, 5's, in order
Longest String of 10's starting with target #1
6. **SHOOTING:** Archer must have a part of the body touching the stake when shooting. Archers will rotate who shoots first. ABCD, BCDA, CDAB, DABC, through the 30 stations.
7. **BOUNCE OUT / PASS THROUGH:** Witnessed bounce-outs or pass-through will be re-shot. Contact the Range Officer. A glance off will be counted as a miss and will be scored a 0.
8. **ROBIN HOOD:** If a shot arrow sticks in an arrow already in the target, or hits an arrow and falls out, and the arrow it hit can be determined it will score the value of the arrow it is stuck in or damaged, if not then it will be re-shot before moving to next target. If the arrow deflects off another arrow then sticks in the target it will score the value of where it sticks in the target.

4-H National Archery Competition Scoring Rules

General: Each score card will have empty boxes for the individual score of each arrow, a total box for each end of scoring for the sum total of all arrows shot in THAT END, and there will be a running total box which will contain the cumulative total score of all arrows shot UP TO THAT POINT in the competition. There will be two scorers per group. MAKE SURE YOUR SCORES MATCH UP AFTER EACH END!

FITA Competition

Target #	1	2	3	4	5	6	Total	Running Total
Meters 60-1	10	10	9	9	9	9	56	56
Meters 60-2	x	x	10	9	9	9	57	113
Meters 60-3	x	x	x	x	10	10	60	173
							Total	173
Meters 50-1	x	x	x	9	8	8	55	228
Meters 50-2								

There will be two practice ends before starting the tournament at 60 meters, there will also be one practice end before starting the 40 meter portion of the tournament. Score all arrows for the end as well as the total for that round. The running total shall be the sum of all end totals up to that point in the tournament.

Field Competition

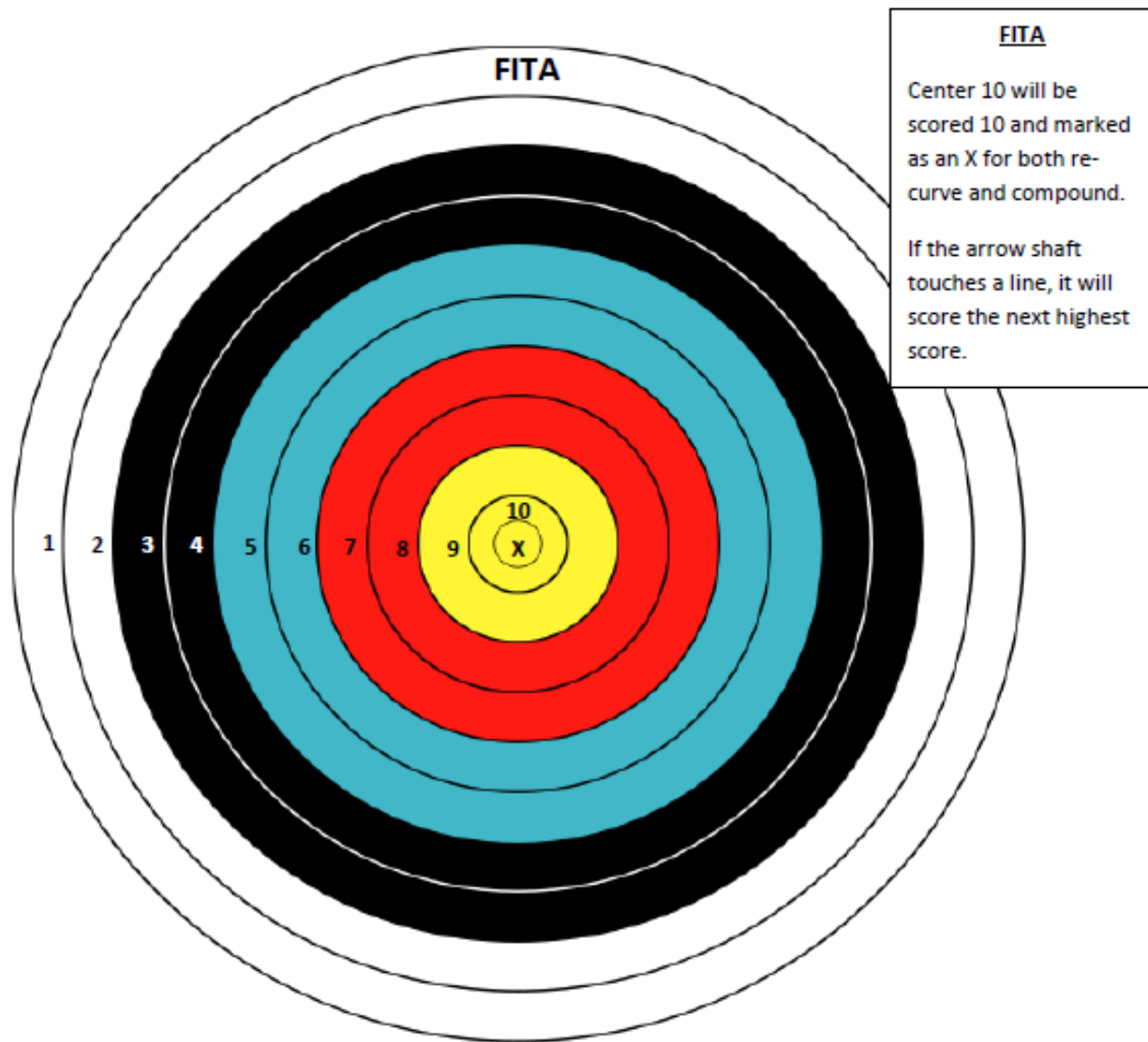
Target #	1	2	3	4	Total	Running Total
1						
2						
3						
4	x	5	3	3	16	16
5	5	5	3	3	16	32
6	5	5	5	3	18	50
7	x	x	x	5	20	70

The first end of shooting will be a practice end. You will move to the next target to begin scoring. Start recording scores on the target number at which you started shooting. Example – You start shooting on target #3. This is a practice. You then move to target #4 and will start scoring on line 4.

3D Competition

Target #	Score	Running Total
1		
2		
3		
4	5	5
5	8	13
6	11	24

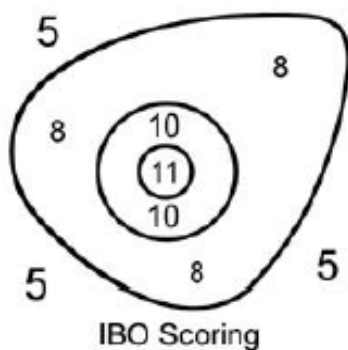
Start recording scores on the target number you start on. Example – If you start shooting on target 4, start scoring on line 4. Record the score of the arrow shot at the target, and record the running total up to that point. The center ring centered inside the "10 ring" shall be counted as 11 points. If there are multiple rings inside the "10 ring" the center ring shall be the 11 ring worth 11 points, while all other area within the "10 ring" shall be worth 10 points.



3D

If the arrow shaft touches a line, it will score the next highest score.

Arrow must hit "hair color". If arrow hits horn, rock or dirt mound it scores zero.

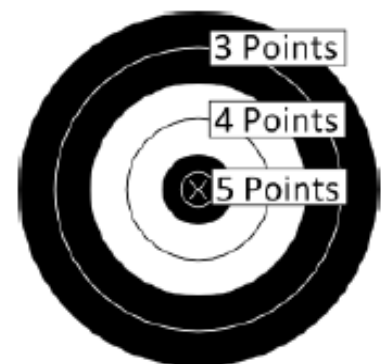


If a target has a 12 or 14 ring, these will not be used for scoring.

FIELD

If the arrow shaft touches a line, it will score the next highest score.

Center 5 will be scored 5 and marked as an X for both re-curve and compound.



Trajectory and Trajectory Experiments

Ronald A. Howard Jr.

Many people think that bullets, shot or arrows travel in straight lines just like light. It does not take much shooting experience to realize that projectiles and light behave quite differently. The physics of projectiles (ballistics) is discussed at the end of this fact sheet for those interested. The main purpose of this material is to help you understand how trajectory enters into shooting.

Under normal conditions, light travels in straight lines. Changes in the density of substances it passes through may deflect it, but within substances of uniform density (like air) light travels in straight lines. Electromagnetic forces, like magnets can bend light, but it has no mass (weight).

Projectiles like bullets or arrows have mass. Thus, they respond to gravity under normal conditions. As soon as an arrow leaves the string or a bullet leaves the muzzle, it begins to fall, accelerating toward the earth under the influence of gravity. In fact, if an arrow or bullet was fired parallel to the surface of the earth on level ground, it would hit the earth at the same time as one dropped from the same height at the same time much farther away. In addition to their mass, projectiles are solid objects. Pushing them through a dense medium, like air, causes friction and turbulence. Both forces affect the projectile immediately. The projectile begins to slow down as soon as it leaves the string or the muzzle.

The slowing influence is cumulative until the projectile finally comes to rest.

These two factors combined cause projectiles to follow a curved flight path. If two straight lines are used to show the line of the bore or the resting position on the string and the line of sight, the line of flight (path of the projectile) would relate to those lines as shown below (Figure 1).

The curved flight path requires that

the bore must be pointed above the line of sight to hit a distant object on the line of sight. If the sights are above the bore or the arrow, it must cross the line of sight twice, once while rising and a second time while falling toward the earth. The exact shape of the trajectory curve can be determined by complicated mathematics or by testing. Actual testing yields better results for a given shooter and his or her equipment and is more easily understood.

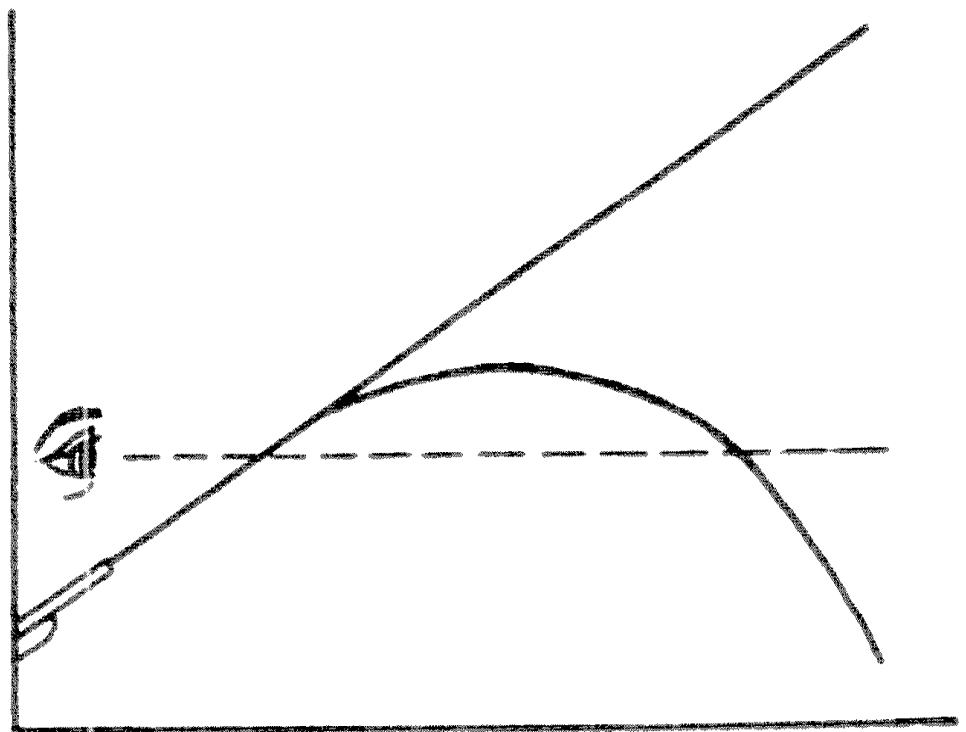


Figure 1. Relationships among line of sight, line of bore, flight path and drop.

The projectile accelerates toward the earth at a rate of about 9.8 meters/second² (32 feet per second²). If the projectile was fired parallel to the ground, it would drop 4.9 centimeters (0.16 feet) in the first 0.1 second, 19.6 centimeters (0.64 feet) in 0.2 second, 122.5 centimeters (4 feet) in 0.5 second, and 490 centimeters (16 feet) in 1 second (Table 1). In 3 seconds, it would have dropped 44.1 meters (144 feet). If a projectile could travel at a constant velocity of 60.96 meters/second (200 feet/second), the trajectory would look like the graph in Figure 2. The actual flight path would curve more sharply downward, since the projectile would be slowing its horizontal motion as gravity pulls it to earth.

You can calculate the trajectory of your personal equipment as you have it set up using the worksheet attached. Shoot the same arrows throughout the experiment if possible. If not, shoot matched arrows with matched fletching. Leave the sight setting the same for all shots, and use the same aiming point for each shot and all distances. Measure from the aiming point to the center of the group of arrows and carefully record the distance above (+) or below (-) the point of aim for each distance. Stop shooting if the arrows are falling short (or nearly falling short) of the target. Plot the flight path of the arrows relative to the line of sight. The elevation angle can be calculated if desired by following these steps.

1. Measure the true draw length of the arrow at full draw (the distance from the anchor point to the arrow rest).
2. Measure the height of the sight pin above the arrow rest.
3. Measure the height of the center of the eye above the bottom of the arrow shaft at the anchor point.

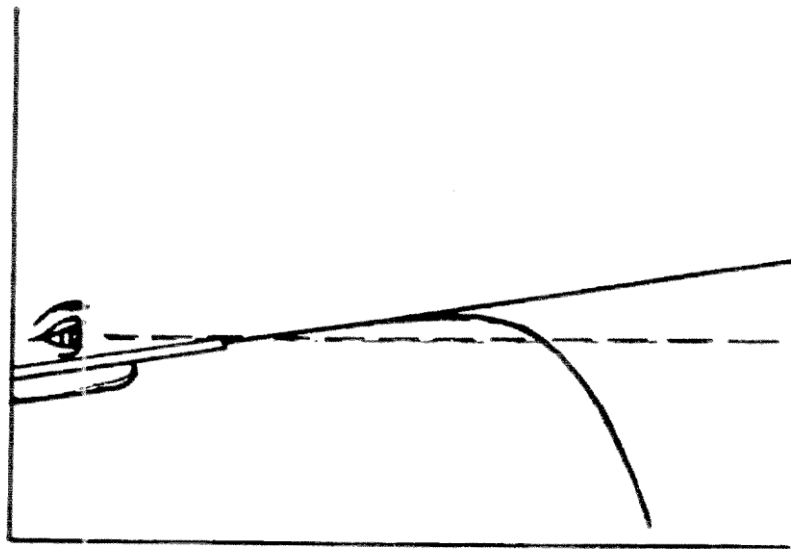


Figure 2. Trajectory of an idealized projectile traveling at a constant 60.96 meters/second (200 feet/second).

4. Subtract the sight pin height from the eye height.
5. Divide that length by the true draw length.
6. The dividend is the natural sine of the angle of elevation from the horizontal.
7. Use a sine table to locate the angle with that sine value.
8. Plot a horizontal line through the eye and sight to the center of the target.
9. Plot a line starting with the distance from the eye to the anchor point below the line of sight at the calculated angle of elevation above horizontal. This is the line of the shaft or the line of the bore.
10. Plot the true line of flight at the distances selected.

This same procedure can be used with rifle bullets, but a longer range is needed and the differences in impact points should be recorded in centimeters or inches rather than meters or feet.

For Those Who Want to Know More

Ballistics is the science of projectiles. It focuses on the dynamics of projectile flight and the energy stored and released by the projectile. One of the components of ballistics is the study of trajectory, the flight path of projectiles. In shooting, trajectory related the straight line of sight to a target with the curved flight line of the projectile. The ballistics of bullet or arrow trajectory involves complex concepts in physics and engineering.

Newton's first law, the law of inertia, states that objects tend to remain at rest or to travel in a straight line at a constant speed unless they are acted upon by an outside force. For projectiles, the forces include the energy that accelerates them initially, the acceleration of gravity, friction of the air and drag. Projectile mass, shape and even construction can influence those forces. Complex formulas have been developed to calculate the projectile's ability to retain its energy and velocity (speed).

in a direction). Sectional density and ballistic coefficient are two measures of the “slipperiness” of a projectile.

A projectile starting at rest is accelerated by the stored energy of the limbs, air charge or expanding gases of the fired round. The internal ballistics (those inside the firearm bore or while the arrow is on the rest) limit the motion to horizontal and vertical vectors (components of the total velocity of the projectile). Under most conditions the horizontal velocity is greatest.

External ballistics are more complex, and they begin as soon as the projectile leaves the bore or the bow. The horizontal vector of velocity is measured by its horizontal speed toward the target. The vertical vector is measured by its speed upward, perpendicular to the surface of the earth. Both the horizontal and the vertical vectors of velocity begin to decrease immediately. Friction and turbulence in the air reduce the horizontal velocity. The pull of gravity reduces the vertical velocity. Note that a negative acceleration or velocity in the vertical component means the projectile is moving toward the earth rather than away from it. Wind currents or the rotation of the projectile may cause a lateral movement.

High initial and retained velocities result in a “flatter” trajectory. That is, the arc of the projectile from the shooter to the target is less peaked. The less time the projectile is in flight; the less outside forces influence it. The obvious conclusion is that “faster is better.” However, obtaining optimum ballistic performance involves balancing competing factors rather than simple maximization of any one factor. Limits are imposed by the chemical structure of the

powder, strength of the materials used, mass of the firearm and the strength or recoil resistance of the shooter. Other factors, like barrel life, consistency in energy release, economics, projectile construction and many more reduce the upper limit toward some optimum value. Changing a single factor of the internal ballistics can result in major changes in external ballistics. Altering the mass of a projectile results in changing its shape. Both sectional density (a measure of the mass divided by the diameter or basal area) and ballistic coefficient (a measure of the bullet’s ability to overcome resistance of the air, which involves sectional density in its calculation) are related to the shape of the bullet. Optimizing mass and initial velocity with performance and terminal velocity involves many factors.

The results of changing bullet mass may be surprising. An empirical test could be done using bullets of similar shape and diameter but different weights. Thirty caliber bullets are available in flat-based spitzer shapes in weights from about 110 grains to 200 grains. Interested shooters could fire a test series with bullet weight and compare trajectory curves to determine the optimum bullet weight for that shape in their rifle.

Both momentum and energy are related to the velocity and mass of the projectile. Momentum is the product of the mass and the velocity. Kinetic energy (the energy of moving objects) is the product of the mass and the square of the velocity divided by two.

Projectile use is a major determining factor in balancing momentum and energy. When a projectile comes to rest, the remaining energy and momentum is translated into penetration and

shock. On target ranges bullets and arrows need only enough momentum and striking force to penetrate the target. The shot must have enough remaining energy and momentum to break clay targets. In hunting situations, small game arrows, shot and bullets kill by hydrostatic shock. The energy of the striking bullet displaces water in the tissue, causing immediate disruption of vital functions. Momentum is not critical, but kinetic energy is. Big game arrows kill by penetration and hemorrhage. Very little hydrostatic shock is produced, so momentum is much more important than kinetic energy. Big game bullets must combine shock with adequate penetration to reach vital areas. Considering the use of the projectile adds complexity to making ballistic decisions. This may explain the large array of arms and ammunition available today.

Many ballistic experiments can be tried by shooting sports participants. Most would be worthy of entry in science fair competitions under the categories of physics and engineering. Altering one factor at a time, such as sectional density or velocity, may offer easier explanations of the events taking place. For the shooter, more interested in performance on targets or game, the arms and ammunition companies have tables that can assist in selecting the appropriate combinations of factors to do the job at hand. Wise shooters will test the listed values for themselves using their own firearms, particularly where the shape of a trajectory curve is concerned. Their observed data is much more valuable than the theoretical data from the tables.

Table 1. Theoretical values for drop from the acceleration of gravity and distance traveled for idealized projectiles fired parallel to the surface of the earth at a constant velocity of 60.96 meters/second (200 feet/second) and 914 meters/second (3000 feet/second) is given below. The lower velocity corresponds to a very fast arrow. The higher velocity approximates a high velocity center-fire rifle cartridge.

Time	Distance Dropped		Distance Traveled @ 200ft.sec		Distance Traveled @ 3000ft.sec	
(sec)	(cm)	(ft)	(m)	(ft)	(m)	(ft)
0.1	4.7	0.16	6.1	20	91.4	300
0.5	19.6	0.64	12.2	40	182.8	600
0.3	44.1	1.44	18.3	60	271.2	900
0.4	78.4	2.56	24.4	80	365.6	1200
0.5	122.5	4.00	30.5	100	457.0	1500
0.6	176.4	5.76	36.6	120	584.4	1800
0.7	240.1	7.84	42.7	140	693.0	2100
0.8	313.6	10.24	48.8	160	731.0	2400
0.9	369.9	12.96	54.9	180	822.6	2700
1.0	490	16.00	61.0	200	914.0	3000
1.25	765.6	24.00	78.2	250	1142.5	3750
1.5	1102.5	36.00	91.4	300	1371.0	4500
1.75	1500.6	49.00	106.7	350	1599.5	5250
2.0	1960	64.00	121.9	400	1828.0	6000

Trajectory Worksheet

This worksheet will help you determine trajectory of an arrow using your equipment. Distances and trajectory measures should be made in the same measurement units, either metric or English units. The suggested increment of distance for English units is about 5 feet. For metric units try an increment of 1 or 2 meters. Measure the distances above or below the line of sight in either inches or centimeters. If those distances become too great, feel free to convert them to feet or meters. Record the following information before you start.

Height of sight above arrow rest (bore) _____

Height of pupil above nock of drawn arrow _____

[illegible]

Penetration and Shock Demonstrations

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This demonstration is an effective way of contrasting the actions of firearms and archery equipment. It requires an adequate range. For best results, use a high velocity cartridge loaded with frangible bullets in the rifle. A bow powerful enough to completely penetrate the backstop material completely should be used. Have junior leaders or parents assist.

First, shoot water filled (completely!) milk jugs, oil cans or similar containers with each arm. The targets should be at the same range from the firing line and close enough to hit them easily. The rifle should produce a response resembling an explosion. The bullet has high

kinetic energy that is quickly transferred to the water as hydrostatic shock. Since water is incompressible, it moves away from the impact area violently. Water in living things behaves similarly, and the bullet kills by tissue disruption and hydrostatic shock.

The arrow should easily penetrate both sides of the jug, and may pass through the container without too much disturbance, merely causing a leak or making the jug tip over. It has relatively little kinetic energy and causes very little hydrostatic shock. Arrows are penetrating and cutting projectiles, and they kill large game by massive and rapid hemorrhage.

Repeat the performance on jugs filled with sand, hay bales or some similar backstop. The rifle bullet should be stopped by the material, but the arrow should pass completely through again. This should help the youngster to realize that even a relatively light bow can drive an arrow through material that can stop a bullet. Use the graphic demonstration as an introduction to a discussion of safety and the functions of both bullets and arrows in taking game animals.

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