Motion and Stability: Forces and Interactions

Motion and Design

BIG IDEA: Forces acting on an object affect its motion.

Questions-Targets-Activities

1. What do I know about motion?
   Targets: I can identify what I already know about motion.
   I can ask meaningful questions about motion.
   Activities: View: [http://www.youtube.com/watch?v=qybUFnY7Y8w](http://www.youtube.com/watch?v=qybUFnY7Y8w)
   Challenge: Working in small groups, design a way to move a ball to knock over a domino 6 feet away without touching the ball with your hand.

   Students Share Claims and Evidence: Students share claims and evidence to whole group. Class discussion will be aimed at identifying: what we observed, what our balls did and why, what commonalities we notice in our evidence?
   Small groups brainstorm the important terms to share what they already know about motion. Make class Living Concept Map.
   Peruse non-fiction books about force and motion to assist in asking meaningful questions to guide our learning. Categorize our questions as Nice to Know or Need to Know and Testable or Researchable.

2. How can a model be built to meet design requirements /solve a problem?
   Targets: I can use the technological design process:
   I can define the problem and list criteria for a solution.
   I can work with others to generate possible solutions.
   I can build a model of the design.
   I can test the solution and modify the design if necessary.
   I can share/argue my solution/claim persuasively by speaking, writing or illustrating the process/product.
   I can build a model to move a given distance.

   Lessons: #1 Building a vehicle to meet design requirements.
   #2 Students persuasively make their claims with evidence about how and why their vehicle meets requirements and illustrate their vehicles. Then they build a standard vehicle/model-controlled variable for future investigations.

   Read: "The Race That Wasn't Run" (Plan as a close reading lesson.)

Small Group Inquiry: How can people use their knowledge of forces and interactions and design in their lives? [http://smartr.edc.org/content/science-force-and-motion](http://smartr.edc.org/content/science-force-and-motion)

Target: I can describe activities/careers that require what I learned in this lesson.

3. How does the amount of pull (gravitational force) affect the distance a standard vehicle will travel in a given time?

Targets: I can plan as a group and conduct an investigation to answer our question. I can describe activities/careers that require what I learned in this lesson.

(I can make a prediction, identify variables, follow a procedure, make observations, record and analyze data to make a conclusion.) I can write a conclusion. I can measure and compare the distance travelled with different amounts of pull in a given time. I can explain how speed is related to force/pull.

Activities: Motion and Design Unit:

Lesson #3 Change this investigation to include a given amount of time so students measure and compare distance travelled using different amounts of pull.

Students Share Claims and Evidence: Class discussion aimed at these questions:

How did the number of washers affect the distance? How do you know? Why did this happen?

Check with the Experts. (Students research and share out claims and evidence about gravity.) [http://idahoptv.org/dialogue4kids/season12/gravity/facts.cfm](http://idahoptv.org/dialogue4kids/season12/gravity/facts.cfm) [http://coolcosmos.ipac.caltech.edu/cosmic_kids/AskKids/def_gravity.shtml](http://coolcosmos.ipac.caltech.edu/cosmic_kids/AskKids/def_gravity.shtml)

Student Posed Questions: What do you want to know now? (What do these questions imply? Which question(s) do we investigate and how? Include claims, evidence and scientific argument in class discussion. How can we revise our Living Concept Map?)

4. How does the load (mass) of a vehicle affect the time the vehicle takes to travel a given distance?

Targets: I can conduct an investigation to answer a question and write a conclusion. I can measure and compare the time it takes a vehicle to travel a given distance. I can explain how speed is related to load.

Activities: Motion and Design Unit:

Lesson #4 Students test how adding load to their vehicles affects their motion.

Students Share Claims and Evidence: Class discussion aimed at these questions: How did the load affect the time? How do you know? Why did this happen? How do these results...
reflect a pattern? What might you predict? How might you affect the speed of your vehicle? (How does this connect with Newton's Laws?)

**Check with the Experts:** [http://teachertech.rice.edu/Participants/louviere/Newton/](http://teachertech.rice.edu/Participants/louviere/Newton/)

**Student Posed Questions:** Possibly one of their questions might lead us back to the ball and domino design. How might a ball with more mass affect their design? Students could investigate this question, changing one variable—the mass of the ball. Include claims, evidence and scientific argument in class discussion.

**Students Summarize Learning in Writing**

*How can we revise our Living Concept Map?*

5. How can a model be built to meet design requirements / solve a problem?

**Target:** I can use the technological design process:

- I can define the problem and list criteria for a solution.
- I can work with others to generate possible solutions.
- I can build a model of the design.
- I can test the solution and modify the design if necessary.
- I can share/argue my solution/claim persuasively by speaking, writing or illustrating the process/product.

**I can plan and conduct an investigation to answer my question.** (I can make a prediction, identify variables, follow a procedure, make observations, record and analyze data to make a conclusion.) I can explain gravity as a force that pulls objects toward the earth's center.

**Activities:** Motion and Design Unit:

**Lessons:** #5 Students build a vehicle to meet requirements. (Design Challenge Card)

Students record what made their vehicle move slowly and what made it move fast.

**Students Share Claims and Evidence:** Students persuasively make their claims with evidence and illustrate their vehicles. Class discussion is aimed at these questions: How did your group prepare before building? How did you solve problems? How did you test to determine whether it met requirements? How did it move? Did you make any changes in your vehicle or falling weight system? What changes and how did you make the changes? (Discussion could lead into forces that cancel each other. How might that connect to something else they know?)

**Read:** “Lunar Rover: Making Tracks on the Moon” (Plan as a close reading lesson.)

**Check with the Experts:** (Sites about Newton's Laws and Force and Motion

[http://teachertech.rice.edu/Participants/louviere/Newton/](http://teachertech.rice.edu/Participants/louviere/Newton/)

[http://www.wisc-online.com/objects/tp1202/tp1202.swf](http://www.wisc-online.com/objects/tp1202/tp1202.swf) interactive site
Student Posed Questions: This might be a place where students’ questions might lead them to plan and conduct an investigation to answer a question about gravity. Include claims, evidence and scientific argument in class discussion. How can we revise our Living Concept Map?

6. How might we use a rubber band to move our vehicle?
   Targets: I can explore and record how energy is transformed in the rubber band vehicle. I can plan and conduct an investigation to answer my question. I can write a conclusion. I can describe examples of how potential energy is converted to kinetic energy. I can describe activities/careers that require what I learned in this unit.

Student Posed Questions: Given a basic design for a vehicle powered by a rubber band, students could conduct an investigation to answer one of their questions that would involve changing one variable. Include claims, evidence and scientific argument in class discussion.

Check with the Experts: http://www.youtube.com/watch?v=t2vnyfNK870 (Potential and Kinetic Energy)

Students Summarize Learning in Writing: Students view the video and reflect on their understanding of how potential energy is transformed to kinetic. How can we revise our Living Concept Map?

Physics Fair/Olympics

7. How can friction affect the motion of our vehicle.
   Targets: I can explain that friction is a force that slows things down. I can create a model to demonstrate how friction can affect motion. I can record my observations.

http://eschooltoday.com/science/forces/frictional-forces.html
http://eschooltoday.com/science/forces/air-resistance.html

Read: "Shirley Muldowney-Drag Racer" plan as close reading lesson http://www.youtube.com/watch?v=G9iS801CiwI dragster racing video

Student Posed Questions: Given a basic design for a vehicle powered by a rubber band, students could conduct an investigation to answer one of their questions that would involve changing one variable to add friction. Lesson #10 in which students use sails to affect air resistance could be used. Include claims, evidence and scientific argument in class discussion.
Check with the Experts: Students could revisit their initial study of friction or use non-fiction to include Benchmark Title: Forces and Motion on Earth

How can we revise our Living Concept Map?

8. How can motion be affected in a propeller-driven vehicle?
   Targets: I can identify what I know about propeller-driven vehicles.
   I can build a model to demonstrate how motion is affected by a propeller-driven vehicle. I can record my observations.
   Student Posed Questions: Given a basic design for a vehicle powered by a rubber band and propeller, students could conduct an investigation to answer one of their questions that would involve changing one variable that involves the propeller. Lessons #11-12 in which students use propellers and rubber bands to power their vehicles could be used. Include claims, evidence and scientific argument in class discussion.
   Check with the Experts:
   
   http://teachertech.rice.edu/Participants/louviere/Newton/law3.html

How can we revise our Living Concept Map?

Assessment: Formative assessment can take place throughout the unit as students reach learning targets and share their claims and evidence/negotiate meaning in discussions or in writing. Summative assessment could include the Motion and Design Assessment and students writing about their learning using the Living Concept Map or designing their own concept map.