ENERGY FUNDAMENTALS – LESSON PLAN 1.4

Newton's Third Law of Motion

This lesson is designed for 3rd – 5th grade students in a variety of school settings (public, private, STEM schools, and home schools) in the seven states served by local power companies and the Tennessee Valley Authority. Community groups (Scouts, 4-H, after school programs, and others) are encouraged to use it as well. This is one lesson from a three-part series designed to give students an age-appropriate, informed view of energy. As their understanding of energy grows, it will enable them to make informed decisions as good citizens or civic leaders.

This lesson plan is suitable for all types of educational settings. Each lesson can be adapted to meet a variety of class sizes, student skill levels, and time requirements.

Setting	Lesson Plan Selections Recommended for Use
Smaller class size, higher student ability, and /or longer class length	• The "Modeling" Section contains teaching content. • While in class, students can do "Guided Practice," complete the "Recommended Item(s)" and any additional guided practice items the teacher might select from "Other Resources." • NOTE: Some lesson plans do and some do not contain "Other Resources." • At home or on their own in class, students can do "Independent Practice," complete the "Recommended Item(s)" and any additional independent practice items the teacher selects from "Other Resources" (if provided in the plan).
Average class size, student ability, and class length	• The "Modeling" Section contains teaching content. • While in class, students complete "Recommended Item(s)" from "Guided Practice" section. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.
Larger class size, lower student ability, and/or shorter class length	• The "Modeling" Section contains teaching content. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.

Electrical Safety Reminder: Teachers should remind students that electricity is dangerous and that an adult should be present when any recommended activities or worksheets are being completed at home. Always obey instructions on warning labels and ensure one has dry hands when touching electronics or appliances.

Performance Objectives

By the end of this lesson, students will be able to:

- **Explain Newton's Third Law of Motion.**
- **Compare Newton's Three Laws of Motion.**
- **Contrast Newton's Three Laws of Motion.**
- **Provide examples of Newton's Third Law of Motion in real life.**

Public School System Teaching Standards Covered

State Science Standards

- AL 3.PS.4 3rd
- AL 4.PS.4 4th
- GA S3P1 3rd
- GA S3CS7 3rd
- GA S4P3 3rd
- KY PS.1 3rd
- KY PS.2 3rd
- KY 3.PS2.1 3rd
- MS GLE 9.a 4th
- NC 3.P.1.1 3rd
- TN GLE 0307.10.1 3rd
- TN GLE 0307.10.2 3rd
- TN SPI 0307.11.1 3rd
- TN SPI 0307.11.2 3rd
- TN GLE 0407.10.1 4th
- TN GLE 0507.10.2 5th

Common Core Language Arts/Reading

- CCSS.ELA-Literacy.RI.3.8 TN, KY, NC, AL, GA 3rd

I. Anticipatory Set (Attention Grabber)

Essential Question

When we bounce a tennis ball, why does it come back up and not stay sitting on the ground? The same law that explains why rockets launch explains why the tennis ball bounces back up. We'll learn Newton's Third Law of Motion today.

Videos

Newton's Third Law of Motion Video: http://www.youtube.com/watch?v=DNbjL8gr1iM

II. Modeling (Concepts to Teach)

Newton's Third Law of Motion states that for every action force there is an equal, but opposite reaction force. Forces always exist in pairs. These are called action-reaction force pairs. Whenever two objects interact they exert a force on each other. When a person sits in a chair, that person applies a force down onto the chair and the chair applies a force up on him/her. These forces are equal in magnitude, but opposite in direction.

Experiment with pushes, changes in force, and differences in mass:
Students find a partner. Each set of partners stands facing one another with feet together. With their hands, have students push each other. Or, use a plastic toy fish and demonstrate the push and pull forces of swimming. Use various forces, and watch reactions. Look for Newton's Third Law (action-opposite and equal reaction), and also Newton's Second Law (force and mass affect acceleration, therefore a smaller person accelerates faster, and more force would be needed to accelerate more mass, etc.)

Show video:
http://studyjams.scholastic.com/studyjams/jams/science/forces-and-motion/action-and-reaction.htm

Consider the propulsion of a fish moving through water. A fish uses its fins to push water backwards. But a push on the water will only serve to accelerate the water. Since forces result from mutual interactions, the water must also be pushing the fish forwards, propelling the fish through the water. The size of the force on the water equals the size of the force on the fish; the direction of the force on the water (backwards) is opposite the direction of the force on the fish (forwards). For every action, there is an equal (in size) and opposite (in direction) reaction force. Action-reaction force pairs make it possible for fish to swim.

III. Checking for Understanding

Teachers can ask students these questions to determine understanding of concepts.

REMEMBER	Newton's Third Law of Motion explains the action - reaction force pairs. (Teachers can write the question on the board and discuss with the class.)
UNDERSTAND	Explain Newton's Third Law of Motion in your own words. (Class discussion)
ANALYZE	Compare and contrast all three of Newton's Laws of Motion using a Venn diagram. **http://www.learninggamesforkids.com/graphic_organizers/writing/venn-diagram.htm**
CREATE	Compose a drawing with captions that explains Newton's Third Law of Motion. (Teachers can ask students to draw their pictures on a sheet of paper. Ex: a swimming fish, sitting in a chair, riding a bicycle, jumping on a trampoline.)

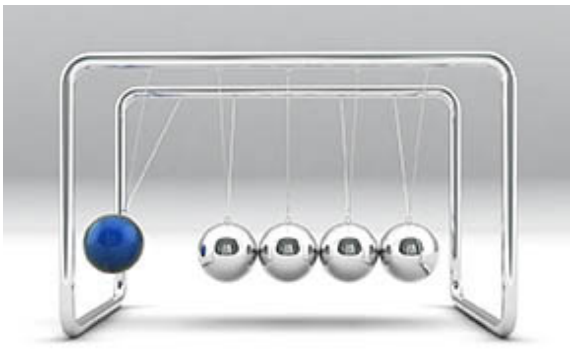
IV. Guided Practice Ideas

Recommended Items

Hero's Engine and Newton's Cradle (see below)

Experiments

- Hero's Engine: **http://www.education.com/science-fair/article/newton-law-motion-action-reaction/**
- Newton's Cradle: Teachers show Newton's Cradle video demonstrating Newton's Third Law of Motion. (Approximately 1 minute). **https://www.youtube.com/watch?v=2Y7jBKENvfA**



NEWTON'S CRADLE

- Balloon Propeller: **http://www.kiwicrate.com/projects/Balloon-Propeller-Newtons-Third-Law-/331**
- Skate Ball: Have a student or the teacher stand still in roller skates and throw a ball. What happens? The person will roll in the opposite direction as the ball.

V. Independent Practice Ideas

Recommended Items: Venn diagram; Poster/skit/story

- Create a poster illustrating and diagramming Newton's Third Law of Motion (ex: sitting in chair, bicycling, fish swimming, rocket launching, running, skating, swinging by pumping your legs, etc.).
- Journal on results of experiment (if the students have a journal). Teachers ask students to record the results of their experiment in their journals.
- Venn diagram comparing all of Newton's Three Laws of Motion (or the two of their choice). **http://www.learninggamesforkids.com/graphic_organizers/writing/venn-diagram.html**

VI. Assessment

These items provide a check for understanding so teachers can easily determine whether concepts need to be reinforced. These items can be graded, if desired.

- Quiz: **http://teachertech.rice.edu/Participants/louviere/Newton/law1.html**
  (this has a quick review, followed by an online quiz)
- This lesson plan does not include a Worksheet; below is one additional assessment resource:
  - Poster: **https://teacherweb.com/CT/RHAM/.../Newtons-Laws-Poster2012.doc**

VII. Materials Needed

The following materials are needed for the **Hero's Engine Experiment** in "Recommended Items" in the Guided Practice section.

- Plastic cup
- 2 plastic bendable straws
- String
- Craft knife
- Water and sink
- Modeling clay

VIII. Closing the Lesson

In addition to the Essential Question shown below, teachers can reference Performance Objectives at the top of the Lesson Plan.

Essential Question

When we bounce a tennis ball, why does it come back up and not stay sitting on the ground?