

RAMP UP – LIFTOFF Lesson Plan

Title of Lesson:	Energy Investigators: Conducting Energy Experiments with Straw Rockets
Grade Level:	4th
AL COS Standard:	SC15.4 - Investigate to determine changes in energy resulting from increases or decreases in speed that occur when objects collide.
NGSS:	4-PS3-1 Energy - Use evidence to construct an explanation relating the speed of an object to the energy of that object. 4-PS3-3 Energy - Ask questions and predict outcomes about the changes in energy that occur when objects collide.
Learning Targets/Objectives:	<ul style="list-style-type: none">● Students will be able to differentiate between potential and kinetic energy● Students will be able to explain how energy can be transferred in various ways and between objects● Students will be able to collect evidence to determine the changes in energy when two straw rockets collide
Materials Needed:	<ul style="list-style-type: none">● Videos<ul style="list-style-type: none">○ Energy The Dr. Binocs Show Educational Videos For Kids - https://www.youtube.com/watch?v=Q0LBegPWzrg&t=116s○ STS-135 Space Shuttle Launch - https://www.youtube.com/watch?v=ljwjEyJJtJA○ How Can We Transfer Energy? MightyOwl Science 4th Grade - https://www.youtube.com/watch?v=su2zFgts7JI● Website<ul style="list-style-type: none">○ Generation Genius - https://www.generationgenius.com/videolessons/potential-vs-kinetic-energy-video-for-kids/

	<ul style="list-style-type: none"> ● RAMP UP LIFTOFF Kit <ul style="list-style-type: none"> ○ All materials needed for the LIFTOFF experiment are included in the kit. ● Other Materials <ul style="list-style-type: none"> ○ paper (for recording experiments in Explore phase) ○ pencils (for recording experiments in Explore phase) ○ Tape measure (for measuring distances the straw rockets travel) <p>Links to the videos and website can also be found on the LIFTOFF Kit Resources page https://uahrampup.org/liftoff/</p>
Preparation:	<ul style="list-style-type: none"> ● Locate a space to do the experiment (should be an open area such as a hallway, gym, outside, etc.) ● Make sure all videos are working ● Check weather if experiment is to be done outside ● Construct launchers prior to Explore phase ● Make sure all students have a computer device for Extend phase
Lesson Logistics:	<ul style="list-style-type: none"> ● 4-day lesson (can be adjusted to be shorter or longer) ● Whole group instruction
Vocabulary:	<ul style="list-style-type: none"> ● potential energy ● kinetic energy ● variable ● relative speed ● relative motion ● collide
Safety Considerations:	See RAMP UP LIFTOFF guide for safety considerations.
Engage: Day 1	Step One: Introduce a KWL chart on the board (example below). Ask students what they know about energy in general. Ask about potential energy, kinetic energy, and what they know about energy transfer (can be more topic-specific by asking about what happens when objects collide). Write student responses in the K (What I Know) column.

K-W-L Chart		
Topic: _____		
What I Know	What I Want to Know	What I Learned

Step 2: Ask students what they want to learn about energy. Ask them to imagine different things they could do to explore energy changing from potential energy to kinetic energy or how to demonstrate energy transfer. Record their wonderings in the W (What I Want to Know) column.

Step 3: Show the video, Energy | The Dr. Binocs Show | Educational Videos For Kids. It serves as a good resource to cover the basics of energy. Following the video, ask students to discuss what they learned that they did not already know. Ask them about the different forms of energy discussed in the video.

Step 4: Show the video, STS-135 Space Shuttle Launch and ask students what kind of energy they think is used to launch rockets. Explain to students that they are going to explore energy with straw rockets.

Explore:
Day 2

The LIFTOFF experiment will be conducted in this phase.

Step 1: Begin by having students make their straw rockets. All materials needed are included in the RAMP UP LIFTOFF kit. Provide each student with a piece of paper and pencil to use in recording their experiments when launching the straw rockets.

Step 2: Once students have made their straw rockets, take them to the designated experiment site and line them up behind the launchers. Have students practice launching their straw rockets three times. Instruct them to label each launch as Experiment #1, Experiment #2, and Experiment #3. They will change variables such as angle at which the rocket is launched, height of the white tube, distance from the target if one is being used, etc. They will record the variables and their noticings. Guide their attention to the speed, height, and distance traveled during their launches and have them record the information. Ask them to think about forms of energy as they conduct the experiments.

	<p>Step 3: Have the students set up the launchers to face each other. Explain to the students that they will be working in teams of two (because there are two launchers) to figure out how to make the straw rockets collide. Have them record details from each experiment. Once the rockets collide, ask them to take notice of what happened to the rockets during the collision.</p>
<p>Explain: Day 3</p>	<p>Step 1: Hold a class discussion and ask about the LIFTOFF experiment. Discuss forms of energy. For example, the rocket launch video is an example of chemical energy. Straw rockets rely on mechanical energy.</p> <p>Step 2: Have students explain the variables for each experiment conducted and talk about the definition of what a variable is and how we can change outcomes by changing variables.</p> <p>Step 3: Ask students to think about raising the white tube of the launcher at different heights for the experiments. Explain that when lifting up the white tube on the launcher, you are creating potential energy (height), where the white tube now has the potential to fall. When letting go of the white tube, that energy is converted to kinetic energy (speed) as it drops down. A higher placement of the tube will result in more potential energy, leading to more kinetic energy, meaning the tube will be traveling faster when it hits the piston at the bottom. If the white tube is traveling faster, the piston is pushed downwards faster, sending the puff of air quickly out of the brass tube, sending the straw rocket even farther. If the white tube isn't traveling as fast, the force may not be enough to push the piston down much at all. This results in less air being pushed in the tube, leading to less pressure and a much slower rocket launch.</p> <p>Step 4: Ask students to refer to the collision experiment. Ask students what they noticed about the speed of the rockets prior to the collision. What changed when the rockets collided? How did the motion of the rockets change? Explain that when objects collide, energy can be transferred from one object to another causing the objects' motions to change.</p> <p>Step 5: Show the students the video, How Can We Transfer Energy? MightyOwl Science 4th Grade.</p>
<p>Extend: Day 4</p>	<p>Students will explore the Generation Genius website to extend their knowledge of energy and energy transfer. They will watch</p>

	<p>videos, review vocabulary, and explore different reading materials. The site includes quizzes and games.</p> <p>https://www.generationgenius.com/videolessons/potential-vs-kinetic-energy-video-for-kids/.</p>
<p>Evaluation: Day 4</p>	<p>Using a whole group discussion, have students fill in the L (What I Learned) column of the KWL chart on the board and discuss the topics and vocabulary addressed throughout the phases. Discuss answers, ask for examples and explanations, and help guide thinking. Examples of questions to ask:</p> <ul style="list-style-type: none">● What forms of energy did we learn about?● What happened to the speed of the rocket when we lifted the white tube higher or lower? Why did this happen?● What happened to the speed and motion of the rockets when they collided?● How did changing variables affect the height, speed, and distance traveled by the rockets?