Lesson Plan: Using Balloon Rockets to Explore the 'Big Ideas' of Energy Transfer and Conservation in the Grade 4 Science Curriculum

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Established Goals (Big Ideas): –

One of the main goals for this balloon rocket lesson is to develop learner's knowledge of energy. The associated experiment will develop student's understanding of the curricular "Big Ideas" of how "energy can be transformed" through an exploration of energy transfer and the Law of the Conservation of energy.

Rationale

A simple balloon is a marvelous and extremely fun tool for allowing learners to explore the principles of energy transfer and energy conservation. In this scenario, the initial elastic potential energy within the filled balloon transforms into kinetic, sound and thermal energy when released. Furthermore, the experiment also allows for a brief introduction to Newton's Third Law where every action has an equal reaction. In this case, the force being exerted is air rushing out of the balloon and the opposite reaction is the balloon moving forward.

Essential Questions

- How does blowing up and releasing the balloon rocket represent the transfer of energy while still fulfilling the Law of Conservation of energy?
- What types of energy are involved in the cycle of the rocket balloon?

Students will be able to: *(Competencies)*	**Students will know:** *(Content)*
● Make predictions based on prior knowledge. ● Suggest ways to plan and conduct an inquiry to find answers to their questions. ● Safely use appropriate tools to make observations and measurements. ● Collect simple data ● Sort and classify data and information using provided tables ● Make simple inferences based on their results and prior knowledge	● Energy transfer and conservation.

Learning Intentions

I can detail the type of energy transfer going on during the balloon rocket experiment.
I can explain the Law of Conservation of energy through observations of the balloon rocket experiment.

Prerequisite Concepts and Skill:

- Identify questions about familiar objects and events that can be investigated scientifically.
- Experience with planning and conducting experiments.
- Process and analyze basic data.
- Evaluate and communicate the results of experiments.

Materials and Resources with References/Sources (per group):

1. Balloons (Large, small) = $3.00
2. Clamps to hold balloon closed = $3.00
3. String = $4.00
4. Plastic straws = $1.25
5. Masking Tape (full roll) = $1.25
6. Meter stick = $0.00 (provided)
7. Two chairs about 10 feet apart (with clear space in between) = $0.00
8. Printed sheet for estimates (x1) = $0.10
9. Printed sheet with space for data collection (x1) = $0.10
10. Pen or pencil to record results (x1) = $1.00
11. **Total Cost = $13.70**

Differentiated Instruction (DI):

- **Explanation of energy transfer and the Law of Conservation of energy will be both broad and detailed enough to mould into different learning levels.**
- **Use of multimedia for concepts and visual directions for experiment.**
- **Conducting experiment will assist with tactile learners.**

Activities	Student Activities	Pacing
Intro ● Lesson will begin with unique, teacher created website appearing on overhead projector. This will catch students' attention with visual elements. A video of the space shuttle launch will be played so as to immediately create	Watch Video	2 min

excitement and anticipation about the experiment. (http://edpb507balloonrocket.weebly.com/) **Body** ● Teacher will introduce key concepts in the lesson. Concepts of energy will be introduced with an explanation of what types of energy exist in the balloon rocket experiment, the transfers involved and the overarching idea of the Law of Conservation of energy. ● Open the classroom to questions. ● Utilizing photos and videos on the website, teacher will succinctly go over the procedures required for the experiment. Students who have access to ipads, chromebooks will be able to access website during experiment in order to answer any potential questions. ● **Step 1:** Following the roles set out by your animal cards, as a group gather the supplies needed from the supply table and return to your experiment area. The equipment needed will be two balloons of differing size, two strips of masking tape, estimate sheet, data sheet, and a meter stick for distance measurement. ● **Step 2**: Attach the two pieces of masking tape to the straw which is already looped through the string. You will be using these two pieces of masking tape to attach the balloons to the straw. Keep the masking tape on the straw between experiments. ● **Step 3:** Inflate the balloon and then carefully press it onto the masking tape, thereby attaching it to the straw. Once the balloon is secure, ensure the straw is at the correct starting position and wait for teacher's permission before releasing the first balloon. ● **Step 4:** You can now let it go! Once the balloon has come to a full stop, measure the distance it has traveled and record this on the data sheet. ● There are no safety issues associated with this experiment other than errant balloons striking eyes. Teacher will stress importance of only releasing balloons along string track. **Procedure** 1. **Organize groups.** Due to the exciting nature of the experiment and potential for balloons to go flying off in every direction, classroom management will be achieved by assigning each member of the group a distinct role. Every member of group will be given a card that will designate them as a certain animal with written roles in the	Listen Questions Listen to Experiment process explanation Begin designated roles	4 min 1 min 2 min 2min

experiment. This will change in regard to size of group. In addition, it will be explicitly stated that balloons are not to be released until teacher gives go-ahead for experiment to begin. As a method to silence learners and recollect their attention, the space shuttle takeoff video can be replayed - volume loud. 2. **Roles of each group member is assigned according to animal card: Elephant** = Collect 2 different sized balloons. In charge of blowing up each balloon. Work with Ostrich when releasing balloons. **Ostrich**= Collect masking tape. Help Elephant to attach balloon to straws. Return masking tape once experiment is completed. **Lion** = Collect tape measure. Measure the distance balloon travels down string. Return tape measure once experiment is completed. **Hyena** = Collect the data recording sheet. Record the results on data sheet. Return filled in data sheets once experiment is completed. **Rhino** = Collect estimate sheets. Read the sheet to group before experiment so group can arrive at estimates regarding distance each different balloon may travel. Record estimates. Return estimate sheets once experiment is completed. 3. Groups will then move to where the strings have already been set up between chairs with straws attached. 4. Teacher will assist and ensure students are following set out roles. Students are guided and told not to begin until all groups are ready and balloons are only to be released after teacher has given go ahead. 5. **Experiment begins**. (a) Groups examine estimate sheet and make postulations regarding questions there. (b) Balloon is blown up and then closed with clamp. (c) Balloon is attached to the straw with at least 2 strips of masking tape. (d) The balloon will be released following a count-down. (e) The distance from starting position to front of straw is measured and given to data recorder. (f) Experiment is then conducted again with same sequence but with different sized balloon, with all data being recorded. (g) Equipment is returned to boxes following roles designated by animal cards. (h) Begin discussion among groups concerning each group's estimates and the actual data results from the experiments.	Begin experiment	10 min
<u>Assessment</u> Learners will work in groups to fill-in experiment estimate and data sheets. These will be handed in after the experiment so as to gauge the involvement of the students in the learning process.	Answer questions verbally and discuss	

A discussion following the experiment will also offer a formative assessment opportunity. The following questions can help guide the discussion: 1. What differences did you find between the different sized balloons? 2. What are the factors related to the different distances travelled? 3. What types of energy existed during the different stages of the experiment? 4. How could the Law of Conservation of energy be applied to the balloon rocket experiment? 5. What might happen if the string was angled upwards at increasing inclinations? 6. Can you think of any ways to make your balloon rocket more efficient so that it might travel further?		

Introduction to Balloon Rocket Experiment

What we all just watched, the incredible takeoff of the the space shuttle Atlantis with its heat, fire, roar and chest thumping vibration, well, it can all be brought back to one central concept: energy or the ability to do work. How do we manage to lift a 170,000 lbs shuttle out of orbit and into space? How do we stay warm in our car while driving down the highway at 90 km/hr in the rain while sipping coffee? The simple answer is energy.

In the case of the space shuttle, it is chemical energy that is utilised to lift the massive weight all the way into space. Our balloon rockets, unfortunately, don't have liquid rocket fuel but rather are simply filled by our lungs with air. Still, as we attach them to our string and watch them careen forward with their own version of a roar, we will be witnessing a transfer of energy.

In the case of our balloon rocket takeoff, there will be numerous physics concepts involved but today i want you to all concentrate on energy. And i want you to focus on these two aspects of energy. One, energy transfer. In other words, what types of energy are present in this experiment and how does the transfer of that energy into different forms of energy work? Two, the Law of Conservation of Energy which states that energy cannot be created or destroyed, but only changed from one form into another or transferred from one object to another.

So, beginning with our balloon. As we fill it with air we begin to store energy inside it. This is called elastic potential energy and it increases as the balloon is stretched out from its original shape. More air in the balloon - the greater the elastic potential energy. When the balloon is

finally released, it wants to return to its original shape and so the air is expelled and the potential energy is transferred into kinetic energy or the energy of motion.

Now, as the balloon goes zooming along the string, not all the potential energy is converted into kinetic energy. Some is transferred into sound energy, heat energy and lost to friction on the string. In other words, the potential energy is converted to kinetic energy which moves the balloon down the string until all of the kinetic energy has been completely transferred to a different form.

And here it is again important to remember the Law of Conservation of energy. The potential energy stored in the balloon is not lost when our rockets takeoff. Neither does it disappear because as we know it cannot be destroyed or lost. Rather it simply changes form.

We can also briefly touch on another law that can be witnessed during the launch of our balloon rockets. That of Newton's Third Law. You will need to watch your balloon rockets carefully in order to begin to understand Sir Isaac's Law. Clearly, the balloon is blowing air out of one end, this is the action force. Now, according to the Law, for every action there must be an equal and opposite reaction. And what is the reaction in our case? Well, it is the balloon rocket being pushed forward down the string in the opposite direction.

And so, enough of the physics talk. Let us move on and watch it in action! The first thing your groups will receive is what we call an estimate sheet. This is sort of a guessing activity. Here you can use the information i just shared with you to guess or estimate some of the potential outcomes for your balloon rockets. We will also be collecting data from the actual launch. So, at the end we will be able to gauge or test our estimates against real world results. Good luck!

Estimate Sheet for Balloon Experiment

Team Member Names:

- The purpose of this sheet is to provide a starting point to the experiment by detailing our assumptions concerning the balloon rockets and their potential characteristics.
- Please fill in the estimates below before the actual experiment. This will allow you to compare your assumptions with the final data.

Question	Estimate or Answer
Do you think the balloon rockets will be able to travel in a straight direction down the string?	
How far do you think the balloons will approximately travel down the string? (Answer in meters/centimeters)	
Which of the three balloons (large, small and irregular) do you think will travel the furthest?	

Balloon Experiment Data Sheet

Team Member Names:

- Please record the distance travelled by the balloon rocket following release. Your data should be captured in the spreadsheet below.
- The distance should be recorded as accurately as possible in meters and centimeters.
- The distance measured should be from the start of the string to the tip of the straw, after all movement has ceased.

Balloon type	Distance travelled (m, cm)
