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5th grade
Science Unit: Force & Motion—How Can Energy Be Changed to Other Forms?
4-5 days

Essential Questions:

How are different systems connected?
How can we see energy?

Enduring Understanding:

A system may be thought of as any collection of things or processes that interact to perform a function. Various physical, chemical, and biological systems allow us to observe energy transformations from one form into another. Energy, which is the ability to cause change, can be transferred and can change form.

Objective:

TSWBAT contrast potential energy and kinetic energy, demonstrate that potential energy can change to kinetic and back, and explain how energy can be transformed from one form to another.

Standards:

CH 5.27 The student performs science activities in a safe manner
CH 5.28 The student engages in activities using problem-solving, decision-making, information gathering, inquiry and cooperative skills.
CH 5.31 The student uses math skills as a tool for problem-solving in science.

Content:

- Potential energy is stored energy.
- Chemical potential energy is energy stored in chemical bonds.
- The joule is the basic unit of energy used by scientists.
- Gravitational potential energy is energy stored in an object because of tis position above the ground.
- Kinetic energy is energy of motion.
- Potential energy can change to kinetic and back.

Materials:

- Student textbook
- Clay balls—2 different color sets
- Rubber bouncy balls
- Clear aquarium tubing—abut 3 meters/group
- Masking tape
- Student handouts: Observations and Conclusions for "To Bounce or Not to Bounce" and "Roller Coaster Energy", synthesis homework sheets for "Energy Changes" and "Energy on a Roller Coaster"
- Process Skills Checklist for "To Bounce or Not to Bounce" and "Roller Coaster Energy"

Lessons:

Day 1 Activity: To Bounce or Not to Bounce

Objective: TSWBAT explore how height affects potential energy of an object and discover that a rubber ball bounces higher and a clay ball is deformed more when each is dropped from a greater height.

Anticipatory Set:

1. Ask students: *What does the word "potential" mean?*
2. Ask students: *What do you think "potential energy" means?*
3. Hold up clay ball and rubber ball, and ask: *Which ball do you think stores more potential energy that will create the most motion?*
4. This morning, you will be exploring this question through a lab experiment: *To Bounce or Not to Bounce.* You will work in small groups of 3 to do the experiment.

New Information:

- Potential energy=stored energy
- Kinetic energy=energy of motion
- Relationship: the higher the potential energy is, the greater the kinetic energy will be; at the greatest potential energy, the kinetic energy is zero because there is no movement. Ex. Top of the roller coaster

Materials:

1. Student textbook p. C14-C15
2. Clay balls—2 different color sets
3. Rubber bouncy balls
4. Student handout: Observations and Conclusions

Modeling:

1. Refer to p. C14 in textbook to model how to conduct the experiment
2. Show students where to get their lab materials
3. Remind students to be careful while getting on chair

Checking for Understanding:

Ask students: *How many clay balls do you need? Which ones? Where do you get your materials? Where are the procedures of the experimental lab?*

Student Activity / Guided Practice:

1. Review safety precautions with students
2. Students work in small groups of 3-4 to conduct "To Bounce or Not to Bounce" activity on p. C14-15
3. Students may take turns dropping the balls, making measurements, and recording measurements and observations
4. Students record their observations on the handout provided
5. Show students how to look at the ruler from the side to measure how high the ball has bounced
6. Before Step 3, ask: *Which ball do you think will bounce higher, the rubber ball or the clay ball? Why?*
7. Students analyze and draw conclusions while thinking about and answering questions on the student sheet

Closure:
Class discussion: *What did you notice? What were some of your observations? What conclusions can you make regarding potential and kinetic energy?*

Assessment:
Students complete analyze and conclude questions on the student sheet for homework.

Day 2 Activity: Pool Class Data
Lesson: Energy Changes

Objective: TSWBAT explain different forms of potential energy.

Activate Prior Knowledge:
1. Review terms: potential and kinetic energy
2. Share and review analyze and conclude questions

Connecting Activity:
1. Students record their group data on chart paper
2. In their lab groups, students use class data to calculate the average heights the rubber ball bounced when dropped from a height of 1 meter and from a height of 2 meters.

Anticipatory Set:
1. Ask students: *What do you think happens to energy after you use it?*
2. Ask students: *What ways can you think of to store energy?*

New Information:
- Joule=basic unit of energy used by scientists (like meters and inches to measure length)
- Different chemical storages of energy
- Calorie=unit for finding the stored energy in different foods
- Chemical potential energy=energy stored in chemical bonds

Closure:
Class discussion: *What is the class average for the height of the rubber ball's bounce when dropped from a height of 1 meter and at 2 meters?*

Independent Practice:
Students read p. C 18-19 and complete synthesis sheet for HW

Assessment:
Student synthesis sheet to be collected

Day 3 Activity: Pool Class Data
Lesson: Energy Changes

Objective: TSWBAT make a model of a roller coaster with plastic tubing and a bouncy ball pellet and observe changes in energy as the bouncy ball travels through the tubing.

Activate Prior Knowledge:
Review synthesis sheet p. C18-20

Anticipatory Set:
1. Ask students: *Who has ever been on a roller coaster?*

New Information:
A roller coaster car has stored energy as it sits at the top of the first hill
In today's experiment, you will find out how the energy changes as the car speeds down the first and up the next

Materials:
1. Student textbook p. C16-17
2. Clear aquarium tubing—abut 3 meters/group
3. Marbles or bouncy balls
4. Masking tape
5. Student handout: Observations and Conclusions

Modeling:
1. Refer to p. C16 in textbook to model how to conduct the experiment
2. Show students where to get their lab materials
3. Remind students to be careful while getting on chair

Checking for Understanding:
Ask students: *Where are the procedures of the experimental lab? Where do we record our observations?*

Student Activity / Guided Practice:
1. Review safety precautions with students—do not throw balls and pick them up immediately if any should fall onto the floor
2. Students work in small groups of 3-4 to conduct "Roller Coaster Energy" activity on p. C16-17
3. Students follow the procedures and record their observations on the handout provided
4. Students can keep their roller coaster tracks stable by positioning the bottom of each curve on a desk and lightly taping down the tubing
5. If students have difficulty designing a track through which the bouncy ball can completely travel, ask them to point out the spot where the bouncy ball stopped and discuss what happened before it stopped. Have students experiment with different designs for their roller coasters from that spot on
6. Students analyze and draw conclusions while thinking about and answering questions on the student sheet

Closure:
Class discussion: *What did you notice? What were some of your observations? Why does the bouncy ball travel all the way through some roller coasters but stop in the middle of other tracks?*

Assessment:
Students complete analyze and conclude questions on the student sheet for homework.

Day 4 Lesson: Energy on a Roller Coaster

Objective: TSWBAT use the "Roller Coaster Energy" activity to explain how the potential and kinetic

Activate Prior Knowledge:

1. Review terms: potential and kinetic energy
2. Share and review analyze and conclude questions

Anticipatory Set:

Ask students: *Which parts of a roller coaster are most exciting?*

New Information:

- Gravitational potential energy=energy stored in an object because of its position above the ground
- Where is KE and PE greatest, zero, increasing, and decreasing

Checking for Understanding:

Students work in pairs to write out definition cards in their own words, numbers, and/or symbols to define kinetic energy, potential energy, gravitational potential energy, and chemical potential energy

Closure:

Class discussion: *Where on the roller coaster course did the bouncy ball have the most gravitational potential energy? How would gravitational potential energy change if you rolled a heavier ball down the tube?*

Independent Practice:

Students read p. C 19-21 and complete synthesis sheet for HW.

Independent Group Practice:

Students work in their groups to diagram their roller coasters and label the points at which KE and PE are greatest, zero, increasing, and decreasing

Assessment:

Diagrams of student roller coasters, student synthesis sheet to be collected

Name _____ # ____ Science

Date _____ Lab Activity: To Bounce or Not to Bounce

To Bounce or Not to Bounce ?!

Object	Height of Drop	Observation / Height of Bounce
Rubber ball	1 meter	
Rubber ball	2 meters	
Clay ball	1 meter	
Clay ball	2 meters	

Analyze and Conclude #1-4 (p. C15)

1. _____

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2. _____

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3. _____

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4. _____

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Name _____ # _____ Science

Date _____ "To Bounce or Not to Bounce"

Process Skills Checklist

	You Got It ☺	Almost There !	Try Harder ☹
1. Did you accurately measure and record how high the rubber ball bounced when dropped form two different heights?			
2. Were the two measurements different?			
3. Did you predict how high the rubber ball would bounce?			
4. Did you interpret your data to determine if it supported your predictions?			
5. Did you observe the clay ball after it hit the floor?			
6. Did you note that the ball changed in shape?			

Name _____ # _____ Science

Date _____ "Roller Coaster Energy"

Process Skills Checklist

	You Got It ☺	Almost There !	Try Harder ☹
1. Did you make a model of a roller coaster track?			
2. Did the model include a series of hills that allowed the bouncy ball to move all the way through?			
3. Did you make accurate observations of the bouncy ball in different parts of the track?			
4. Did you observe that the bouncy ball moved faster in some parts than in others?			

Name _____ # _____ Science

Date _____ HW: Read p. C18-C19

Energy Changes

1. A skier increases her or his potential energy by climbing higher. How did you demonstrate the same kind of energy change in the "To Bounce or Not to Bounce" activity?

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2. What kind of energy did you use as you lifted the balls in the activity?

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3. Where did you get the energy to lift the balls?

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4. What are some kinds of foods that have a lot of calories?

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5. How does the amount of chemical potential energy in those foods compare with that found in foods that are low in calories?

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Name _____ # ____ Science

Date _____ Lab Activity: Roller Coaster Energy

Roller Coaster Energy

Procedure	Observations
Step 2. Beginning	
Step 3. Sketch your model	
Step 4. As it moves through the roller coaster	

Analyze and Conclude #1-5 (p. C17)

1. _____

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2. _____

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3. _____

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4. _____

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5. _____

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Name _____ # _____ Science

Date _____ HW: Read p. C20-C21

Energy on a Roller Coaster

1. Why do you think energy stored in tan object raised above the ground is called gravitational potential energy?

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2. How is the roller coaster described on page C21 similar to and different from the roller coaster you designed with the plastic tubing and the bouncy ball in the "Roller Coaster Energy" activity?

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3. How does the potential energy and kinetic energy of the bouncy ball compare with that of the cars in a roller coaster?

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