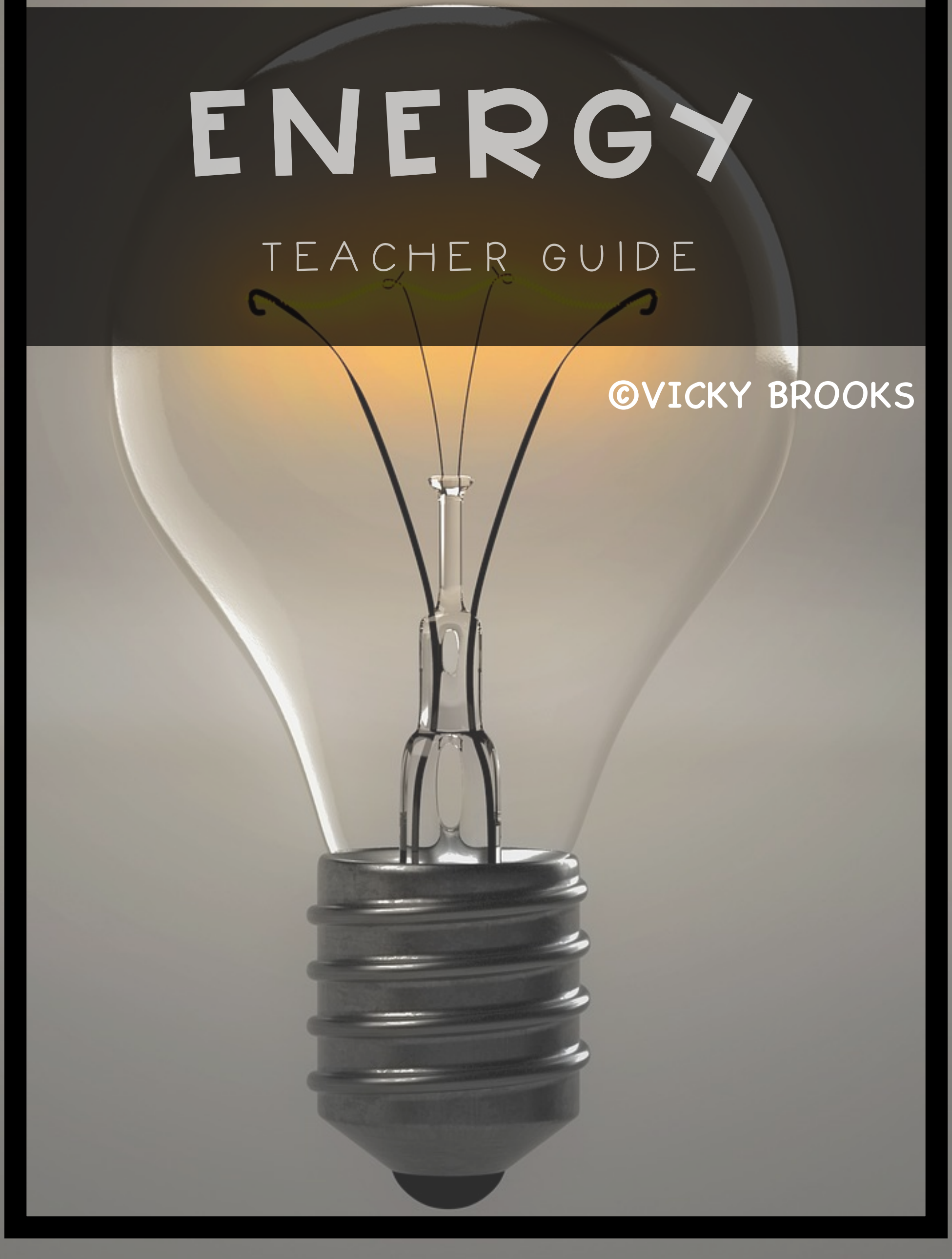
ENERGY

TEACHER GUIDE



For your Purchase!

- There are 10 units of learning within this teaching sequence.
- The pace of the lessons can be extended over more than one period or shortened to fit a given time.
- You can print off the entire student journal and move through each unit, or, print off various resources to suit your own planning.
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Huge thank you to the following talented entrepreneurs for letting me use their amazing clipart and font to make this product.

SHOPPING LIST

Suggested resources for the unit	
1	Food Coloring
2	Plastic Cups
3	Plastic droppers
4	Yard Sticks
5	Hot Wheels Cars/Toy Cars
6	Track for hot wheels {or could use card/yardsticks}
7	Pencils
8	Rubber Bands
9	Popsicle sticks
10	Tape/Glue
11	Scissors
12	Plastic bottle tops
13	Sugar cubes
14	Kitchen roll tubes
15	D-Cell Batteries
16	Resources for PBL project - e.g dominoes, marbles, ping pong balls
17	5 electrical items for stations e.g hair dryer, toaster, flashlight.

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ENERGY - TEACHER GUIDE

Overview

LESSON 1 What is Energy?	**LESSON 2** Potential and Kinetic Energy	**LESSON 3** Gravitational Potential Energy
LESSON 4 Elastic Potential Energy	**LESSON 5** Energy Transference	**LESSON 6** Forms of Energy
LESSON 7 Energy Transfers and Transformations	**LESSON 8** Electrical Energy	**LESSON 9** Energy Sources
LESSON 10 Renewable and Nonrenewable sources	**END OF UNIT PROJECT** WACKY RUBE GOLDBERG MACHINES	

ENERGY - TEACHER GUIDE

Lesson 1

What is Energy?

Learning Objective(s)	Resources/Prep
● To define work and energy, and explain how they are related ● To use evidence to construct an explanation	● Student Journal ● Beakers or Plastic Cups ● Food Coloring ● Hot/Room/Ice Water ● Thermometers

Teaching Input

STARTER:

Discuss: What is Energy?

Complete Time to Think activity in science journals

MAIN:

Discuss:What is matter? Recap previous knowledge - Discuss the three states of matter, especially in terms of the movement (speed) of molecules in each state: solid, liquid, and gas. What state of matter is heat? The class should conclude that heat does not fit into any of the states of matter. This is because heat is energy, not matter.

Read What is Energy?' in the student journals, as a class, in pairs or independently. Keep note of important and/or unfamiliar vocabulary on the board or class anchor {Energy, motion, work, matter}

Complete Let's Check your Understanding! questions individually, in pairs, or as a homework assignment to evaluate student understanding.

Demonstrate energy using two volunteers from the class. Have two students stand in front of each other and have them place their arms forward with their hands touching palm to palm. Do you feel energy? No? Next, push on each others hands. Now do you feel the energy?** {Highlight to the students that the energy was always present, but we do not notice energy until we are using it or seeing it being used. Further explain that energy comes in many forms, which will be explore later on in this unit.}

Students complete the Dye Dispersion Experiment in groups using their student journals to guide their learning.

Discuss: Conclude today's learning. Why did the hotter water have a faster rate of dye dispersion? {The hot water had more heat energy, therefore the particles were moving faster. Faster water molecules help to push the food dye around the water quicker.}

Reflection Task:	What have you learned about energy so far? What examples of energy can you find in your everyday life? What questions do you still have about energy?

Lesson 2

How can you increase energy?

Learning Objective(s)	Resources/Prep
● To identify the relationship between the speed of an object and the energy of that object ● To use scientific evidence to construct and explanation	● Science Journals ● Hot Wheels Cars or Toy Cars ● Ramps Yard Sticks

Teaching Input

STARTER:

Watch Hot Wheels Video <u>Hot Wheels Video</u>

After the video, give students a few minutes to write a reflection on their observations in their science journals.

MAIN:

Discuss: Have students share what they found interesting about the video they watched as our starter:

- What did you notice about the design of the ramp?
- How do you think the engineers got the car to do the jump?
- What did you notice about the track and the car?
- How was the car different from cars you usually see people drive?
- How were the tracks different from the streets in your neighborhood?

<u>Explore</u>: Show students the Hot Wheels cars, tracks, yardsticks, and books (or something to elevate the tracks). Ask students: As an engineer, how would you build a ramp to get your Hot Wheels car to go as far as it can? Give small groups time to explore the materials and the cars.

- Materials per group of 3-4 students
- 2-4 Hot Wheels cars
- 1-2 long piece of track (If not available, use a measuring stick) ●3 textbooks (approximately 2 inches thick
- Have students work through their science journals to help guide their exploration.

Reflection Task:	If you were an engineer, how would you design a ramp to make sure the car could go as far as possible? Explain using scientific reasoning and vocabulary.

Lesson 3

How can energy be transferred?

Learning Objective(s)	Resources/Prep
● To ask questions and predict outcomes about the changes in energy that occur when objects collide.	● Science Journals ● Hot Wheels Cars or Toy Cars ● Ramps ● Yard Sticks

Teaching Input

STARTER:

Read 'Potential and Kinetic Energy?' in the student journals, as a class, in pairs or independently. Keep note of important and/or unfamiliar vocabulary on the board or class anchor.

Complete Let's Check your Understanding! questions individually, in pairs, or as a homework assignment to evaluate student understanding.

MAIN:

Discuss: Explain to students that they are going to explore how making a steeper ramp affects the distance a car travels using their textbooks.

- They are going to start by building a ramp that is 1 book high and record how far the car travels.
- Then they will record how far the car travels when the ramp is 2 and 3 books high.
- Ask students to think about what they did in the previous lesson and discuss with their group how they should construct their ramp.
- Tell them about the importance of the class having a uniform way to conduct the experiment

As a class, develop an experimental procedure. Discuss the importance of having a consistent procedure so the data is accurate.

<u>The class will need to decide:</u>

a.) How to construct the ramps: where will you put the end of the ramp on the book?

b.) How to release the cars: where will you place the car? How will you let it go so you don't push it?

c.) How to measure the distance: where will you measure from, the end of ramp or from the books? What unit of measure will you use? (Scientists and engineers usually use centimeters)

Reflection Task:	On a roller coaster, energy changes from potential to kinetic energy and back. Can you describe the energy of each stage of this roller coaster going up and down a hill?

Lesson 4

Can we increase energy?

Learning Objective(s)	Resources/Prep
• To build a working catapult using elastic potential energy.	• Science Journals • Rubber Bands • Pencils • Popsicle Sticks • Plastic bottle top • Sticky Tape • Paper balls + Bowls

Teaching Input

STARTER

Students complete the 'Time to Think' activity in their science journal.

MAIN:

Recap students understanding of potential and kinetic energy so far. Tell the students that today we will be exploring a different type of potential energy - elastic.

Hold up an elastic band and stretch it back and hold. Ask the students, does this elastic band have potential energy? What would happen if I released it? Release the elastic band to demonstrate that the potential energy was converted into kinetic energy and the elastic band was able to travel. How could I make the elastic travel further? {Pull it back tighter}

Tell the children that today we will be engineers. We will be building a machine that uses elastic potential energy to do work: Catapults. Who has heard of catapults? What are catapults used for? (Listen to student ideas and experiences.) Originally catapults were designed for use during battles or wars. These days, catapults are used for a variety of reasons, from toys to even launching planes and jets from aircraft carriers that have limited runway space!

Watch this video to learn how to build a catapult: How to make a Catapult with rubberband Give students time to play the Crazy Catapult Competition in their student journals.	
Reflection Task:	How did you make the catapult shoot different distances? Explain your strategy using your knowledge of energy.

Lesson 5

How can energy be transferred?

Learning Objective(s)	Resources/Prep
● To ask questions and predict outcomes about the changes in energy that occur when objects collide.	● Sugar Cubes ● Kitchen Roll ● Tubes or paper rolled into a similar shape. ● D-Cell Batteries

Teaching Input

STARTER:

Hand a tennis ball to a student and ask him or her to gently toss the ball to you. Once you've caught the ball, ask students to tell you what's happened to the energy that was in the moving ball now that you've caught and stopped it from moving. Highlight that if you didn't catch it the ball would keep going. Recap Law of Conservation. So where did the energy go? What would happen if they threw a bowling ball at you? What happens when a bowling ball hits pins? .

MAIN:

Next, apply their learning to real life examples of energy collisions. Tell students to think of the tennis ball as a car with people inside and your hand as a tree or similar solid immovable object that stops the car/tennis ball suddenly. Encourage students to draw comparisons between the two situations. If the concept of 'air bag' is brought up, probe for understanding of how airbags help protect passengers in cars. Why do we have airbags? What happens when a car collides with another object?

Write the following prompt on the board: What is the most effective way to use cushion wrap to protect a sugar cube from a potentially damaging collision?

Show students a sugar cube and a D-cell battery. Ask if they think the battery could crush the sugar cube. Demonstrate that it can.

Next, hold battery 2cm above and ask students to predict if you let go what will happen to the sugar cube?

Show students some cushion wrap and ask do they think this could prevent the sugar from being crushed?Accept a few responses without comment and tell students they are now going to work in groups to investigate how best to protect a sugar cube from being crushed.

Recap that we must use a scientific method and therefore we must all be dropping from the same height. Review the importance of controlling variables in an investigation. Show students a paper towel tube and demonstrate how to place the tube over a sugar cube, hold the battery at the top of the tube, and let the battery fall through the tube on to the sugar cube. Students complete this task first.

Next, give students cushion wrap and suggest that they can cut it into smaller pieces with scissors. Tell students they can also use plain writing paper in their design if they like. Now that students know the challenge and have seen the materials available to them, let them work in groups to design a protection system before they receive the actual materials. This step does not need to take long nor do the groups need to develop a written plan since this investigation relies somewhat on trial and error. Once you feel the groups are ready, distribute the materials, assist as needed, and let the testing begin.

Reflection Task:	Students draw their best design and explain the results of the investigation.

Lesson 6

What forms of energy exist?

Learning Objective(s)	Resources/Prep
● To research information about the different forms of energy.	● Access to computers, books, research materials.

Teaching Input

STARTER:

Students complete the Time to Think activity in their journals. Create a do's and don't list for effective research skills.

MAIN:

Watch Bill Nye

As the class watches the video, tell the students to keep notes about the different forms of energy as it will be useful for today's activity.

Once the video is over, the students work in groups to complete the energy forms research task in their science journals. The students must find information about the different forms of energy. Students can use textbooks, internet, or whatever resources you have available to them.

Students complete the research chart in their student journals. Recap that there are two forms of energy - potential and kinetic. Can we remember the types of potential energy we discussed?

Teach students the mnemonic to help them remember the 7 forms of energy. Then give students time to come up with their own idea for mnemonic and share with the class.

Reflection Task:	What form of energy do you think is the most useful on Earth? Why?

Lesson 7

How does energy move?

Learning Objective(s)	Resources/Prep
● To identify and explain energy transfers and transformations.	● Video ● Student ● journals

Teaching Input

STARTER:

Students complete the vocabulary crossword in their science journals.

MAIN:

Read 'Potential and Kinetic Energy?' in the student journals, as a class, in pairs or independently. Keep note of important and/or unfamiliar vocabulary on the board or class anchor. Students can watch a video to further their learning by scanning the QR code or by going to. https://www.youtube.com/watch?v=z8a-L1lkq3w

Complete Let's Check your Understanding! questions individually, in pairs, or as a homework assignment to evaluate student understanding

Explain that energy can be transformed from one form to another. Share examples e.g hot air balloons. Chemical-thermal-kinetic.

Watch 'The most outrageous way to share a coke" . Then re-watch the video and ask students to take notes of the transfers and/or transformations they notice. As a class discuss all of the transfers and transformations and keep a list in their student science journals.

Apply your learning: Have students find 3 examples of energy transformations in the classroom. Students illustrate a picture of their object then describe the energy transformation. E.g Light switch - electrical energy - radiant energy

Reflection Task:	What form of energy do you think is the most useful on Earth? Why?

Lesson 8

How can we transform electrical energy?

Learning Objective(s)	Resources/Prep
● To identify how electricity can be converted into different forms.	Electrical Appliances for the centers. e.g Waffle Iron, Hair dryer, Toaster,Lamp, Radio Student Journals Instructions for stations (below)

Teaching Input

PRIOR TO LESSON: Bring 5 electrical items to create stations for the students to explore and observe electrical energy transformations. Here are some examples:

- Station A: Waffle Maker and pre-made batter
- Station B: Hairdryer
- Station C: A Lamp
- Station D: Toaster and bread
- Station E: Flashlight

Put the instructions sheet (below) for each station next to the items.

STARTER:

Students complete the Time to Think activity in their journals. How many electrical items have you used today?

MAIN:

Read 'Welcome to the science lab' to familiarize themselves with behavior expectations for today's lesson.

Explain to the students that today they will be exploring how electrical energy can be transformed. They will spend 4-5 minutes at each station. First the students must hypothesize what the transformation is - electricity into what? Then one member of the group follows the instructions while the others observe. Give students 2 minutes to discuss what they have observed. Finally, students record their observations in their student journals and then when instructed move to the next station and repeat.

Reflection Task:	What would your life be like without electricity?

STATION A

Waffle Maker

1. Turn the waffle iron on and let it heat up.
2. Open the lid of the waffle iron.
3. Using the measuring cup provided, pour ¼ cup of waffle mix into the waffle iron.
4. Close the lid of the waffle iron.
5. Time the cooking on the clock for 2 minutes.
6. After 2 minutes lift the lid of the waffle iron and take out the cooked waffle using the provided spatula.

Discussion Time: What did you observe while the waffle was cooking? What form of energy do you think the energy was transformed into?

Now complete your lab report.

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STATION B

Hairdryer

1. Pick up the hair dryer

2. Turn on the hair dryer and let it run for 20-30 seconds,making sure to direct the hair dryer at the table/floor and not at anyone's face or body.

3. Give you and your teammates 1 minute to observe the hair dryer while it is on, make sure to time your team on the clock

4. Turn the hair dryer off and put it back on the table

Discussion Time: What did you observe while the hair dryer was running? What form of energy do you think the energy was transformed into?

Now complete your lab report.

STATION C

Lamp

1. Carefully, plug in the lamp
2. Turn the lamp on.
3. Give you and your teammates 1 minute to observe the lamp while it is on.
4. . Turn the lamp off.
5. Unplug the lamp
6. Turn the lamp on
7. Give you and your teammates 1 minute to observe the lamp while it is on.
8.

Discussion Time: What did you observe while the lamp was on? What was the difference between it being plugged in and not being plugged in? What form of energy do you think the energy was transformed into?

Now complete your lab report.

STATION D

Toaster

1. Set the toaster to the number 2..
2. 2. Pick up one piece of bread.
3. Put the one piece of bread in the toaster
4. Pull the lever down to place the toast in the toaster
5. Allow teammates to observe the bread while it is cooking in the toaster.
6. When the bread pops out of the toaster carefully take it out of the toaster and put it on the counter for teammates to observe.
7. After one minute of observation (use the clock to time the team), throw out the bread.

Discussion Time: What did you observe while the toaster was running? 2. Have a 1-2 minute discu What form of energy do you think the energy was transformed into?

Now complete your lab report.

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STATION E

Flashlight

1. . Pick up the flashlight

2. Turn the flashlight on, making sure to direct the flashlight at the table/floor and not at anyone's face or body.

3. Give you and your teammates 1 minute to observe the flashlight while it is on, make sure to time your team on the clock

4. Turn the flashlight off and put it back on the table.

Discussion Time: What did you observe while the flashlight was on? What form of energy do you think the energy was transformed into?

Now complete your lab report.

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Lesson 9

Where does energy come from?

Learning Objective(s)	Resources/Prep
● To identify sources of energy	● Student Journals ● Access to internet ● Science Books

Teaching Input

STARTER:

Students brainstorm in pairs and record in their student journals "Where does Energy come from?"

MAIN:

Read 'Where does energy come from?' to get an introduction to sources of energy.

{Optional Videos to further learning}

- https://www.youtube.com/watch?v=KEeH4EniM3E
- https://www.youtube.com/watch?v=wM0pMka6PJI&t=88s

Next look at 'Energy Sources' in their journals. Students can work individually or as a group to complete the task. Students may need to complete some research to discover the correct answers.

Once complete, students choose ONE energy source to investigate further and create an informative report. Students use the questions provided to help guide their research.

Once students have edited their rough drafts they can copy up their final report in the space provided in their student journals.

Reflection Task:	Students swap reports and read each others, then give their partner 3 features they enjoyed about the report and 1 area they could improve.

Lesson 10

How can we use energy responsibly?

Learning Objective(s)	Resources/Prep
● To compare and contrast renewable and nonrenewable sources of energy.	● Video ● Pennies ● Student Journal

Teaching Input

STARTER:

Read 'Fossil Fuels text in student journals and watch the following video:Fossil Fuels 101

MAIN:

Prior to lesson: Hide 100 pennies around the classroom - some easy to find some more difficult. In today's lesson students participate in a demonstrating to see how fossil fuels will eventually run out.

Read the instructions as a class on page 68 of the science journals.

Students work in groups to collect pennies from the classroom.

Give students 30 seconds and explain to them that they need to collect as many pennies as possible and record how many they have.

Do this 3 times without adding any pennies to the classroom. The pennies should become more difficult to find as they are all collected.

Students then graph their results in their journals.

Have students reflect on the tasK using the following guiding questions:

- In which search did you find the most pennies?
- In which search did you find the least pennies?
- Why do you think it became increasingly harder to find pennies?
- .Did your strategy for finding pennies change as it became harder to find pennies? How?
- What does this activity tell you about fossil fuels like coal, oil, and natural gas?

Renewable and Nonrenewable Energy - Students organize the energy sources into renewable and non renewable.

Watch: https://www.youtube.com/watch?v=IkUE0BZtTRc&t=16s

Renewable Energy - In pairs, or small groups have students research the advantages and disadvantages of various renewable energy sources. Students complete the tree diagram to show their level of understanding.

Reflection Task:	What is the difference between renewable and nonrenewable energy sources. What are some advantages and disadvantages of both?

End of Unit Project - Rube Goldberg Machines

{Time Frame - As long as you want!}

Introduction:

ENGAGE: Watch 'The most outrageous way to share a coke' https://www.youtube.com/watch?v=LZweYkjx0c0 Then, re-watch the video, this time ask students to write down all the examples of forces they see in action that creates the motion of the machine.

Project: Tell the students that they will now be utilizing all of the knowledge they have gained about ENERGY throughout the entire unit to build their own crazy machine that must complete a simple everyday task.

As a class read Rube Goldberg, and watch the famous invention 'The self operating napkin' https://www.youtube.com/watch?v=AwjOFvL8VTc Students can scan the QR code or you can display at the front of the class. Instruct students to pause the video and answer the questions in their journal.

Read - 'Your Challenge' and allow students some time to individually brainstorm their own ideas for a crazy chain reaction machine.

Rubric - Read through the rubric to ensure students understand the grading criteria for the project

Assign groups.

 Team Planning - Students choose an everyday action that their machine will complete and then brainstorm ideas.

- {Optional} If students are stuck for ideas you can show some examples using the following videos (These are third grade students)
  - https://www.youtube.com/watch?v=rvJoOfHTZqk
  - https://www.youtube.com/watch?v=dDDhMgCRENg
  - https://www.youtube.com/watch?v=29mo-_Wu6gQ
  - https://www.youtube.com/watch?v=4HWFuxe4ihg

 Blueprint - Students draw a detailed blueprint of their machine in their student journals before building.

 Build - Allow students to build their machine.

 Steps - Students identify each step in their machine and what examples of energy are in action and record in their student journals.

 Presentation - As a group, students use the checklist to create a presentation for the class. Students give a live demonstration of their machine explaining all the energy transfers/transformations that they used to create motion.

 Reflect: Students reflect on the project using the reflection sheet in student journals

End of Unit Assessment

ANSWER KEY

Q1	C
Q2	A
Q3	D
Q4	B
Q5	C
Q6	D
Q7	A
Q8	B
Q9	Advantages:: Solar energy is renewable as the sun will continue to radiate energy. The energy from the sun is free. Disadvantages: The solar collector panels are expensive to install. Cost recovery may take many years.
Q 10	Energy Transfer is the passing of energy from one object to another object. Energy Transformation is the changing of energy from one form to another.