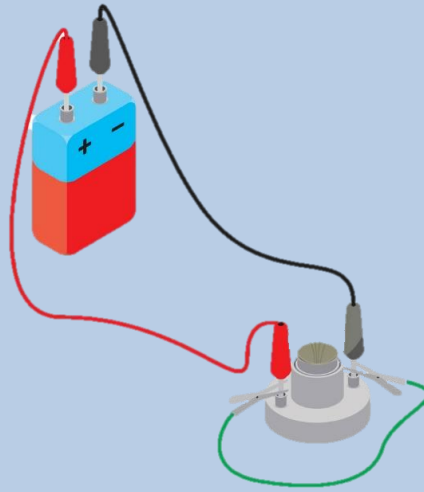


# Exploring Electricity and Energy

# Experiment with Electrical Circuits



## Science Project-Based Learning Grades 3-5

### Design and Build a Model Phone Charger

### Think Like an Inventor

### Experiment with Electrical Circuits



# Lesson Plan: Exploring Electricity and Energy

## ABOUT THIS PROJECT-BASED LESSON

This project-based learning unit is designed to teach and reinforce the concepts in an elementary science unit on electricity and magnetism and can be used in conjunction with existing curriculum materials.

The project is divided into 5 Milestones; each Milestone includes a self-contained student project activity. Done in sequence, the Milestones connect to enable students to produce a comprehensive capstone activity.

The minimum suggested duration for completing this project is 5 class periods. However, it is completely flexible and can be lengthened or shortened as necessary, based on available class time and interest level.

## HOW TO USE THIS TEACHING GUIDE

Each Milestone for this project-based learning unit includes detailed daily activities presented in step-by-step order, with teaching notes, instructional guidance, and page references to resources and materials included in the Teacher Pack and Student Pack.

Daily activities are organized for you as follows:

- **Prepare (Bell-ringer/opener activity)**  
Use these short opening activities at the beginning of class.
- **Present (Lecture/model)**  
Use this portion of the lesson to deliver new subject material and project information, and to model any instructions or activity required for Produce or Participate elements.
- **Produce (Student project work)**  
Use this portion of the lesson to allow students to work independently or in small groups on activities and other project elements.
- **Participate (Student/group share)**  
Use this portion of the lesson to allow students to share out any project, research, or presentation materials.
- **Practice (Homework/assessment/independent)**  
Use this optional portion of the lesson, if desired, to give students homework activities.

# Step-By-Step Project Teaching Guide

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## THE IMPORTANCE OF ELECTRICITY

### Overview, Objectives, Inquiry Questions, and Planning

#### THINGS TO CONSIDER FOR MILESTONE #1

- Cross-curricular resources, like books about energy transfer and how power is generated, may be helpful in making prior knowledge concrete. You can find a list of suggested books on page 4 of the Teacher Pack.
- If your students don't have experience with losing power, read them the book **You Wouldn't Want to Live Without Electricity** to get some ideas of things they wouldn't have if there wasn't power. Have them take notes on the "You Wouldn't Want to Live Without Electricity" printable on page 3 of the Student Pack. They can use their notes to help them write their story.

#### LEARNING OBJECTIVES FOR MILESTONE #1

At the conclusion of this milestone, students will be able to:

- Write a story about a time they lost power by explaining why they didn't have power and what they did while they waited for the electricity to come on again.
- Identify things that require electricity to work and why they are important.

#### EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #1

- Are there local institutions (i.e. museums, science centers) who could serve as partners in this lesson?
- Are there other resources or extensions that you can link this project to in order to enhance prior knowledge or introduce new knowledge? For example, take a virtual field trip to learn about types of energy. [Powering the Planet](#) teaches students about ways to get energy that don't harm nature. The students can complete the printable on page 4 of the Student Pack as they watch the virtual field trip. Use the


“Powering the Planet Answer Key” on page 5 of the Teacher Pack to discuss the answers.

## STUDENT INQUIRY QUESTIONS FOR MILESTONE #1

- When was a time you lost power? What did you do until the electricity came on again?
- What are three things that require electricity to work, and why is it hard to live without them?

## ASSESSMENT FOR MILESTONE #1

- **Formative Assessment for Individual Activity:** Check each student’s “A Time Without Power Writing” printable on page 5 of the Student Pack.
- **Formative Assessment for Group Activity:** Listen in as the students share their stories to make sure they included all of the important parts.
- **Summative Assessment:** Have the students complete the response printable on page 6 of the Student Pack for the Inquiry Question, “What are three things that require electricity to work, and why is it hard to live without them?”

 **Student Pack**  
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• Page 6

 **Teacher Pack**  
• Page 6

## Project Activities for Milestone #1: The Importance of Electricity

### PREPARE (Bell-ringer/opener activity)

Demonstrate the operation of an emergency flashlight or radio. Have the students turn and talk about the question, “When would it be handy to have one of these inventions?” Call on students to share their answers.

### PRESENT (Lecture/model)

Read the “A Time Without Power Sample Story” on page 6 of the Teacher Pack or tell your own story about a time when you lost power and needed a charged cell phone. Tell the students that in this story having a charged cell phone would have been helpful when there was no power. Tell them that they are going to write their own stories about a time when they lost power and needed a charged cell phone.

### PARTICIPATE (student/group share, group activity)

Distribute the “A Time Without Power Writing” printable on page 5 of the Student Pack. Remind the students that their story should be fictional. It can

be based on something that really happened to them, but they can add to it to make it more exciting. Have them work on writing their stories.

As the students finish writing, put them into groups of 2 or 3 to share their stories.

**Formative Assessment:** Listen in as the students share their stories to make sure they included all the important parts.

### **PRACTICE (Homework/independent work/extensions)**

Give each student the writing response template on page 6 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “What are three things that require electricity to work, and why is it hard to live without them?”

### **ASSESSMENT**

**Formative Assessment for Individual Activity:** Check each student’s “A Time Without Power Writing” printable on page 5 of the Student Pack.

**Formative Assessment for Group Activity:** Listen in as the students share their stories to make sure they included all the important parts.

**Summative Assessment:** Have the students complete the response printable on page 6 of the Student Pack for the Inquiry Question, “What are three things that require electricity to work, and why is it hard to live without them?”



# CREATIVE WAYS TO CHARGE A PHONE

## Overview, Objectives, Inquiry Questions, and Planning

### THINGS TO CONSIDER FOR MILESTONE #2

- If your students haven't done a lot of research, you might want to do a mini lesson to show them how to find important information online. Use the "How to Do Good Research" printable on page 7 of the Student Pack to review good research skills.

### LEARNING OBJECTIVES FOR MILESTONE #2

At the conclusion of this milestone, students will be able to:

- Explain the meaning of the quote, "Necessity is the mother of invention."
- Research ways cell phones can be charged without electricity by using the internet.
- Explain the types of energy that are used by items in a house.

### EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #2

- Have the students do the "Electric Spaghetti, Please" activity on pages 8 through 9 of the Student Pack to help them understand the importance of electricity and power.

### STUDENT INQUIRY QUESTIONS FOR MILESTONE #2

- What does the quote "Necessity is the mother of invention." mean?
- How can cell phones be charged without electricity?
- What are two things at your house that use energy? What types of energy do they use? How do you know?

### ASSESSMENT FOR MILESTONE #2

- **Formative Assessment for Individual Activity:** Check each student's "Energy Video" printable on page 10 of the Student Pack. Use the "Energy Video Answer Key" on page 7 of the Teacher Pack to check their answers.
- **Formative Assessment for Group Activity:** Have each group share their favorite way to charge a cell phone without electricity.
- **Summative Assessment:** Have the students complete the response printable on page 13 of the Student Pack for the Inquiry Question, "What are two things at your house that use energy? What types of energy do they use? How do you know?"

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- Page 12
- Page 13

## Teacher Pack

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# Project Activities for Milestone #2: Creative Ways to Charge a Phone

## PREPARE (Bell-ringer/opener activity)

Show the students the "[Shark Tank](#)" TV show pitch for the Power Pot, which is a commercially-available device that enables people to charge their mobile phones using a simple cable and a pot of boiling water. Have the students turn and talk about why the inventors created this invention.

## PRESENT (Lecture/model)

Give the students the "Energy Video" printable on page 10 of the Student Pack. Show them the "[Energy](#)" video and have them fill in the top of the page with information from the video.

When the video is over, use the "Energy Video Answer Key" on page 7 of the Teacher Pack to discuss the answers. Then, help the students complete the guided notes at the bottom of the page.

Give the students the "Electricity and Energy Project Guidelines" on page 11 of the Student Pack. Go over the expectations for the project. Tell the students that they will work on the first part today.

## PARTICIPATE (Student/group share, group activity)

Give the students the "Need for Inventions" printable on page 12 of the Student Pack. Have them work independently to answer the question at the top.

Put the students into groups of 2 or 3. Have them discuss their answers to the question. Then, they should work together to research creative ways to charge a cell phone without electricity. They should take notes about the ways they find in the "Crazy Chargers" section at the bottom of the page.

**Formative Assessment:** Have each group share their favorite way to charge a cell phone without electricity.

## PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 13 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: "What are two things at your house that use energy? What types of energy do they use? How do you know?"

## ASSESSMENT

**Formative Assessment for Individual Activity:** Check each student's "Energy Video" printable on page 10 of the Student Pack. Use the "Energy Video Answer Key" on page 7 of the Teacher Pack to check their answers.

**Formative Assessment for Group Activity:** Have each group share their favorite way to charge a cell phone without electricity.

**Summative Assessment:** Have the students complete the response printable on page 13 of the Student Pack for the Inquiry Question, “What are two things at your house that use energy? What types of energy do they use? How do you know?”





# DESIGNING AN ELECTRICITY-FREE PHONE CHARGER

## Overview, Objectives, Inquiry Questions, and Planning

### THINGS TO CONSIDER FOR MILESTONE #3

- If your students didn't finish their research yesterday, they might need more time to look at examples of electricity-free phone chargers.

### LEARNING OBJECTIVES FOR MILESTONE #3

At the conclusion of this milestone, students will be able to:

- Explain the difference between renewable and nonrenewable energy sources and identify advantages and disadvantages of each.
- Explain how a battery works by describing an electrical circuit.
- Brainstorm ideas for an electricity-free phone charger and the materials that would be needed to create it.

### EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #3

- Could you have the students conduct an experiment to make a [simple electrical circuit](#) or show them [this video](#) of how one is created?

### STUDENT INQUIRY QUESTIONS FOR MILESTONE #3

- What are renewable and nonrenewable energy sources?
- What are the advantages and disadvantages of using renewable and nonrenewable energy sources?
- How does a battery work?
- How can you create a phone charger that doesn't require electricity? What materials do you need?
- What is something you own that uses batteries? How do the batteries work to power it?

### ASSESSMENT FOR MILESTONE #3

- **Formative Assessment for Individual Activity:** Check each student's "Types of Energy" printable on page 14 of the Student Pack. Use the "Types of Energy Answer Key" on page 8 of the Teacher Pack to check their answers.
- **Formative Assessment for Group Activity:** Meet with the groups and discuss how they plan to build their chargers.

- **Summative Assessment:** Have the students complete the response printable on page 17 of the Student Pack for the Inquiry Question, “What is something you own that uses batteries? How do the batteries work to power it?”
- **Summative Assessment:** Have the students complete the “Electricity and Energy Quick Quiz” on page 10 of the Teacher Pack. Use the “Electricity and Energy Quick Quiz Answer Key” on page 11 of the Teacher Pack to correct the quizzes prior to starting Milestone #4.

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#### Teacher Pack

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## Project Activities for Milestone #3: Designing an Electricity-Free Phone Charger

### PREPARE (Bell-ringer/opener activity)

Tell the students that there are many different ways we get energy. Give them the “Types of Energy” printable on page 14 of the Student Pack. Show them the video “[Types of Energy for Kids](#)”. Have the students answer the questions as they watch.

When the video is over, use the “Types of Energy Answer Key” on page 8 of the Teacher Pack to discuss the answers.

### PRESENT (Lecture/model)

Tell the students that one way we store energy is in a battery. Review the basics of how a battery works. Distribute the “Inside a Battery” printable on page 15 of the Student Pack. Have the students independently read the information at the top of the page, color the battery, and fill in the blanks. Use the “Inside a Battery Answer Key” on page 9 of the Teacher Pack to discuss the answers.

Explain that today the students are going to create a design for a phone charger that works without electricity and batteries.

### PARTICIPATE (Student/group share, group activity)

Have the students get into their groups from Milestone 2. Give them the “Invent a Charger” printable on page 16 of the Student Pack. Have the students work together to design their charger.

**Formative Assessment:** Meet with the groups and discuss how they plan to build their chargers.

### PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 17 of the Student Pack and ask them to write an answer to the inquiry question for this

Milestone: “What is something you own that uses batteries? How do the batteries work to power it?”

## ASSESSMENT

**Formative Assessment for Individual Activity:** Check each student’s “Types of Energy” printable on page 14 of the Student Pack. Use the “Types of Energy Answer Key” on page 8 of the Teacher Pack to check their answers.

**Formative Assessment for Group Activity:** Meet with the groups and discuss how they plan to build their chargers.

**Summative Assessment:** Have the students complete the response printable on page 17 of the Student Pack for the Inquiry Question, “What is something you own that uses batteries? How do the batteries work to power it?”

**Summative Assessment:** Have the students complete the “Electricity and Energy Quick Quiz” on page 10 of the Teacher Pack. Use the “Electricity and Energy Quick Quiz Answer Key” on page 11 of the Teacher Pack to correct the quizzes prior to starting Milestone #4.



# BUILDING THE PHONE CHARGER

## Overview, Objectives, Inquiry Questions, and Planning

### THINGS TO CONSIDER FOR MILESTONE #4

- For this lesson, your students will need craft supplies, like pipe cleaners and construction paper. You can find a full list of supplies on page 3 of the Teacher Pack. You might want to designate an area in the classroom as a supply station so your students can get the materials they need.

### LEARNING OBJECTIVES FOR MILESTONE #4

At the conclusion of this milestone, students will be able to:

- Use pipe cleaners and other craft supplies to create their phone chargers.
- Assess the effectiveness of their design and make improvements to it.
- Explain how their cell phone charger works.

### EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #4

- Could you have the students design their own emergency supply kit? Have them read the article "[How to Build a Kit for Emergencies](#)" to get some ideas. Then, give them the "Emergency Supply Kit" printable on page 18 of the Student Pack to create their own emergency supply kit. Challenge them to gather those supplies at home and keep them in a safe place in case there is an emergency.

### STUDENT INQUIRY QUESTIONS FOR MILESTONE #4

- How can craft materials be used to create the phone charger?
- What improvements could we make to our design to make it even better?
- How does your group's cell phone charger work?

### ASSESSMENT FOR MILESTONE #4

- **Formative Assessment for Individual Activity:** Check each student's "Design Your Charger" printable on page 19 of the Student Pack.
- **Formative Assessment for Group Activity:** Meet with the groups and discuss how they combined all of their ideas to make a phone charger.
- **Summative Assessment:** Have the students complete the response printable on page 20 of the Student Pack for the Inquiry Question, "How does your group's cell phone charger work?"

## Project Activities for Milestone #4: Building The Phone Charger

### PREPARE (Bell-ringer/opener activity)

Show students the Florida Power & Light videos “[Restoring Power After a Storm](#)” and “[High Tech Tools Speed Restoration](#)”. Have the students turn and talk about how power is restored after a widespread power outage.

### PRESENT (Lecture/model)

Remind the students that they are trying to solve the problem of not being able to charge a cell phone during a power outage. Explain to the students that they will work in their groups to design a model of their group’s phone charger using craft materials and labels.

### PARTICIPATE (Student/group share, group activity)

Show the students the craft supplies that are available for them to use to make their phone chargers and labels (pipe cleaners, cardboard, colored paper, etc.). They should look back at their “Invent a Charger” printable from Milestone 3 to see the materials they listed. Tell them that they are going to use these craft supplies to represent the real materials they brainstormed. They should use the labels to tell what real items they would use. For example, a pipe cleaner could represent a wire. Give the students the “Design Your Charger” printable on page 19 of the Student Pack. Have them work independently to design a charger in the box at the top.

Have the students meet with their groups to share and review the sketches they designed. Have them discuss the ideas and offer feedback to improve each design. The students should use the ideas to write a way to improve their charger by answering the question at the bottom of the page.

Have the students work together to combine their best ideas and design their phone charger using the craft supplies. Remind them to label the parts with the names of the items they would really use to build it.

**Formative Assessment:** Meet with the groups and discuss how they combined all of their ideas to make a phone charger.

### PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 20 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “How does your group’s cell phone charger work?”

## ASSESSMENT

**Formative Assessment for Individual Activity:** Check each student's "Design Your Charger" printable on page 19 of the Student Pack.

**Formative Assessment for Group Activity:** Meet with the groups and discuss how they combined all of their ideas to make a phone charger.

**Summative Assessment:** Have the students complete the response printable on page 20 of the Student Pack for the Inquiry Question, "How does your group's cell phone charger work?"



# CHARGER DEMONSTRATIONS

## Overview, Objectives, Inquiry Questions, and Planning

### THINGS TO CONSIDER FOR MILESTONE #5

- You might want to keep the students' projects at school until you have a chance to use the rubric to assess them all.

### LEARNING OBJECTIVES FOR MILESTONE #5

At the conclusion of this milestone, students will be able to:

- Present their phone chargers and explain the materials they used to make them.
- Demonstrate their understanding of energy transfer by answering evaluation questions.
- Explain what other inventions would be helpful during a widespread power outage.

### EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #5

- Are other grades or classes at your school learning about the transfer of energy, too? You could invite another class to listen to your students' presentations.

### STUDENT INQUIRY QUESTIONS FOR MILESTONE #5

- Would my phone charger design really work?
- What other uses could my invention have, and how could it help people?
- What other inventions would be helpful to have on hand in the event of a widespread power outage?

### ASSESSMENT FOR MILESTONE #5

- **Formative Assessment for Individual Activity:** Check the students' "Invention Reflection" printable on page 21 of the Student Pack.
- **Formative Assessment for Group Activity:** Use the "Electricity and Energy Project Rubric" on page 14 of the Teacher Pack to assess the students' phone charger designs.
- **Summative Assessment:** Have the students complete the response printable on page 22 of the Student Pack for the Inquiry Question, "What other inventions would be helpful to have on hand in the event of a widespread power outage."

- **Summative Assessment:** Give the students the “Electricity and Energy Summative Assessment” on page 12 of the Teacher Pack. Use the “Electricity and Energy Summative Assessment Answer Key” on page 13 of the Teacher Pack to correct the assessments.

### Student Pack

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- Page 22

### Teacher Pack

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## Project Activities for Milestone #5: Charger Demonstrations

### PREPARE (Bell-ringer/opener activity)

Show the video “[How to Charge your Phone in an Emergency](#)”. Ask the students if they would have all those materials at home. Have them turn and talk about other items that would be important to have during an emergency.

### PRESENT (Lecture/model)

Explain that the groups will be sharing their inventions with the class today.

### PARTICIPATE (Student/group share, group activity)

Have each group show their cell phone charger model and explain how it would work. While discussing their models, students should indicate which materials they would use in creating a real, functional version of their charger.

After all of the groups have shared, give the students the “Invention Reflection” printable on page 21 of the Student Pack.

**Formative Assessment:** Use the “Electricity and Energy Project Rubric” on page 14 of the Teacher Pack to assess the students’ phone charger designs.

### PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 22 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “What other inventions would be helpful to have on hand in the event of a widespread power outage? Name at least 3 and explain why they would be helpful.”

### ASSESSMENT

**Formative Assessment for Individual Activity:** Check the students’ “Invention Reflection” printable on page 21 of the Student Pack.



**Formative Assessment for Group Activity:** Use the “Electricity and Energy Project Rubric” on page 14 of the Teacher Pack to assess the students’ phone charger designs.

**Summative Assessment:** Have the students complete the response printable on page 22 of the Student Pack for the Inquiry Question, “What other inventions would be helpful to have on hand in the event of a widespread power outage?”

**Summative Assessment:** Give the students the “Electricity and Energy Summative Assessment” on page 12 of the Teacher Pack. Use the “Electricity and Energy Summative Assessment Answer Key” on page 13 of the Teacher Pack to correct the assessments.



**Exploring Electricity and Energy**

# Teacher Pack



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# Materials Needed for the Projects in this Unit

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## Electric Spaghetti, Please Extension Activity (Optional)

String

## Building an Electrical Circuit Extension Activity (Optional)

- Energizer® Power Bank (available at [Amazon](#) or [Walmart](#))
- Spring-tension wood or plastic clothespin
- 22 AWG insulated copper bell wire (available at most hardware stores)
- Small block of wood
- Nail, thumbtacks, and paper clip
- 3-volt flashlight bulb

## Design a Charger

Each group will need:

- Pipe cleaners
- Construction paper
- Cardboard
- Straws
- Art supplies, like markers, colored pencils, and crayons



# Books About Energy and Electricity

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**Note for the Teacher:** Gather as many books as you can about energy and electricity.

## Suggested Books:

**Charged Up: The Story of Electricity** by Jacqui Bailey and Matthew Lilly

**DK Eyewitness Books: Energy** by Dan Green

**DKfindout! Energy** by Emily Dodd

**Electricity** by Hugh Westrup

**Energy** by Suzanne Barchers

**Energy: Heat, Light, and Fuel** by Darlene Ruth Stille and Sheree Boyd

**Energy Makes Things Happen** by Kimberly Bradley and Paul Meisel

**Energy: Physical Science for Kids** by Andy Diehn and Hui Li

**Harvesting Solar, Wind, and Tidal Power** by Baby Professor

**How Does My Home Work?** by Chris Butterworth and Lucia Gaggiotti

**Shocking: Where Does Electricity Come From?** by Bobo's Little Brainiacs Books

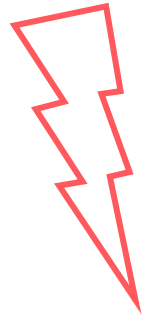
**The Big Book of Invisible Technology: A Look at How Things Work for Kids** by Chloe Taylor

**The Magic School Bus and the Electric Field Trip** by Joanna Cole and Bruce Degan



# Powering the Planet Answer Key

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**Teacher Notes:** Show your students the virtual field trip “[Powering the Planet](#)”. Have them answer the questions as they watch. You might want to pause the video as the questions are answered to give them a chance to record their responses. Use the sample answers to discuss energy use.

**1. What are two ways you use energy every day?**

*to power my television*

*to power flashlights*

**2. What are two renewable energy resources?**

*wind*

*sun*

**3. Answer the question from the video: How do we get energy?**

*Sample answers: We get energy from gas, coal, and oil. We get energy from our food.*

**4. How do they use renewable energy on the Palmyra Atoll?**

*They installed solar panels and used renewable energy from the sun. They use a wind turbine to make electricity. They had to make a special design to keep the birds safe.*

**5. How do they use renewable energy in the Mojave Desert?**

*They capture the energy from the sun with solar panels and they concentrate solar power by using mirrors that reflect sunlight onto a solar tower.*

**6. Answer the question from the video: What items in your home or school use energy?**

*Sample answers: Computers and microwaves use energy.*

**7. Why is it important to use more renewable resources to create energy?**

*Renewable resources will never run out. If we keep using nonrenewable resources, there won't be any left for future generations. It's also important because renewable sources of energy are better for the environment.*



## A Time Without Power Sample Story

**Teacher Notes:** Use this story or a story from your own personal experience to have your students imagine a time without power when they would need a cell phone.

I was sitting in the living room watching TV as I noticed the sky outside getting darker and darker. I could hear the rumble of thunder in the distance, and I saw streaks of lightning in the sky. My mom was in the kitchen making dinner. She had just put the chicken in the oven.

Suddenly, rain started pouring from the sky. I could hear it pounding on the roof, and the thunder sounded like it was going to break down the walls of the house. There was a bright streak of lightning, and then everything went dark. “Mom,” I called in a panicked voice. “What happened?”

“We lost power,” she said. “Let me find some candles to light so we can see.”

I could hear her moving things around in a drawer until she found a candle and a pack of matches. She lit a match and used it to light the candle. It illuminated the kitchen. I was still a little bit scared, but I was starting to feel better.

“Well, I guess my chicken isn’t going to cook,” said Mom. “The oven doesn’t work without power. I’m starving. Let’s call for some pizza.” Mom grabbed her cell phone and tried to turn it on. “Uh oh!” she exclaimed. The battery is dead, and I don’t have a way to charge it. I guess we’re eating cheese and crackers for now.”

Mom grabbed a box of cheese from the pantry and some slices of cheese from the refrigerator. “I hope the power comes back on soon, so the food in the refrigerator doesn’t go bad,” she said.

Mom carried the snacks and the candle into the living room. “I guess I’m going to miss the end of my show,” I said sadly. “Can we play a game while we wait for the power to come back on?”

“Sure,” said Mom. She picked up the UNO cards and started shuffling them. As she dealt the cards, I noticed that the sky was starting to get brighter again. The sound of the thunder was quiet as the storm moved away from our house. Suddenly, I heard a click, and everything turned back on - the lights, the TV, and the oven. Mom and I cheered excitedly. The power had only been off for 30 minutes, but it felt like an eternity.

“Can you please charge your cell phone so we can order that pizza now? The chicken will take a long time to cook, and I’m still really hungry,” I said. We finished our game of UNO while we waited for our pizza to be delivered.



## Energy Video Answer Key

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**Teacher Notes:** Show the students the “[Energy](#)” video. Go over the answers together when the video is over.

**What is energy?** *Energy is the ability to do work.*

**What are two ways that your body gets energy?** *Your body gets energy from the food you eat and from the sun.*

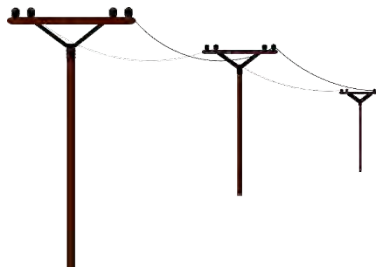
**What is the difference between kinetic and potential energy?** *Kinetic energy is energy in motion. Potential energy is the energy stored inside an object.*

Energy can neither be *destroyed* nor *created* , but it can *transform* from one form of *energy* to another.

**Directions:** Work with your teacher to fill in the blanks.

*Electric* energy is important to our everyday life and can be converted into many useful forms of energy, such as *thermal* energy, or heat.

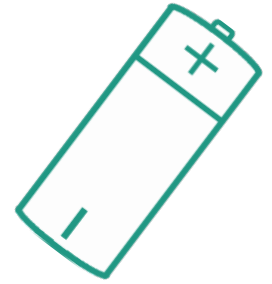
Electric energy can be stored in *batteries* as chemical energy, and then used at a later time.







# Types of Energy Answer Key



**Teacher Notes:** Show the students the “[Types of Energy for Kids](#)” video. Discuss the answers together when the video is over.

1. What are three renewable sources of energy?

wind

the sun

sea waves

2. What are the advantages of using renewable energy?

*Renewable energy sources are environmentally friendly. They are limitless because they come from natural resources that don't run out. They are safer for our health.*

3. What are the disadvantages of renewable energy sources?

*The sources of renewable energy vary by location and aren't found everywhere. They are randomly obtained because we can't predict the amount of rainfall or wind.*

4. What are four nonrenewable sources of energy?

oil

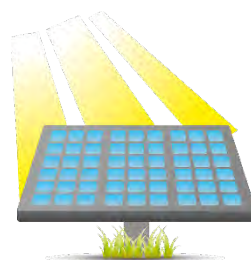
coal

natural gas

nuclear power

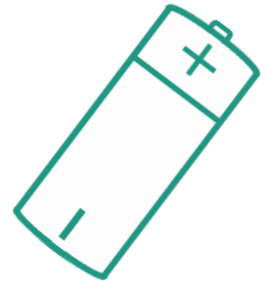
5. What are the disadvantages of nonrenewable energy sources?

*They are not good for the environment. They release contaminated gases into the air. Nuclear energy has radioactive residue. Accidents can cause environmental catastrophes.*





# Inside a Battery Answer Key



**Directions:** Read the information about batteries. Color the battery according to the color key. Then, fill in the blanks.

The batteries used in flashlights are called dry cells. Dry cells also run most battery-powered toys.

Dry cells work because of a chemical reaction. Zinc has more electrons than carbon. When you use a battery, electrons move from zinc to carbon. The electrons move through your lightbulb or toy and make it work. This is the flow of electricity.

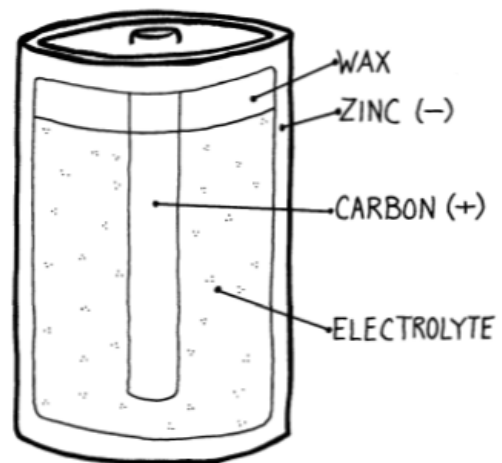
## Color:

Carbon - black

Zinc - blue

Electrolyte - red

Wax - yellow



1. A dry cell works because of a *chemical* reaction inside.

2. Electrons move from *zinc* to *carbon*.

3. Name two things that use dry cell batteries.

*flashlights*

*battery-powered toys*



# Electricity and Energy Quick Quiz



**Directions:** Read each question. Circle the best answer. Use information from your phone charger project to complete the sentences.

**1. How does a dry cell battery work?**

- A** Wind moves through the battery from north to south and creates electricity.
- B** Electrons move from zinc to carbon creating electricity through a chemical reaction.
- C** There is water inside the battery, and the hydrogen and oxygen react to form electricity.
- D** Coal burns inside the battery to create electricity.

Two things that are run by batteries are ..... and .....

**2. Which of these is a result of losing power?**

- A** You won't have running water.
- B** Your flashlight won't work.
- C** You won't be able to play ball.
- D** Your refrigerator won't keep food cold.

The phone charger I designed will still work if the power goes out because .....

**3. Which of these is a type of renewable energy?**

- A** Oil
- B** Wind
- C** Batteries
- D** Coal

We should try to use more renewable energy sources because .....

# Electricity and Energy Quick Quiz

## Answer Key

---



**Directions:** Read each question. Circle the best answer. Use information from your phone charger project to complete the sentences.

### 1. How does a dry cell battery work?

- A** Wind moves through the battery from north to south and creates electricity.
- B** *Electrons move from zinc to carbon creating electricity through a chemical reaction.*
- C** There is water inside the battery, and the hydrogen and oxygen react to form electricity.
- D** Coal burns inside the battery to create electricity.

Two things that are run by batteries are *Answers will vary.*

### 2. Which of these is a result of losing power?

- A** You won't have running water.
- B** Your flashlight won't work.
- C** You won't be able to play ball.
- D** *Your refrigerator won't keep food cold.*

The phone charger I designed will still work if the power goes out because *Answers will vary.*

### 3. Which of these is a type of renewable energy?

- A** Oil
- B** *Wind*
- C** Batteries
- D** Coal

We should try to use more renewable energy sources because *renewable energy sources are better for the environment, and they will never run out.*

Name .....

Date .....

# Electricity and Energy Summative Assessment



## PART A

**Directions:** There are two types of energy, renewable energy and nonrenewable energy. Read each word below and put “R” on the line if it is an example of renewable energy and “N” on the line if it is an example of nonrenewable energy.

- |       |            |       |         |       |             |
|-------|------------|-------|---------|-------|-------------|
| ..... | Water      | ..... | Solar   | ..... | Natural Gas |
| ..... | Geothermal | ..... | Coal    | ..... | Wind        |
| ..... | Oil        | ..... | Biomass | ..... | Nuclear     |

## PART B

**Directions:** Answer these questions using complete sentences.

Choose one of the types of energy from Part A. Explain how that type of energy is transferred to electrical energy. Name something it can be used to power.

.....

.....

.....

.....

Which type of energy should we try to use more of: renewable or nonrenewable? Why?

.....

.....

.....

.....

# Electricity and Energy Summative Assessment Answer Key

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## PART A

**Directions:** There are two types of energy, renewable energy and nonrenewable energy. Read each word below and put “R” on the line if it is an example of renewable energy and “N” on the line if it is an example of nonrenewable energy.

R	Water	R	Solar	N	Natural Gas
R	Geothermal	N	Coal	R	Wind
N	Oil	R	Biomass	N	Nuclear

## PART B

**Directions:** Answer these questions using complete sentences.

Choose one of the types of energy from Part A. Explain how that type of energy is transferred to electrical energy. Name something it can be used to power.

*Answers will vary.*

.....

.....

.....

Which type of energy should we try to use more of: renewable or nonrenewable? Why?

*We should try to use more renewable energy because we will never run out of renewable sources of energy, like the sun and wind. Renewable energy sources are also better for the environment and help us protect the planet.*

Name .....

Date .....

# Electricity and Energy Project Rubric

	4	3	2	1
<b>Project Planning</b>	The “Crazy Chargers” portion of the project lists five accurate ways cell phones can be charged without electricity. The “Invent a Charger” section includes well thought-out plans and materials for the phone charger.	The “Crazy Chargers” portion of the project has 4 accurate ways cell phones can be charged without electricity. The “Invent a Charger” section includes plans and materials for the phone charger.	The “Crazy Chargers” portion of the project has 2 or 3 accurate ways cell phones can be charged without electricity. The “Invent a Charger” section is missing the plans or materials.	The “Crazy Chargers” portion of the project has 0 or 1 accurate ways cell phones can be charged without electricity. The “Invent a Charger” section is missing the plans and materials.
<b>Project Design</b>	The students used the provided materials to create a detailed model of the phone charger. They used labels to name all of the materials that were used.	The students used the provided materials to create a model of the phone charger. One or two parts are missing labels.	The students used the provided materials to create a model of the phone charger, but there are no labels.	The students did not use the provided materials to create a model of the phone charger. There are no labels.
<b>Project Presentation</b>	The students clearly explained how the phone charger works in detail. They described the materials that are needed to make it.	The students explained how the phone charger works and named the materials that are needed to make it.	The students explained how the phone charger works, but it was confusing. They named the materials that are needed to make it.	The students didn’t explain how the phone charger works or the materials that are needed to make it.
<b>Reflection</b>	All three answers in the “Invention Reflection” portion of the project are complete and accurate.	Two of the answers in the “Invention Reflection” portion of the project are complete and accurate.	One of the answers in the “Invention Reflection” portion of the project is complete and accurate.	None of the answers in the “Invention Reflection” portion of the project are complete and accurate.

Teacher’s comments: .....

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.....



**Exploring Electricity and Energy**

# Student Pack



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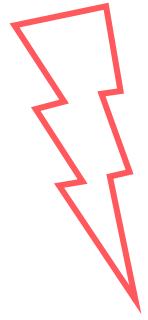
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# You Wouldn't Want to Live Without Electricity



**Directions:** Listen to the book **You Wouldn't Want to Live Without Electricity**. Use it to answer the questions.

What are four things that require electricity to work?

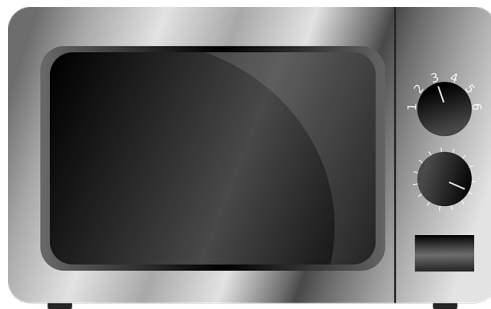
1. ....
2. ....
3. ....
4. ....

Which electric invention do you think is the most useful? Why?

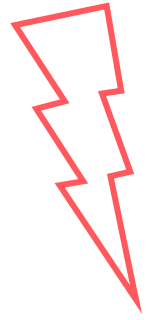
.....  
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Would you want to live without electricity? Why or why not?

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# Powering the Planet



**Directions:** Answer these questions as you watch the virtual field trip “Powering the Planet”.

1. What are two ways you use energy every day?

.....

2. What are two renewable energy resources?

.....

3. Answer the question from the video: How do we get energy?

.....  
.....

4. How do they use renewable energy on the Palmyra Atoll?

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.....

5. How do they use renewable energy in the Mojave Desert?

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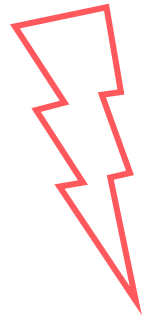
6. Answer the question from the video: What items in your home or school use energy?

.....  
.....

7. Why is it important to use more renewable resources to create energy?

.....  
.....

# A Time Without Power Writing



**Directions:** In the space below, write about a time when you were without power, either by choice (such as a camping trip) or due to an event (such as a weather-related power outage). How did you feel? What did you do while you were waiting for the electricity to come back on? How long did the power outage last? Why was it important to have a charged cell phone.

A large rectangular area enclosed by a red border, containing 20 horizontal dotted lines for writing.

Name ..... Date .....

# Milestone #1 Inquiry Question

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**Directions:** Use what you learned in this milestone to answer the question.

What are three things that require electricity to work, and why is it hard to live without them?

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# How to Do Good Research

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**Follow these steps when you are doing research online.**

1. Open your search engine and type in your keywords. These should be as specific as possible. For example, type in “phone chargers that don’t use electricity” instead of just “phone chargers”.
2. Click on the top link. Read the article and look for useful information to answer your questions.
3. When you find an answer, put the information in your own words. You can’t just copy what the author wrote. This is called plagiarism, and it can get you in trouble.
4. Keep reading the first website to find the answers to more questions.
5. When you get to the end of the article, click the back arrow to go back to your search results. Click on the second article and read it to find the answers to more of your questions.
6. Repeat these steps until you find all of the answers you need.

# Electric Spaghetti, Please

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**Making the Connection:** Sometimes understanding science involves looking at everyday things in a new light, in order to learn how things work.

Pretend you can put on a special pair of “Science Sensor” goggles to see how some of the things we do everyday actually work. Start by putting on the goggles before you get up in the morning. As you wake up, list the first five things you do that use some form of stored energy. Also list where that energy has come from.

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.....

.....

First thing in the morning, ask yourself: Is your house warm? Is the milk for your cereal cold? Are the red-yellow-green street signals working? Where is all that energy coming from?

.....

.....

.....

Most of us live in areas where the electricity is created by a large power plant. That power can be generated by the force of a river, or by burning coal, or any number of other ways. But who decides how much you and your family get to use? In America, people pay the electric company for power based on how much they use. The more electricity consumed in your house, the more money you pay every month.

Electricity makes life a lot easier. One hundred years ago, dishes were all washed by hand. So were clothes. There was music only when someone sang or played an instrument. There was no television to watch. Kids did their homework by candlelight, or gas light. It took a lot more human energy to get through the day, because we were not able to use nature’s energy so easily to help us out.

Now we are all wired, one way or another, to that power plant. Most of us do not think about that when we turn on the light. Once in a while, however, there is not enough power to go around. Sometimes during summer heat waves, or after big storms, power has to be lowered and spread around from area to area. If that happened in your area, who do you think should have power restored first?

Make a list of the most important five users of power in your town. Do not forget about hospitals, grocery stores, the police station, and other places that keep the town going.

.....

.....

.....

On another sheet of paper, make a rough map and put down the five most important power users. Use string to connect them to each other and the power plant to complete the circuit.

Where does that leave the rest of us? Sitting in the dark, eating food out of a can? How long could we manage without electricity?

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Maybe it would be more fair if the town took turns, section by section, each one getting power for a couple of hours every day. How would your family use its couple of hours?

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.....

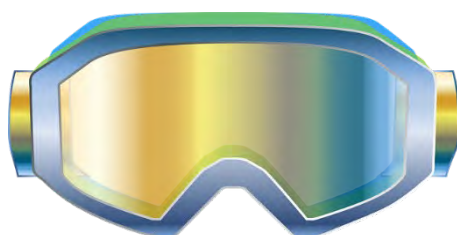
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Ok. The crisis is over. Draw some houses and other less important power users on your map and reconnect the rest of the town with string. Look at your map. If you could really see all of the power lines in your town, it would look like a plate of wire spaghetti with the power plant being the meatball in the middle.

Now take off the science sensor goggles. You have restored the power, and it is time for a break. Name the first two things you want to do with the power on again. You earned them!

.....

.....





Name .....

Date .....

# Power Map

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**Directions:** Use this page to draw your map for the “Electric Spaghetti, Please” activity.

# Energy Video



**Directions:** Watch the “Energy” video. Use the information to answer the questions.

What is energy? .....

What are two ways that your body gets energy? .....

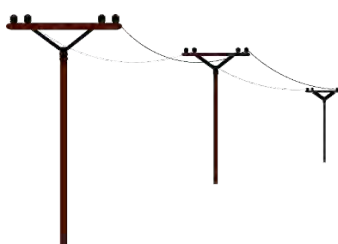
What is the difference between kinetic and potential energy? .....

Energy can neither be ..... nor ..... ,  
but it can ..... from one form of .....  
to another.

**Directions:** Work with your teacher to fill in the blanks.

..... energy is important to our everyday life and can be  
converted into many useful forms of energy, such as ..... energy,  
or heat.

Electric energy can be stored in ..... as chemical energy, and then  
used at a later time.



# Electricity and Energy Project Guidelines

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## Project Requirements:

- Research ways people have created cell phone chargers without using any electricity. Write about 5 of them.
- Invent and build a model of your own cell phone charger using your knowledge of energy transfer and power sources.
  - Draw a design for the phone charger.
  - Use feedback to improve your design.
  - Use craft supplies to represent the actual materials.
  - Label all of the parts.
  - Present your project and explain how the phone charger would work.

# Need for Inventions



**Directions:** Answer the question about inventions.

It is thought that perhaps Plato first used the phrase, “Necessity is the mother of invention.”  
What do you think Plato meant?

.....

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.....

## Crazy Chargers

Use the Internet to research ways people charge their cell phones without electricity.

Write your 5 favorite ways on the lines.

1. ....

.....

2. ....

.....

3. ....

.....

4. ....

.....

5. ....

.....

Name ..... Date .....

## Milestone #2 Inquiry Question

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**Directions:** Use what you learned in this milestone to answer the question.

What are two things at your house that use energy? What types of energy do they use? How do you know?

.....

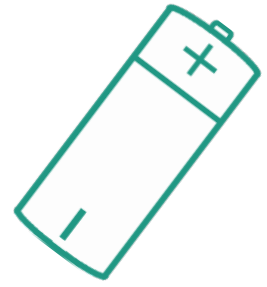
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# Types of Energy



**Directions:** Watch the “Types of Energy for Kids” video. Use the information to answer the questions.

1. What are three renewable sources of energy?

.....

2. What are the advantages of using renewable energy?

.....  
.....

3. What are the disadvantages of renewable energy sources?

.....  
.....

4. What are four nonrenewable sources of energy?

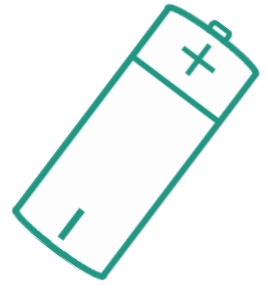
.....  
.....

5. What are the disadvantages of nonrenewable energy sources?

.....  
.....



# Inside a Battery



**Directions:** Read the information about batteries. Color the battery according to the color key. Then, fill in the blanks.

The batteries used in flashlights are called dry cells. Dry cells also run most battery-powered toys.

Dry cells work because of a chemical reaction. Zinc has more electrons than carbon. When you use a battery, electrons move from zinc to carbon. The electrons move through your lightbulb or toy and make it work. This is the flow of electricity.

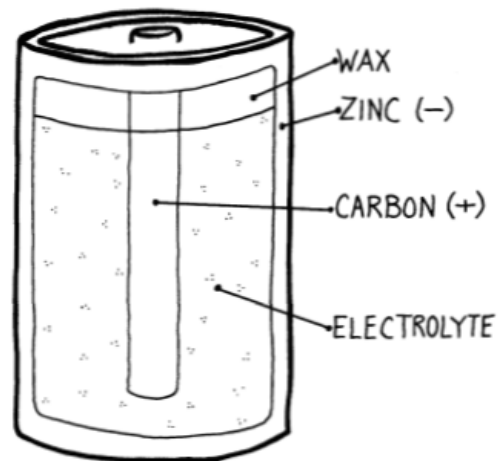
## Color:

**Carbon** - black

**Zinc** - blue

**Electrolyte** - red

**Wax** - yellow



1. A dry cell works because of a ..... reaction inside.

2. Electrons move from ..... to .....

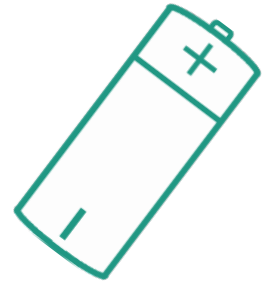
3. Name two things that use dry cell batteries.

.....

.....



# Invent a Charger



**Directions:** You and your group members need to invent a charger for the next time there is a widespread power outage. Think of things that are readily available in and around your home. Using your knowledge of energy transfer and the ideas you found while searching the internet, think of how you could create a charger for your cell phone. Think about what you learned about renewable resources. Write your group's ideas below:

List your materials in the box.

Explain how you would create the charger. Be sure to explain how you will put the parts together and how it will work.

.....

.....

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.....

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Name ..... Date .....

## Milestone #3 Inquiry Question

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**Directions:** Use what you learned in this milestone to answer the question.

What is something you own that uses batteries? How do the batteries work to power it?

.....

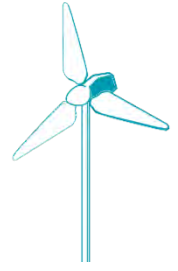
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# Emergency Supply Kit



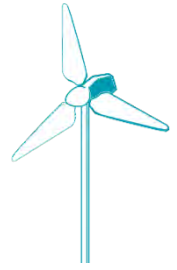
**Directions:** Read the article “How to Build a Kit for Emergencies”. In the box, draw and label at least 5 items you would put in an emergency kit for your family. At the bottom of the page, write a sentence explaining why you would include each item.

1. ....  
.....
2. ....  
.....
3. ....  
.....
4. ....  
.....
5. ....  
.....

Name .....

Date .....

# Design Your Charger



**Directions:** In the box, draw a picture of your phone charger. Label the parts to show what craft material you will use to make it and what real item it represents.

Share your phone charger design with your group. Have them offer suggestions to improve it. What is one thing you could change to make it better?

.....

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.....

.....

Name ..... Date .....

## Milestone #4 Inquiry Question

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**Directions:** Use what you learned from this milestone to answer the question.

How does your group's cell phone charger work?

.....

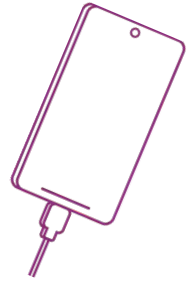
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# Invention Reflection



**Directions:** Think about the phone charger you invented. Answer these questions about how it could help in an emergency.

1. If you built your model with real materials, do you think it would work? Explain.

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.....

2. In an emergency situation, such as a hurricane, sometimes it takes days or weeks to restore power. How could your group's invention help emergency personnel and private citizens?

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3. What else could your group's invention be used for?

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# Milestone #5 Inquiry Question

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**Directions:** Use what you learned during this unit to answer the question.

What other inventions would be helpful to have on hand in the event of a widespread power outage? Name at least 3 and explain why they would be helpful.

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