

# CONNECT SCIENCE OVERVIEW

## Our Vision

We believe that high quality service-learning instruction engages and motivates students and teaches important science concepts and collaborative skills. Students who participate in service-learning gain the knowledge, attitudes and skills needed to become an engaged citizen and solve environmental challenges that lie ahead. We strive to support teachers' science instruction, boost students' collaborative skills, and spark students' interest in future civic work.



## Overview

### Purpose

Participants will explore the topics of energy and natural resources in depth, and try new ways of engaging their students in science that align with the three dimensions of the Next Generation Science Standards.

Participants will model and teach students the collaborative skills needed to work together to impact authentic problems in their community.

Participants will facilitate a high quality service-learning project with their students.

## Grade Level

### Fourth Grade

## Timeframe

### Project-Based Learning

Approximately 8 weeks of 30-60 minute daily lessons with students.

Teachers may customize the calendar in ways to match their class schedule and needs.

## Overview of the Connect Science Program

Students learn new concepts and skills through service-learning.

*Service-Learning involves 8 steps:*

- Step 1: Define service-learning.
- Step 2: Discover needs and problems.
- Step 3: Investigate problems.
- Step 4: Research solutions.
- Step 5: Decide on a project.
- Step 6: Plan the project.
- Step 7: Implement the plan.
- Step 8: Evaluate impacts.

## Connect Science 2018

**Participants Attend Trainings:**

- 4-day training in June 2018
- 1 day of professional development and reflection, August 2018
- Individual consultation and coaching with Tracy Harkins during implementation

**Participants Receive:**

- Sequenced lessons that target science, literacy, mathematics and social and emotional concepts and skills as they enact a successful service-learning project
- KIDS As Planners: A Guide to Strengthening Students, Schools and Communities Through Service-Learning, Revised and Expanded Third Edition (2011, KIDS Consortium)
- A set of materials needed to teach science lessons
- Read-aloud books to supplement the curriculum

**Expectations for Participation:**

- Participating teachers will implement a service-learning project with students in fall, 2018
- Teachers will attend all professional development opportunities (see above)

## Essential Understandings

Systems thinking can be useful in understanding interactions in the world and designing solutions to challenging problems.

Energy is present in different forms as it moves through natural and human-made systems.

Limited amounts of natural resources are available on earth. Each decision we make about our use of natural resources can have positive or negative impacts on the environment and other people.

Every citizen has a responsibility to find creative solutions to problems they notice in the world around them.

The best solutions arise when people with different knowledge and perspectives listen to each other, communicate respectfully, and collaborate to solve problems.

Kids can use their skills and knowledge to improve their community and our world by engaging in a service-learning project.

## Science Knowledge and Skills

### Disciplinary Core Ideas:

- Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. (NGSS PS3)
- Energy can be “produced,” “used,” or “released” by converting stored energy. (NGSS PS3)
- Energy and fuels that humans use are derived from natural sources. Some resources are renewable over time, and others are not. (NGSS ESS3)

### Science and Engineering Practices:

- Developing and Using Models
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Obtaining, Evaluating and Communicating Information
- Using Mathematics and Computational Thinking

### Crosscutting Concepts:

- Systems and system models
- Energy and matter: Flows, cycles and conservation

## English Language Arts Knowledge and Skills

**RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

**W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.

**SL 4.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

**SL 4.3** Identify the reasons and evidence a speaker provides to support particular points.

**SL 4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

## Collaborative Skills Instruction

### Social and Emotional Skills

Students learn to listen to one another, communicate respectfully, resolve conflict, give and receive feedback and understand that people have different perspectives.

Students learn skills needed to create and implement a plan, manage stress, make decisions effectively, persevere when work gets difficult, stay motivated and measure progress toward goals.

## Our Source Materials

Collaborative for Academic, Social and Emotional Learning (2017). *Core social and emotional learning competencies*. Retrieved from [www.casel.org/social-and-emotional-learning/core-competencies/](http://www.casel.org/social-and-emotional-learning/core-competencies/)

KIDS Consortium (2011). *KIDS as planners: A guide to strengthening students, schools and communities through service-learning* (3rd ed.). Waldoboro, ME: Harkins Consulting.

National Research Council (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press, doi:10.17226/13165.

# 1.4 RESPECTFUL COMMUNICATION

## Lesson Summary

Students will be able to use respectful language to agree, disagree, and ask questions about other students' ideas. Group work can be challenging and it is essential for students to learn respectful ways to agree and disagree with each other. Further, respectful language is important in science as students question each other's lines of reasoning in their search for high quality scientific explanations of phenomena. Learning and practicing sentence stems to agree, disagree and ask questions will help students prepare for the challenges of group work.

*(Approx. total time: 40 min.)*



## Standards

### Social and Emotional Competencies

**Social Awareness:** The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.

**Relationship Skills:** The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.

**Self-management:** The ability to regulate one's emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.

*Excerpted text from CASEL (2017).*

## Objectives

### By the end of the lesson students will

**Know (facts/information):**

- Respectful communication sentence stems and respectful language.

## *Understand (concepts, big ideas):*

- The best solutions arise when people with different knowledge and perspectives listen to each other, communicate respectfully, and collaborate to solve problems.

## *Be able to do (skills/behaviors):*

- Use respectful language to agree, disagree and ask questions about other student's ideas.
- Show respect, even when they disagree with another student's ideas.
- Communicate needs and feelings verbally (MNPS 4th Grade SEL "I Can" Statements).

## Vocabulary

- **respectful communication:** a way of speaking, listening and behaving toward others that shows that you care about them and that you are open to their ideas

## Materials

- Teacher Materials:
  - Chart paper
  - Marker
  - Respectful Communication Anchor Chart
  - Respectful Communication Image - Can be used on anchor chart, interactive whiteboard or printable for students

## Instructional Strategies

### Link to Prior Knowledge (5 minutes)

**Introduce the idea that disagreements occur often during group work and that it is okay to disagree.**

*We are going to start with a short activity to get you thinking about situations that may happen when you are working with others. I'm going to say some statements about working with groups and you are going to give me a thumbs up if you agree with the statement, a thumbs down if you disagree, and a thumb in the middle if you are not sure.*

1. *Group members always have to agree with each other.*
2. *If you agree with someone, you should tell him or her.*
3. *If you disagree with someone, you should tell him or her.*
4. *It is okay to disagree with someone.*
5. *There is a respectful way to tell someone that you disagree with them.*

## 1.4 RESPECTFUL COMMUNICATION

*I noticed that some of you said that group members always have to agree with each other. Did you know you don't ALWAYS have to agree with each other? It is important to know that in group work people often disagree. That's a normal part of group work. If people in a group care a lot about their shared work, disagreements can be really common.*

*Many of you did think that if you disagree with someone you should tell them and that there is a respectful way to tell someone that you disagree with them. That is a very important idea.*

**Ask students to talk about how to show respect when they disagree with someone. Explain that even if we disagree, we want to communicate in ways that show respect.**

*Let's take a minute to yourself and think of a way that you could tell a classmate that you disagree with them, but do it in a way that shows respect. When you have an idea, give me a thumbs up on your knee. Share with your partner your idea. Ask your partner how they would feel if you expressed disagreement in this way. Would you feel respected?*

### Instruction (30 minutes)

**Display and explain the image of the person with the thought bubble and the speech bubble.**

*This picture really helps me think about respectful communication. There have been times that I have thought something in my head, but I realized it wouldn't be respectful to say out loud. Has that ever happened to you?*

*I might disagree with someone and think (point to thought bubble), "No! You are wrong!" (Or, I might even get really mad and not be able to think of anything to say!)*

*But, instead, I pause. Then, I use respectful communication to disagree and say (point to speech bubble), "I see why you might think that. But, have you ever thought of trying it like this?"*

*Sometimes I think and pause. Then, I use respectful communication to learn more about the person's idea. Maybe it is a good idea, but I need to hear the whole idea before making a decision. Then, I would say (point to speech bubble), "Can you say more about that idea?"*

**Define respectful communication.**

*Respectful communication is a way of speaking, listening, and behaving toward others that shows that you care about them and that you are open to their ideas.*

## Introduce sentence stems as a way to help us communicate respectfully about ideas.

*Communicating respectfully with each other is an important part of group work, especially when we disagree. Respectful communication is important because it allows you to express your thoughts and feelings and have good relationships with your classmates. Today we are going to learn about sentence stems. Sentence stems give us a new way to communicate respectfully. We are going to create and practice sentence stems so that we can use them to help us be respectful while collaborating. This helps us to filter our thoughts to make sure the words we choose are respectful words and convey our meaning.*

## Start an anchor chart for sentence stems you would like your class to use. Create three categories on the anchor chart (agree, disagree, and ask questions).

You will be adding sentence stems to this chart with input from your class. Ask your students for input and then choose sentence stems that you think your students will be able to use well.

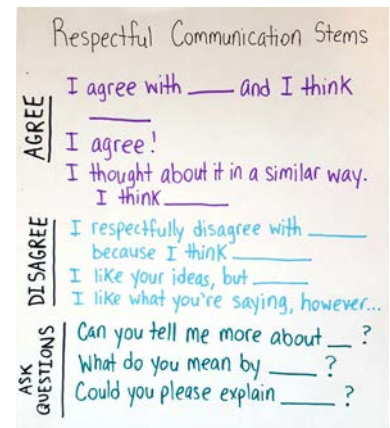
## Have students generate and share what words to use when you agree.

Reword the student phrases (if needed) and write two or three sentence stems to use to agree.

Example goal responses:

“I agree with \_\_\_\_\_ and I think that \_\_\_\_\_.”

“I like what you are saying and \_\_\_\_\_.”



*Sometimes when you're working in a group and you hear an idea that you really like, you may want to share that you're enthusiastic about this idea. You can use one of these sentence stems to agree with someone.*

## Have students generate and share what words to use when you disagree.

Reword the student phrases (if needed) and write two or three sentence stems to use to disagree.

Example goal responses:

“I hear your idea but \_\_\_\_\_.”

“I thought about it in a different way and \_\_\_\_\_.”

“I'm sorry but I disagree with \_\_\_\_\_ because I think that \_\_\_\_\_.”



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*Remember that when we're working as a group, we don't always agree and that's okay. Before you disagree, it is important that you listened carefully to what someone else said. Then, if you disagree, you can use a sentence stem like, "I hear your idea but..." to show respect while you explain that you have a different opinion.*

### Have students generate and share what words to use when you ask questions.

Reword the student phrases (if needed) and write two or three sentence stems to use to ask questions.

*Learning how to listen and ask good questions about other people's ideas is an especially important skill in science. Questions help you learn more about the ideas that someone else is proposing and help you understand their line of reasoning. Instead of agreeing or disagreeing with someone's idea, asking questions helps you deepen the conversation to fully understand what someone else is thinking. Adult scientists work hard to listen carefully to other people's ideas and ask good, precise questions.*

Example goal responses:

"Can you say more about \_\_\_\_\_?"

"What did you mean by \_\_\_\_\_?"

### Create a simple example. Model the use of each statement from the anchor chart.

*Let's take a simple example. Let's say that my friend and I are talking about parks and I think that parks with big empty spaces are nicer than parks with lots of trees. My friend might say, "I like parks with big empty spaces because I like to play soccer and run and play." I could use a sentence stem and say, "I like what you are saying and I think parks with big empty spaces are nice, too."*

*What if my friend says, "I like parks with lots of trees because I think the trees are better for the earth." I may think that parks with trees are boring. Instead of telling my friend that she is wrong, I would say, "I hear your idea, but I like parks with big open spaces because I like to play frisbee."*

*My friend might say, "I like parks with big empty spaces because I like to play soccer and run and play." I could add on to my friend's idea and say, "I'd like to add on to your idea. Big empty spaces are good for soccer and to run and play. Big open spaces are good for frisbee, too, and I like to play frisbee. Big spaces help kids like us get exercise and time outdoors and that helps us be healthy."*

### Have students practice sentence stems with a partner.

Ask students to choose a partner. Provide them with a topic. Have each student use the sentence stem to agree with the topic. Then, have each student use the sentence stem to disagree with the topic. Have each student use the sentence stem to add on to the topic.

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Sample topics may include:

- I think all kids should ride the bus to school.
- I like to pack my own lunch (versus buy lunch in the cafeteria).
- All kids should have their own cell phone.
- Kids should have TV in their room.

Note: Point out the active listening skills anchor chart to remind students to practice these skills, as well.

### Closing (5 minutes)

**After the students practice, call on a pair of students who used sentence stems effectively to share with the class.**

*Let's hear about your conversation about taking the bus to school. \_\_\_\_\_, why don't you explain that you think all students should take the bus to school.*

*Then, \_\_\_\_\_, let's hear you use a sentence stem to agree with your friend.*

*Then, let's hear you use a sentence stem to disagree. Next, use your sentence stem to ask questions about your friend's idea.*

**Reflect on respectful communication. Discuss how it is especially challenging to be respectful when you disagree.**

*Let's talk about respectful communication and your use of these sentence stems. Did the sentence stems help you show respect? How?*

*Did anyone notice that it is harder to be respectful when you disagree with someone's idea than when you agree? Why do you think that's the case?*

*What did you notice about your feelings and body language when you used these sentence stems? Do you think you will be able to use these sentence stems when you are talking about ideas in your science class or other subjects?*

*What did you notice about the sentence stem for asking questions? Do you think that using this sentence stem can help you have better conversations about ideas in science?*

*Let's take a look at our chart we made today with these new sentence stems. Throughout the day today, I'm going to listen and notice when I hear you using these stems as you communicate respectfully with your classmates. At the end of the day, we will revisit the sentence stems and see how many we used. We will look at which ones we used, which ones were easy or difficult to use, and how we can use these in the future. If you think of more sentence stems, you can write them down on a sticky note.*

### Assessment

Notice and record instances when you see students using sentence stems for respectful communication with their peers. Refer to anchor chart and remind students to use sentence stems in future weeks.

### Optional Extensions

Practice the sentence stems before science class and show how these stems can be used to help students engage in arguments from evidence. For instance, if one student is saying that plants growing in soil with compost added will grow faster than plants growing in plain soil, another student can use the sentence stem and say, "I agree with you because compost gives the plants extra nutrients they need to grow." Alternatively, a student can say, "I thought about it in a different way and I think plain soil has enough nutrients for the plants, so they will both grow at the same rate." Students can practice asking questions by asking, "Can you say more about why you think compost helps plants grow?" Or, "What did you mean when you said that compost has nutrients?" Here's another example. If one student is saying that paper bags are better than plastic bags, another student can use the sentence stem and say, "I agree with you because paper bags are made from renewable resources." Alternatively, a student can say, "I thought about it in a different way and I think plastic bags are better because we do not have to cut down trees to make them." Students can practice asking questions by asking, "Can you say more about why people should choose plastic bags?" Or, "What did you mean when you said that paper bags are made from renewable resources?"

### References

Collaborative for Academic, Social, and Emotional Learning. (2017). *Core social and emotional learning competencies*. Retrieved from <http://www.casel.org/social-and-emotional-learning/core-competencies/>

### Planning Page

**Students will be able to use respectful language to agree, disagree, and add on to other students' ideas.**

#### Link to Prior Knowledge (5 minutes)

*Introduce the idea that disagreements occur often during group work and that it is okay to disagree.*

*Ask students to talk about how to show respect when they disagree with someone. Explain that even if we disagree, we want to communicate in ways that show respect.*

#### Instruction (30 minutes)

*Display and explain the image of the person with the thought bubble and the speech bubble.*

*Define respectful communication.*

*Introduce sentence stems as a way to help us communicate respectfully about ideas.*

## 1.4 RESPECTFUL COMMUNICATION

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*Start an anchor chart for sentence stems you would like your class to use. Create three categories on the anchor chart (agree, disagree, and ask questions).*

*Have students generate and share what words to use when you agree.*

*Have students generate and share what words to use when you disagree.*

*Have students generate and share what words to use when you ask questions.*

*Create a simple example. Model the use of each statement from the anchor chart.*

*Have students practice sentence stems with a partner.*

### **Closing (5 minutes)**

*After the students practice, call on a pair of students who used sentence stems effectively to share with the class.*

## 1.4 RESPECTFUL COMMUNICATION

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*Reflect on respectful communication. Discuss how it is especially challenging to be respectful when you disagree.*

# 2.3 RENEWABLE ENERGY SYSTEMS

## Lesson Summary

Students will be able understand how electricity is made from solar and wind energy sources. They will be able to draw diagrams to communicate models of how energy systems work to make electricity. They will be able to use observations from their investigation to support an explanation of how energy might flow through a solar energy system.

*(Approx. total time: 90 minutes)*



## Standards

### NGSS Cross Cutting Concepts

#### Energy and Matter

Energy can be transferred in various ways and between objects.

#### Systems and System Models

A system can be described in terms of its components and their interactions.

### NGSS Disciplinary Core Ideas

#### PS3.A: Definitions of Energy

Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)

#### PS3.B: Conservation of Energy and Energy Transfer

Energy is present whenever there are moving objects, sound, light, or heat. (4-PS3-2), (4-PS3-3)

Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. (4-PS3-2), (4-PS3-4)

### NGSS Science and Engineering Practices

#### Planning and Carrying Out Investigations

Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

#### Developing and Using Models

Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

Use models to describe phenomena.

### Objectives

**By the end of the lesson, students will**

***Know (facts/information):***

- Wind and the sun are energy sources that can produce electricity.
- A system is needed to convert an energy source into electricity.
- Models represent ideas.

***Understand (concepts, big ideas):***

- Energy is present in different forms as it moves through natural and human-made systems.
- Systems thinking can be useful in understanding interactions in the world and designing solutions to challenging problems.

***Be able to do (skills/behaviors/scientific and engineering practices):***

- Draw a diagram of a simple energy system.
- Give evidence and observations to support their ideas.
- Listen actively to one another.
- Respectfully communicate with one another.

### Vocabulary

- **energy source:** a material that can be used to produce electricity or heat for human needs
- **renewable resource:** a resource that can be replaced or restored naturally
- **model:** a representation of an object or a system that is used to communicate ideas

### Materials

- Student Materials:
  - Chart paper and markers (optional)
  - Solar Panel with wire and alligator clips
  - DC motor
  - Fan blades
  - Wind Energy System and Solar Energy System Worksheets
  - Wind Power video: <http://www.pbs.org/video/nova-wind-power/>
  - Active listening anchor chart.
  - Respectful Communication STEM's anchor chart.



### Instructional Strategies

#### Link to Prior Knowledge (15 minutes)

##### Review systems thinking.

*Does anyone remember when we explored the lamp as a system? What were the other systems? What are some of the words that we use to describe a system? How were the systems similar? How were they different?*

Make sure that students mention each type of system and tell you that the inputs were all the same (electricity), but the outputs were all different. They may also indicate that some components were the same, like the plug and the cord, but other components were different, like having blades or a speaker. For extension, relate the different components to different outputs. Sound came from a speaker, motion came from blades, light came from the bulb, and heat came from a heating element.

Write the words on the board or refer to the word wall as students provide them: energy system, components, evidence of energy (light, heat, sound, and motion), input and output.

*Today we are going to talk about two systems that produces that input that so many things use—electricity. We are going to learn about the renewable energy systems that use the sun and the wind to make electricity. Instead of talking about electricity as an input, today we will talk about it as the output.*

#### Instruction (60 minutes)

##### Model the wind system together.

Get the video about wind power ready: <http://www.pbs.org/video/nova-wind-power/>

*We are going to watch a video about wind power together. I want you to listen closely to how a wind makes electricity. Think about the input, the output, the components and the evidence of energy in the system.*

Point to the words written on the board from the prior knowledge. Point to the active listening anchor chart and review what active listeners look and sound like. Play the entire video.

*Can anyone name a component of the wind energy system? Can anyone name the output? The input? What are some evidences of energy? Those are great ideas, but we need to be absolutely sure because we are going to draw a model of a wind system. Let's watch part of the video again.*

Write down their suggestions (any suggestion, right or wrong) on the board next to systems words from the prior knowledge section. Play the video again, but only the part about how the wind energy system works (sec 24- sec 59 of the video).

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Now, you are going to brainstorm and draw a model. Turn to your partner and discuss how you think this energy system works. Then draw a model of the system labeling the input, output, evidences of energy in the system and the components. Scientists use models to describe what they are thinking. **A model is a representation of an object or a system that is used to communicate ideas.**

Hand out the wind energy system worksheet. Allow the students to get to a point of drawing the system and labeling some of the components in their science notebook. Go around as they are drawing and guide them in which components to include in their model. Generally, the system should include the wind as an input, the turbine (with blades), and a generator. They may also include the shaft and wires.

Ask a group of students to come to the board or use chart paper and draw their system (or project it) labeling the components, input and output. Once the students have drawn the system, reiterate, using their model, how the wind energy system works to produce electricity. As you explain, write the function of each component next to the label.

*The purpose of this system is to make electricity so electricity is the output. The system uses the wind (the input) as an energy source to make electricity. **An energy source is a material that can be used to produce electricity for human needs.** Wind is one type of **renewable energy source meaning that we can use it and it will not run out.** Remember that each component has a function. Wind cannot make electricity without this system.*

*In the video it says that the wind turbines are designed to convert wind energy into electricity. The wind is the energy source and we know it has energy due to the movement of air that we feel. The blades catch the wind and turn the wind into the motion of the spinning turbine. The spinning turbine spins a generator and the generator turns that motion into electricity. Often in an energy system the components are there to turn one type of energy into another type of energy. The wires allow the electricity to flow to places to be used.*

If time allows let the students make notes on their own diagrams about functions.

### Model the solar energy system.

*Now we are going to build, use and draw a model of our very own solar energy system. Here are the components that you will use to build your system. Do you know what each of these components are? What do you think they do?*

Give each pair of students a solar panel with wires, the motor and the blades and the worksheet. Allow them to touch and talk about what they think each component is and what function each component might have. Then give them time to assemble the components together and draw a model of the system. Have them draw the model on the solar energy systems worksheet.

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*Now your system is put together, is it working? What evidence do you have to support your claim? What do you think we need to get this to work? Right! We need sunlight. We need to go outside to make it work.*

*While we are outside, I want you to observe like a scientist. Take in details and ask yourself questions as you observe. Ask questions like: When is the system working and when is it not working? Does the system work better under some conditions than other? Make sure that you have specific evidence to answer those question. That evidence comes from your observations. For example, we said that the system is not working inside. What observation did you make that supports what I said? Right! The blades are NOT moving or in other words there is not evidence of energy in the system so I know the system is not working. Take your science notebook with your solar energy system so that you can write down some of your observations.*

Take the class outside as the solar panels will not work as well and often not at all in artificial light. Go to each group and ask them how they think the system is working: What is the energy source? What is the purpose of the solar panel and the motor? How do they know when the system is working (what is the output)? For students farther along, have them change the angle of the panel to the sun or cover up part of the panel. Ask them what the different blade speeds mean. Return to the classroom.

*Now we are going to complete your model. Your model is not just a picture of the system it should communicate how the system works. Specifically, your model should answer the question: How does the solar energy system make electricity?". Make sure to label the input, the output, and the name of all the components. On the other side of the worksheet write the name of each component and write a sentence about what you think its function might be. Other students are going to be looking at your model so make sure that all your system parts are drawn clearly. When we display the models, use one partner's worksheet to show the diagram and the other partner's worksheet to show the sentences.*

Have the students hang their model up around the room for a gallery walk. Ask students to walk around the room with their partners and talk about how some of the models are the same and some are different. Circulate with them and note differences in the models with the students. Bring them back together as a class.

*Now that we have seen every group's model, are there any questions that you have about how this system might work? A good way to start this is to would be to use some of the asking questions stems from our respectful communication chart.*

Point to the respectful communication stems and remind students to use respectful communication as they discuss each other's work. The 'asking questions' section is a good place for students to start. Allow the students to ask specific questions about the models, and allow the other students to answer. Only guide enough to keep them on track with the concept "how does the solar energy system make electricity".

This is an important part of building their conceptions. It is not yet important that they 'get it right'. It is more important that they try to understand, ask question and give explanations on their own. Both the models and the discussion acts as a formative assessment allowing you to see how their ideas about systems and energy are developing. As you guide make sure to look for points to expand on their emergent understanding. When they make claims with no evidence ask them to tell you more, or elaborate on why they are making that claim. Your aim is to bring some of the forming ideas to the forefront of the class so that they can talk through

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their emerging concepts together much like scientist do. Once you have worked through the major differences seen in the displayed models ask them:

*From our discussion about “How does the solar energy system make electricity?”, would you want to make any changes to your current model.*

Here you may either lead a discussion about what those changes might be, or you can allow them some time to make those changes on their poster. If you decide to allow the change making, encourage them to cross out their old ideas with one line so they can still be seen. Tell them that this is exactly what scientist do. They make observations, construct a model, discuss the model with others and come up with new ideas. Scientists are always revising models; no model is perfect.

### Closing (15 minutes)

#### Lead a discussion that recaps the major components of the two renewable energy systems.

Ask students to have their model drawings out. Start by leading a discussion around both energy systems.

*The purpose of both systems was to make electricity. What was similar and different about how each system made electricity?*

Some discussion points might be: They use different energy sources. The solar panel converts sun energy into electricity, but the turbine and generator are needed to convert wind into electricity. The solar panel both collects sun energy and converts it to electricity while the blades of the turbine collect wind energy, but a generator is needed for conversion to electricity. They both made electricity from renewable energy sources. Both systems could be used to power the same motor and the evidence of energy was the movement of the fan.

*Who would like to volunteer to draw a model of the solar energy system and explain how it works to make electricity?*

Allow a student to take the class through the system one more time. Either have them draw a new model larger on the board or project their current model to aid in explanation. Ask students to listen actively for use of science words like energy source, renewable energy, component, function, input and output. Once the student is done explaining, ask if the group has anything they would like to add to the explanation.

Alternatively, depending on time and where you think your students are at the end of this lesson, you could draw and summarize the solar energy system on a piece of chart paper. Generally, you might want to say:

## 2.3 RENEWABLE ENERGY SYSTEMS

The solar energy system that we made uses the renewable energy source, sunlight, to make electricity. First, sun light hits the solar panel and the solar panel turns the sunlight into electricity. Then that electricity flows down the wires to the motor where the motor turns the electricity into a spinning motion. We can easily see the evidence of energy, the output, as the blades spin. When the blades spin faster there is more energy in the system and when the blades spin slower there is less energy in the system.

### Assessment

Listen to pair dialogue looking for use of vocabulary and science principles particularly as they do their gallery walk and during the whole class discussion. Look at diagrams and explanations at all steps.

### References

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### Planning Page

Students will be able to make models of renewable energy systems and use observations as evidence to support their ideas.

#### Link to Prior Knowledge (15 minutes)

*Review systems thinking.*

#### Instruction (60 minutes)

*Model the wind system together.*

*Model the solar energy system.*

#### Closing (15 minutes)

*Lead a discussion that recaps the major components of the two renewable energy systems.*

# 2.7 RESPECTING MULTIPLE PERSPECTIVES

## Lesson Summary

Students will be able to identify and analyze different points of view and respect and value perspectives that are different from their own. The teacher will read and discuss *The Sandwich Swap* to show how two children can have different points of view on the same situation. The class will generate sample situations involving more than one point of view. Students will learn strategies to discover more about other people's perspectives and show respect for those perspectives.

(Approx. total time: 50 minutes)



## Standards

### Social and Emotional Competencies

**Social Awareness:** The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.

*Excerpted text from CASEL (2017).*

## Objectives

### By the end of the lesson students will

#### **Know (facts/information):**

- People have different perspectives and these perspectives stem from people's past experiences, attitudes, preferences, and beliefs.

#### **Understand (concepts, big ideas):**

- The best solutions arise when people with different knowledge and perspectives listen to each other, communicate respectfully, and collaborate to solve problems.

#### **Be able to do (skills/behaviors):**

- Identify and analyze different points of view.

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

- Respect and identify other people's perspectives and behaviors (MNPS 4th Grade SEL "I Can" Statement).
- Evaluate social situations based on expression and body language (MNPS 4th Grade SEL "I Can" Statement).

### Vocabulary

- **perspective:** a person's point of view or how one person thinks about a situation
- **respect:** to think and act in a way that shows others you care about their feelings and their well-being

### Materials

- Teacher Materials:
  - *The Sandwich Swap* by Queen Rania of Jordan Al Abdullah and Kelly DiPucchio (If the book is not available, use a version available online, such as: <http://tinyurl.com/Sandwich-Swap>)
- Student Materials:
  - Respecting Multiple Perspectives Chart
  - Respecting Multiple Perspectives Student Reflection Handout

### Instructional Strategies

#### Link to Prior Knowledge (15 minutes)

Read *The Sandwich Swap*. Pause to ask questions about how Salma and Lily have different experiences. Help students link Salma and Lily's experiences to their own lives.

*In a few weeks, we will start working on our service-learning project. When we do, we will find that the students in our class have many different opinions about how to do our work. Today I would like to share with you a book by Queen Rania of Jordan Al Abdullah called, *The Sandwich Swap*. This book will help us understand the importance of respecting multiple perspectives and working together with people who have different opinions than our own.*

Sample questions to ask:

*How do you think Lily and Salma felt when their friend described their sandwich as yucky? Look at their faces in this picture. What do their expressions say about how they feel?*



## 2.7 RESPECTING MULTIPLE PERSPECTIVES

*Have you ever been in a situation where two friends had different opinions and you felt you had to choose sides? This part reminds me of when we learned about respectful communication. Lily and Salma are thinking things in their heads that they shouldn't say aloud.*

*Look closely at the picture. What event did Salma and Lily decide to hold at school? Why do you think they decided to do this?*

*Do you think everyone is going to like every food they try? Is it okay not to like the same things? Sure, of course it's okay not to like the same things.*

*Everyone brings their own life experiences to everything that they do. Some things that are important to one person might not be important to another person.*

*Remember, we don't always have to agree with every other person in our group but we do need to listen to and respect their perspective, even if their perspective is very different from our own. We always treat others in a way that shows that we respect them, even if we do not like their ideas.*

**Discuss the feelings the two girls had and help the students connect those feelings to their own past experiences.**

*Salma and Lily felt frustrated and annoyed toward each other. Have you ever felt frustrated or annoyed toward a friend or family member who liked something different from what you liked? Yes, that can be frustrating, can't it?*

*But, let's think about it. It is okay for two people to have different perspectives on something. Can you both be correct in your feelings?*

*When we work on group projects (like the service-learning project that we will do in a few weeks), we will encounter people that look at the same situation differently.*

*Let's reflect, have you ever had this situation before?*

### Instruction (30 minutes)

**Define perspective. Give an example of when people have different perspectives in your classroom.**

*Everyone brings their own life experiences to everything that they do. Some things that are important to one person might not be important to another person. We always treat others in a way that shows that we respect them, even if we do not like their ideas.*

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

We also want try to understand other people's perspectives. **Perspective means a person's point of view or how one person thinks about a situation.** If we only see a situation from our point of view, then we can't learn from other people and we can't appreciate other people's opinions and interest. Just like *The Sandwich Swap*, if Salma and Lily took a moment to respect each other's point of view, some of their arguing could have been resolved. They would have appreciated each other more and been able to get along better. This is an important life skill. Different people having different perspectives make our lives much more interesting.

### Define respect.

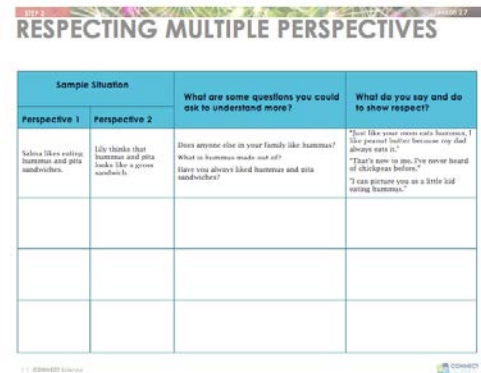
**Respect means to think and act in a way that shows others you care about their feelings and their well-being.** Even if we don't necessarily agree with someone, it is important that we show respect to one another.

### Introduce the Respecting Multiple Perspectives chart.

Now let's take some time to try to understand some ideas from other perspectives. Let's think about how Lily and Salma learned to respect each other's perspectives. Then, we will think about some sample situations that could come up in our classroom.

This chart can be shared on an interactive white board, created on chart paper, or completed with a document camera. Distribute copies of the chart to students.

**As a class, discuss the sample situation from *The Sandwich Swap*. Generate questions Lily could ask Salma to understand more. Brainstorm what Lily can say or do to show respect to Salma.**



Sample Situation		What are some questions you could ask to understand more?	What do you say and do to show respect?
Perspective 1	Perspective 2		
Salma likes eating hummus and pita sandwiches.	Lily thinks that hummus and pita looks like a gross sandwich.	Does anyone else in your family like hummus? What is hummus made out of? Have you always liked hummus and pita sandwiches?	"Don't like your meaty rats hummus, I like peanut butter hummus and egg and always eats it." "That's nice to see. I've never heard of chickpeas before." "I can picture you as a little kid eating hummus."

Let's look at the first example together. In *The Sandwich Swap*, Salma and Lily had different perspectives about Salma's hummus sandwich. Salma enjoyed eating her hummus and pita sandwich, but Lily thought the sandwich looked gross. Instead of being mean to Salma and saying, "Your sandwich looks gross!", Lily can ask her some questions.

What are some questions that Lily can ask Salma to understand more? Some things that I thought of were: Does anyone else in your family like hummus? What is hummus made out of? Have you always liked hummus and pita sandwiches? These questions can help Lily find out more about Salma's perspective.

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

*Next, what are some things Lily might do or say that show she is being respectful of her friend? A few things she might say are: "I never thought of that. Just like your mom eats hummus, I like peanut butter because my dad always eats it," or "That's new to me. I've never heard of chickpeas before," or "I can picture you as a little kid eating hummus."*

*We need to respect others' perspectives, but it is also important to think about why we should show respect. In this instance, some families prefer to eat hummus because it is a traditional food in their culture.*

*People bring their own life experiences to form their beliefs and opinions. We can learn from each other by asking these questions. We don't always have to agree, but we can learn. For example, maybe you didn't know that Salma's mom grew up eating hummus and pita sandwiches with her own parents. Now, through asking respectful questions and showing respect for others' choices, we've learned something new. This can add to or change our own opinions as well.*

The goal is to help students see that they can respect someone else's perspective, even if they would not make the same choice for themselves.

### Discuss a second sample situation with questions and respectful responses.

Model another example about two people with different perspectives. Discuss the example and complete the second row of the Respecting Multiple Perspectives chart as a class. A second sample situation could include differing opinions about becoming an airplane pilot.

- Perspective One: "My friend wants to be an airplane pilot when she grows up."
- Perspective Two: "I think being an airplane pilot would be a scary job."

*Let's imagine that two students are discussing what they think about becoming an airplane pilot. One student says that their friend wants to be a pilot when they grow up, but the other student thinks that being an airplane pilot would be a scary job. Let's look at our chart together and fill out the boxes. What are some questions that the students could ask to understand more? How can they respond to these questions in a way that shows they respect each other's perspective?*

#### Sample Questions:

- When did you first want to become an airplane pilot?
- Being an airplane pilot sounds scary to me. Does that scare you?
- What do you think you would enjoy about being an airplane pilot?

#### Sample Responses:

- "What an interesting idea. I've never been on a plane before. I wonder if my perspective will change if I go on a plane."
- "Thank you for teaching me about this. I never would have thought what that would be like."

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

### Generate two more sample situations and complete the chart.

Generate two more sample situations and allow your students to generate ideas to complete the chart. Continue through the exercise with the class as a whole group or have students partner with someone near them and then share answers before writing them down. This can also be done as an independent activity where students reflect individually about each perspective and then share with a partner or small group.

For the Sample Situation column, choose examples that are relatable for students. A good sample situation is one that is a behavior or preference that students in your class may experience. Avoid sample situations that promote stereotypes or are one-sided (with one option as clearly better than the other).

Examples of good sample situations are:

- I like sharing a room with my little brother.
- I am a vegetarian.
- I prefer to wear shorts, even in the winter.

Also, for the Sample Situation column, you may choose examples relevant to energy use.

- My family tries to save money and gas by taking the bus when we want to go somewhere.
- When I am cold at home in the winter, I put a sweater on instead of turning up the heat.

If time allows, provide opportunities for students to share their responses with the class.

### Closing (5 minutes)

### Draw attention back to *The Sandwich Swap* and discuss situations where people have different perspectives.

*Today we read *The Sandwich Swap* and discussed situations where people had different perspectives. We will be working on a service-learning project this year and there may be times in our work where others in our work group see things from a different perspective. We know this will happen so we need special skills to handle this situation.*

*Is it always easy to see both sides of every situation?*

*Were some situations harder than others? Why do you think that?*

*Let's go back to *The Sandwich Swap*. If Lily had grown up with food like the food in Salma's house, how might things have been different?*

*If Salma had grown up with food like the food in Lily's house, how might things have been different? How could they have each learned by looking at the situations through each other's perspective?*

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

**Optional: Distribute student reflection handouts and lead an exercise to help students take other people’s perspectives.**

*I am passing out a Student Reflection Handout for each of you. I want you to think about a time when you disagreed or got into an argument with your brother, sister, cousin or friend. The Student Reflection Handout says "friend or sibling" but in your mind, you can substitute cousin or another person in the story in your mind.*

*Write one or two sentences about a time when you disagreed or got into an argument with a friend or sibling. Now, take your friend or sibling's perspective. What do you think your friend or sibling was thinking and feeling in this situation? Write about that. Looking back, what do you think you could have done or said differently to respect your friend or sibling's perspective? If you had been more respectful, do you think things would have turned out differently? Explain what you mean.*

*For example, I am writing: One time my sister and I were in a huge fight over the bathroom. She was always taking a long time doing her hair and I needed to get in there to take a shower. I just kept pounding on the door and she kept it locked and ignored me. I needed to take a shower to get to school on time. She didn't get it. When I thought about it from her point of view, I realized she had an important job interview and was trying to make her hair look perfect. She also was stressed out and was short tempered because of it. Maybe if I had asked her nicely or helped her with her hair first, I could have gotten into the shower sooner and would not have had an argument before school.*

### Assessment

Notice and record evidence that students are noticing and respecting different perspectives.  
Read and reflect on the responses on the Student Reflection Handout.

### Optional Extensions

Make a connection to Language Arts. In *The Sandwich Swap*, the author chose to write about a small moment in her life that had a big impact on her point of view. Challenge students to write about something that seemed little but helped them to learn or understand a lot about themselves or others.

Adaptation: The Student Reflection Handout can be done in pairs with one student writing and another student telling his/her story. Alternatively, pairs of students can talk through the questions on the Student Reflection Handout instead of writing responses to them.

### References

Abdullah, A. R. (2010). *The Sandwich Swap*. New York: Disney Hyperion.

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

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Collaborative for Academic, Social, and Emotional Learning. (2017). *Core social and emotional learning competencies*. Retrieved from <http://www.casel.org/social-and-emotional-learning/core-competencies/>

[Melrose High TV]. (2014, June 26). *Summer read along: The sandwich swap*. [Video File]. Retrieved from <https://www.youtube.com/watch?v=2df-XsBYtm4&feature=youtu.be>

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

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### Planning Page

Students will be able to identify and analyze different points of view and respect and value perspectives that are different from their own.

#### Link to Prior Knowledge (15 minutes)

*Read The Sandwich Swap. Pause to ask questions about how Salma and Lily have different experiences. Help students link Salma and Lily's experiences to their own lives.*

*Discuss the feelings the two girls had and help the students connect those feelings to their own past experiences.*

#### Instruction (30 minutes)

*Define perspective. Give an example of when people have different perspectives in your classroom.*

*Define respect.*

*Introduce the Respecting Multiple Perspectives chart.*

## 2.7 RESPECTING MULTIPLE PERSPECTIVES

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*As a class, discuss the sample situation from The Sandwich Swap. Generate questions Lily could ask Salma to understand more. Brainstorm what Lily can say or do to show respect to Salma.*

*Discuss a second sample situation with questions and respectful responses.*

*Generate two more sample situations and complete the chart.*

### **Closing (5 minutes)**

*Draw attention back to The Sandwich Swap and discuss situations where people have different perspectives.*

*Optional: Distribute student reflection handouts and lead an exercise to help students take other people's perspectives.*



# RESPECTING MULTIPLE PERSPECTIVES

Sample Situation		What are some questions you could ask to understand more?	What do you say and do to show respect?
Perspective 1	Perspective 2		
Salma likes eating hummus and pita sandwiches.	Lily thinks that hummus and pita looks like a gross sandwich.	<p>Does anyone else in your family like hummus?</p> <p>What is hummus made out of?</p> <p>Have you always liked hummus and pita sandwiches?</p>	<p>"Just like your mom eats hummus, I like peanut butter because my dad always eats it."</p> <p>"That's new to me. I've never heard of chickpeas before."</p> <p>"I can picture you as a little kid eating hummus."</p>

# RESPECTING MULTIPLE PERSPECTIVES

## Student Reflection

Write one to two sentences about a time when you disagreed or got into an argument with a friend or sibling.

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Take your friend or sibling's perspective. What do you think your friend or sibling was thinking and feeling in this situation?

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What could you have done or said differently to respect your friend or sibling's perspective?

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If you had been more respectful, do you think things would have turned out differently? Explain.

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# 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

## Lesson Summary

Students will be able to distinguish between renewable and non-renewable energy sources. Students will note examples of each and provide justification for why they are renewable or non-renewable sources. They will make a list of energy and resource problems that need solutions.

*(Approx. total time: 45 minutes)*



## Standards

### NGSS Disciplinary Core Ideas

#### ESS3.A: Natural Resources

Energy and fuels that humans use are derived from natural sources. Some resources are renewable over time, and others are not.

#### Science and Engineering Practices

Obtaining, Evaluation and Communicating Information

## Objectives

### By the end of the lesson, students will

#### *Know (facts/information):*

- Most of the electricity in our country is produced by using non-renewable energy sources.

#### *Understand (concepts, big ideas):*

- Limited amounts of natural resources are available on earth. Each decision we make about our use of natural resources can have positive or negative impacts on the environment and other people.

#### *Be able to do (skills/behaviors/scientific and engineering practices):*

- Sort energy sources into renewable and non-renewable sources and justify their decisions.

## 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

### Vocabulary

- **coal:** a sedimentary rock formed from plants that lived millions of years ago
- **hydropower:** moving water released from a dam to produce electricity
- **natural gas:** a clean-burning gas formed in between rock layers from plants and animals that lived millions of years ago
- **non-renewable resource:** a resource that cannot be easily made or replaced naturally in our lifetime
- **perspective:** a person's point of view or how one person thinks about a situation
- **renewable resource:** a resource that can be replaced or restored naturally
- **solar panel:** a panel that uses the sun's light to generate electricity or heat
- **wind turbine:** a machine that uses blades to collect energy from the wind

### Materials

- Teacher Materials:
  - Projector, computer and speakers
    - This video to view: <https://www.youtube.com/watch?v=T4xKThjKkAE>
  - Chart paper to begin an Energy and Resource Problems We've Discovered list
- Student Materials:
  - Resource cards, 1 per student (students can cut or can be cut ahead of time)
  - Student vocabulary cards
  - Students who want to learn more about a specific energy source can click on any of the sources from this page to learn more:
    - <http://tinyurl.com/ConnectScience-energy-sources> or

### Instructional Strategies

#### Link to Prior Knowledge (5 minutes)

#### Elicit prior knowledge about fossil fuels.

*Where do fossil fuels come from? How are they used?*

Allow students to share what they remember about the group activity from an earlier lesson.

## 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

### Instruction (30 minutes)

**Watch a video. Have students construct meanings for renewable and non-renewable resources.**

*Today, you will learn about some other energy sources that are used in our country for transportation and electricity.*

*These resources can be sorted into two groups: non-renewable and renewable. All of the fossil fuels that we learned about the other day were non-renewable. Here's a video that shows some examples of renewable resources:*

Show this video about renewable energy sources:

- <https://www.youtube.com/watch?v=T4xKThjcKaE>

**Note:** at the very end of the video, the narrator uses the term “intermittency,” which means that energy sources like solar and wind provide energy at times but are **not continuously available** (e.g. at night or when the wind is not blowing).

*Let's pause for a few minutes and add non-renewable and renewable resources to our key vocab list. Write your own definition and draw a sketch for each word.*

Don't forget that students make sense of the concepts when they put them in their own words. Let them grapple with creating their own definitions.

*What does non-renewable mean? Can someone help me define it? What about renewable? Take some time to write and draw your own definitions now on your vocabulary cards.*

*Refer to these definitions and word wall cards as needed:*

**Non-renewable resources cannot be easily made or replaced naturally after they have been used up.**

*When deciding if a resource is non-renewable, you have to think about where the resource comes from.*

**Renewable resources can be replaced naturally in our lifetime.** *What are some examples of renewable resources?*

Brainstorm ideas with students about what they could draw in the boxes.

**Support students as they complete a card sort to classify resources into two groups: renewable and non-renewable.**

Pass out the cards to students and give them 5 minutes to read and explore the cards. If needed, ask students to read the words on each card in the whole group or with a partner before the sort activity.

## 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

Read the cards and look at the pictures, thinking about which ones you have heard of and which ones are new.

Now, sort your cards into two groups using the headers (renewable and non-renewable energy sources). A few of them may be new to you; read about them and make your best guess about which group to put them in.

Circulate and note which examples are being placed in each category. If you notice some confusion, spend a moment with the whole class to have students share why a particular example is renewable or non-renewable. Ask students to justify their answers from the perspective of ‘can it be replenished naturally in our lifetime’? Then give groups a moment to revisit their sort.

Review the final sort together. Hold up a few cards and ask the group:

Is this renewable or non-renewable? How do you know?

### Closing (5 -10 minutes)

#### Have students begin a list of energy and resource problems.

Use chart paper to generate a list of problems that students have discovered so far about our use of natural resources for energy in our community.

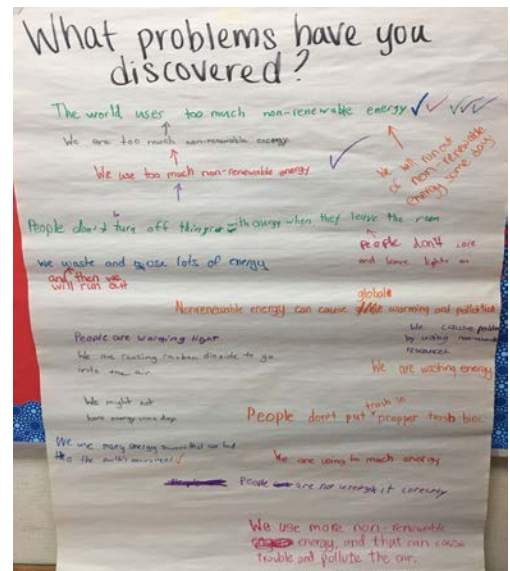
Think back to what we’ve learned so far about where energy comes from, and how we use natural resources as energy sources. We’re going to start a list of problems that we’ve heard about that we might be able to work on together.

Follow-up questions (if needed):

Who can think of a problem about our use of energy and natural resources?

How do we get electricity to our homes? Which energy sources do we use?

What energy sources do we use for transportation? Are those sources renewable or non-renewable?



## Assessment

Use formative assessment for this lesson. The sorting tasks allow you to assess whether students know the definitions of renewable and non-renewable energy sources and can categorize sources into each group.

## 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

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### Optional Extensions

Read *Energy Island* by Allan Drummond, or *The Boy Who Harnessed the Wind (Young Reader's Edition)* by William Kamkwamba, Bryan Mealer, and Anna Hymas.

### References

[Student Energy]. (2015, May 17). *Renewable Energy 101*. [Video File]. Retrieved from <https://www.youtube.com/watch?v=T4xKThjcKaE>

U.S. Energy Information Administration. What is energy? Retrieved from <https://www.eia.gov/KIDS/energy.cfm>

## 2.8 RENEWABLE VS NON-RENEWABLE RESOURCES

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### Planning Page

Students will be able to distinguish between renewable and non-renewable energy sources.

#### Link to Prior Knowledge (5 minutes)

*Elicit prior knowledge about fossil fuels.*

#### Instruction (30 minutes)

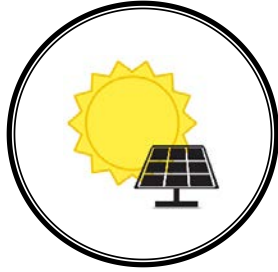
*Watch a video. Have students construct meanings for renewable and non-renewable resources.*

*Support students as they complete a card sort to classify resources into two groups: renewable and non-renewable.*

#### Closing (5 -10 minutes)

*Have students begin a list of energy and resource problems.*





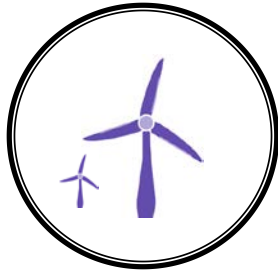
### SOLAR PANEL

A panel that uses the sun's light to generate electricity or heat



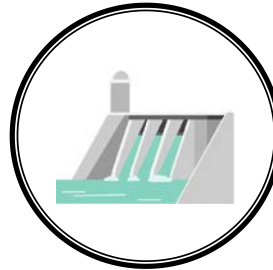
### NATURAL GAS

A clean-burning gas formed in between rock layers from plants and animals that lived millions of years ago



### WIND TURBINE

A machine that uses blades to collect energy from the wind



### HYDROPOWER

Moving water released from a dam to produce electricity



### PETROLEUM

A black liquid found underground from plants and animals that lived millions of years ago



### COAL

A sedimentary rock formed from plants that lived millions of years ago

**NON-RENEWABLE  
RESOURCE**

**RENEWABLE  
RESOURCE**

# 2.9 ENERGY FOR THE FUTURE

## Lesson Summary

Students will be able to review pros and cons of each energy source as well as interpret graphs to identify which sources are used frequently in the United States. Students will discuss which sources should be used more in the future, using evidence to back their decisions.

*(Approx. total time: 45 minutes, longer with extension tasks.)*



## Standards

### NGSS Disciplinary Core Ideas

#### ESS3.A: Natural Resources

Energy and fuels that humans use are derived from natural sources. Some resources are renewable over time, and others are not.

### NGSS Science and Engineering Practices

#### Engaging in Argument from Evidence

Respectfully provide and receive critiques from peers about a proposed explanation by citing relevant evidence and posing specific questions.

#### Obtaining, Evaluating and Communicating Information

Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

## Objectives

### By the end of the lesson, students will

#### *Know (facts/information):*

- Most of the electricity in our country is produced by using non-renewable energy sources.
- Each energy source has pros and cons that must be considered when making a plan for the future.

#### *Understand (concepts, big ideas):*

- Limited amounts of natural resources are available on earth. Each decision we make about our use of natural resources can have positive or negative impacts on the environment, the economy and other people.

- The best solutions are found when people with different knowledge and perspectives listen and communicate respectfully, and then come to an agreement.

### *Be able to do (skills/behaviors/scientific and engineering practices):*

- Analyze and interpret a chart that explains energy sources for electricity production in the United States.
- Respect and value a perspective that is different from their own.

## Vocabulary

- **coal:** a sedimentary rock formed from plants that lived millions of years ago
- **hydropower:** moving water released from a dam to produce electricity
- **natural gas:** a clean-burning gas formed in between rock layers from plants and animals that lived millions of years ago
- **nonrenewable resource:** a resource that cannot be easily made or replaced naturally in our lifetime
- **perspective:** a person's point of view or how one person thinks about a situation
- **renewable resource:** a resource that can be replaced or restored naturally
- **solar panel:** a panel designed to absorb the sun's light as a source of energy for generating electricity or heat
- **wind turbine:** a machine that uses blades to collect energy from the wind

## Materials

- Teacher Materials:
  - Computer and projector
  - Use this video to grab attention at the beginning of the lesson:
    - <https://www.youtube.com/watch?v=Fep4CSRoreE>
  - Select one of these websites to view and project:
    - <https://www.eia.gov/state/>
    - <https://www.tvakids.com/electricity/production.htm>
  - More background information for teachers about local energy production:
    - [https://www.washingtonpost.com/graphics/national/power-plants/?utm\\_term=.2e1b9c202129](https://www.washingtonpost.com/graphics/national/power-plants/?utm_term=.2e1b9c202129)
    - <https://www.tva.com/Energy/Our-Power-System/Renewables>
- Student Materials:
  - Energy source cards from Lesson 2.7, 1 per student (students can cut or can be cut ahead of time)
  - Energy for the Future pros and cons chart 2.8 S handout
  - US Energy Consumption by Source 2.8SE handout (optional)
  - Renewable v. Non-Renewable Chart on US Energy handout for each student (or projected on screen)

### Instructional Strategies

#### Link to Prior Knowledge (5 minutes)

Elicit prior knowledge about energy sources and personal connections to the topic. Share a short video about wind energy.

*What types of energy sources have you learned about? Is there an energy source that you would like to learn more about? Which one?*

Allow students to share what they remember about energy sources from the card sort yesterday.

*What do you remember about wind energy? How does that energy system work?*

If a review is needed, show video and discuss briefly:

- <https://www.youtube.com/watch?v=Fep4CSRoreE>

*Does anyone have a family member who works at a power plant, or a company like a coal mine or other place that sells energy materials? Tell us about the work that they do.*

If students mention a parent who has a job in the industry, take time to emphasize how important the work that they do is in providing energy/transportation fuel, etc. for people.

#### Instruction (30 minutes)

Pass out pros/cons for each energy source and review it with students.

*No energy source is perfect: each has things that are good about it, and problems that come with using it. Here is some information about some of the pros and cons of each energy source. We'll read through the pros and cons of these energy sources together.*

Discuss the table as a group. If they read it independently, ask if there were parts that they didn't understand, or things they had questions about. When they are finished reviewing the table, ask

*What surprised you about different energy sources we use to produce electricity? What new information did you learn?*

Ask students to rank the energy sources from highest to lowest use in the future.

Have them set the petroleum card aside, since petroleum is used mostly for transportation and to make other materials, and not electricity production.

## 2.9 ENERGY FOR THE FUTURE

*People in our country discuss energy sources a lot as they plan for our future. Everyone knows that we need to use more renewable resources in the future, but people don't always agree on which ones, or how we should start setting up systems that use more renewable resources. Have you heard adults around you talking about the cost of gasoline or electricity? What are they saying?*

*You guys will be the city planners and problem solvers in the future. Imagine you are planning for the future of our city, thinking about what you want to change about how we produce electricity in 50 years. Now, look at your energy source cards again. Put them in order from the ones you think we should be using the most in 50 years, down to the ones that we should use the least. The other cards show us energy sources that are used for electricity. Be ready to justify the reasons for your decisions using information about each source from your table. There are no absolutely right or wrong answers to this problem; each state and country chooses different energy sources for different reasons. You may have knowledge about some of these energy sources from other places that will influence your decisions.*

The petroleum card from yesterday is not needed for this lesson. Petroleum is used more for transportation and making things like plastic than for generating electricity.

### **Ask students to explain their reasoning to partners, using information from the chart to back their claims.**

Remind students to use their Active Listening Skills and Respectful Communication Sentence Stems in their discussion.

*Remember to use your active listening and respectful communication skills as you turn and talk with a partner. Share which energy source you each put first on your list and why. Discuss why you agree or disagree. This is a time when there will be a lot of different perspectives about which energy source is best. Remember that we need to be respectful of other perspectives. Often the best ideas are reached after a group of people make decisions based on everyone's ideas. If you change your mind about which sources should be used more in the future after listening to your partner, move your cards around.*

### **Ask students to report their final decisions to the group. Create a visual representation of student ideas about energy sources.**

Teacher choice: Summarize student data in a table or chart. One simple strategy is to ask students to put their first choice on a sticky note to put on a chart paper or whiteboard bar chart.

*Let's take a few minutes to summarize what you guys think.*

*Now that you've discussed ideas and listened to each other's perspectives, write the name of one energy source that you think should be on top of the list (on the board or on a sticky note), to see how much we agree on this important topic.*

Give students time to complete this and discuss the data that represents student choices.

**Reflect on differences between students. Why do some people prefer one source over another?**

*Did you agree on which energy sources should be used the most? Why or why not? I noticed a lot of you wrote\_\_\_\_. Can someone explain why they picked that? Does anyone have a different perspective to add? Do you think we have to pick only one source, or could we compromise and choose a couple of our favorites? This is what our city planners do when they*

If you notice that students are missing some key information that seems to be skewing their perspective, bring their attention to that information in the data. Or ask something like: I notice that a lot of you picked coal. Are there any important problems with coal that we should keep in mind as we plan for the future? Or, would we have enough electricity if we only use wind turbines? Why or why not?

### Closing (10 minutes)

**Briefly discuss which energy sources are used most in your community and state.**

*Each community decides which energy sources to use based on things like how much it costs and which resources are available nearby. Do you know which energy sources we use in our community? Have you seen a power plant anywhere nearby?*

Pull up one of these websites to show students a map or graph, and ask them to tell you what they notice and think about energy sources used in their city/state.

*Why do you think these sources are used in our state?*

- <https://www.tvakids.com/electricity/production.htm>
- <https://www.eia.gov/state/>
- <https://www.tva.gov/Energy/Our-Power-System>
- <https://www.tva.com/Energy/Our-Power-System/Renewables>

## Assessment

Use formative assessment for this lesson. As you circulate and listen to conversations, reflect on how well students are doing with respecting different perspectives. Pause to listen and provide suggestions for sentence stems when students get stuck or disagree with each other.

## Optional Extensions

1. Consider inviting a guest speaker from a local utility or energy company to talk with your students about their energy sources/power plants nearby or planning a field trip to visit a nearby power plant or hydroelectric dam.
2. Have students interpret a chart and reflect on energy use in the United States.

Project the U.S. energy consumption chart using a document camera or projector, or make copies for students to use.

*Now I'd like to show you a chart that shows the energy sources we use in our country right now.*

*What do you notice about this chart?*

Students may notice that petroleum is used a lot. Point out that oil and gas are used for transportation, and this is why there are so many oil barrels in the chart.

Explain what the numbers on the chart mean if students are having a hard time interpreting the chart. Allow students to count and write down the number of each energy source if needed.

Take time to be sure all students can understand this representation of data before proceeding.

*How well does your order match our current energy uses?*

*Is the U.S. using your first choice of an energy source? Why or why not? What are some important reasons why a state or city would choose one type of energy source over another? (Examples include cost, environmental impacts, human impacts, animal impacts, etc.)*

3. Students need to be ready to agree, disagree and ask questions of each other in ways that show respect. You may want to practice the sentence stems before science class and show how these stems can be used to help students engage in arguments from evidence. For instance, if one student is proposing a solar energy plan for the future, another student can use the sentence stem and say, "I agree with your solar energy plan and I think that solar is a great idea for this area because it's so sunny." Alternatively, a student can say, "I thought about it in a different way and I think we'll have problems using solar power because the sun doesn't always shine, and it costs a lot to make batteries to store solar energy." Students can practice asking questions by asking, "Can you say more about your plan to store the solar energy?" Or, "What did you mean when you said that you will find a new kind of battery that uses materials that are easy to find?"

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### Planning Page

Students will be able to review pros and cons of each energy source as well as interpret graphs to identify which sources are used frequently in the United States.

#### Link to Prior Knowledge (5 minutes)

*Elicit prior knowledge about energy sources and personal connections to the topic. Share a short video about wind energy.*

#### Instruction (30 minutes)

*Pass out pros/cons for each energy source and review it with students.*

*Ask students to rank the energy sources from highest to lowest use in the future.*

*Ask students to explain their reasoning to partners, using information from the chart to back their claims.*

*Ask students to report their final decisions to the group. Create a visual representation of student ideas about energy sources.*

## 2.9 ENERGY FOR THE FUTURE






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*Reflect on differences between students. Why do some people prefer one source over another?*

### **Closing (10 minutes)**

*Briefly discuss which energy sources are used most in your community and state.*

# ENERGY FOR THE FUTURE

	PROS	CONS
<b>COAL</b> 	<ul style="list-style-type: none"> <li>• Inexpensive</li> <li>• There is a lot of coal underground in the United States</li> <li>• Many coal power plants are already built</li> </ul>	<ul style="list-style-type: none"> <li>• Non-renewable</li> <li>• Releases carbon dioxide when burned</li> <li>• Leftover ash after burning needs to be treated carefully so that it does not pollute water</li> </ul>
<b>HYDROPOWER</b> 	<ul style="list-style-type: none"> <li>• Renewable</li> <li>• No air pollution or carbon dioxide emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Dams flood large areas of land and change river ecosystems</li> <li>• Fish cannot migrate unless fish ladders are built</li> </ul>
<b>NATURAL GAS</b> 	<ul style="list-style-type: none"> <li>• Inexpensive</li> <li>• Pollutes the air less than coal</li> <li>• There is a lot of natural gas underground in the United States</li> </ul>	<ul style="list-style-type: none"> <li>• Non-renewable</li> <li>• Releases carbon dioxide when burned</li> <li>• Releases another gas called methane into the air when it leaks from wells and pipelines</li> </ul>
<b>SOLAR PANELS</b> 	<ul style="list-style-type: none"> <li>• Solar panels do not pollute air or water</li> <li>• The sun is free and shines everywhere</li> </ul>	<ul style="list-style-type: none"> <li>• Sometimes the sun does not shine</li> <li>• Batteries to store solar power are expensive and use minerals that are hard to find</li> </ul>
<b>WIND TURBINE</b> 	<ul style="list-style-type: none"> <li>• Renewable</li> <li>• No air pollution or carbon dioxide emissions</li> </ul>	<ul style="list-style-type: none"> <li>• When wind is not blowing, other energy sources must be used, or electricity must be stored in expensive batteries</li> <li>• Birds or bats may be injured by blades</li> </ul>