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| **Title** | Lesson 2: Energy Powers Us |
| **Introduction** | After reviewing different sources of renewable and nonrenewable energy, students brainstorm the types of energy they use in a day. Next students use an online simulation to provide power to a city while balancing environmental, economic, and safety concerns. |
| **Curriculum Alignment** | **Grade 8 Science Essential Standard 8.P. 2**—Explain the environmental implications associated with the various methods of obtaining, managing, and using energy resources.  **Grade 8 ELA Common Core Writing Standard 7—**Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.  **Grade 8 ELA Common Core Speaking and Listening Standard 5**—Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. |
| **Learning Outcomes** | Students will use an internet simulation to power a model system of a city. Through this simulation they will note that all types of energy have pros and cons, risks and benefits with regard to economics, environment, and safety, and availability, and they will share these insights with classmates through class discussions. Students will also recognize that consumers use different types of energy for different needs (transportation, electricity, etc.) and that use of all renewable energy will force changes. They apply this awareness in the simulation by powering a city using all renewable energy resources and writing about and discussing the resulting implications. |
| **Time Required and Location** | (Different time options are provided below to help implement the lesson based on your schedule.)  2-3 45 minute periods (consecutive) **OR**  2 60 minute periods (consecutive) **OR**  1 ½ 90 minute periods (consecutive) |
| **Materials Needed** | Chart paper  Markers  Pencil and paper  Computers and internet access  **Technology resources**  Students need access to computers with internet connections to complete the simulation. The ideal situation is one computer per child. If that is not available, students can work in pairs or small groups. As an alternative, teachers can use one computer with a digital projector or interactive white board to complete the activity. |
| **Participant Prior Knowledge** | Students should have a working knowledge of the basic types of energy and renewable, nonrenewable sources of energy. If students completed Lesson 1 (“Sources of Energy”), then they will have the necessary prior knowledge to complete the activity. If not, students should be introduced to the following types of energy: biomass, coal, geothermal, hydropower, natural gas, petroleum, solar energy, uranium (nuclear), and wind energy. A good resource for learning about these types is [www.need.org](http://www.need.org). Use the Intermediate Infobook link for material appropriate for middle grades students. |
| **Facilitator Preparations** | Prepare “Who has used” charts. (These are used in the Exploration portion of the lesson.)Post “Who has used” charts around the room.Gain access to computers and internet access.Make sure your school internet filter will allow access to the site <http://willyoujoinus.com/energyville>Prepare a sample “I notice/I wonder” chartPrepare a” Types of energy pro/con, risk/benefit” chart for use during guided practice. (See attached.) |
| **Activities** | **Exploration:**  1. Put the following questions on chart paper around the room. (One question per piece of paper.)  In the last 24 hours who has used petroleum?  In the last 24 hours who has used coal?  In the last 24 hours who has used nuclear?  In the last 24 hours who has used solar?  In the last 24 hours who has used natural gas?  In the last 24 hours who has used geothermal?  In the last 24 hours who has used propane?  In the last 24 hours who has used wind?  In the last 24 hours who has used biomass?  In the last 24 hours who has used hydropower?  2. Have students place their names on the charts that are applicable to them.    3. Explain to students that electricity in NC (base load) is generated from coal and nuclear plants. Help them to understand that this means they have used coal and nuclear power recently, at least indirectly. Have students make necessary additions to charts. Discuss other ways that students might use these energy sources in daily life (propane for cooking, solar calculator, burning wood in a fireplace, etc.).  4. Help students to generalize that we currently need many types of energy to meet our energy needs.  **Model System:**  1. After the Exploration activity above, let students know that they will use a simulation to “power” a city.  2. Have students go to the website <http://willyoujoinus.com/energyville> and click on “Guided Play.” Encourage them to make wise choices when powering their city. Have students make notes about the process using an “I notice, I wonder chart.” Share an example of an “I notice, I wonder chart. You can model for students what entries on the “I notice/ I wonder” chart might look like. For example, I notice that the oil rig is in the water. I wonder how that affects the water quality? The idea of the chart is to get students to generate observations and questions of their own, but if your students need more structure, you can set a required number of observations or you can provide more examples as scaffolding.  Make sure that students read the pop ups associated with their choices. (These pop ups explain the types of energy and pros/cons of their choices of power.)  \*Note that propane is not used in this simulation. It is sometimes considered a part of natural gas.  3. Share results as a class. (This is a good place to stop if you have a 45 minute or 60 minute class period.)  4. Now have students attempt to power their city using only renewable energy. Students should make notes in their “I notice, I wonder” charts.  **Content Wrap-Up:**  5. Share results from powering the city using only renewable energy. Discuss with students the following questions.   * Which factors made an all- renewable city possible? (All forms of renewable energy have to be available and operational. Money to pay for these types of energy sources must be available.) * What needs to change in order for this to happen? (Transportation will need to change. Currently, petroleum is needed to power vehicles and airplanes.) * What are the pros/cons of an all renewable city? (Costs are higher, environmental impacts are lower, some security issues arise. Different types of energy plants must be built—turbines, dams, solar arrays, etc.). * Use student responses to these questions as formative assessment of their understanding of the key ideas. (These are listed in the parentheses after each question.)   **Guided Practice**  1. Have the students select a partner and assign each pair of students a type of energy (biomass, coal, geothermal, hydropower, natural gas, petroleum, solar energy, uranium (nuclear), and wind energy.  2. Each pair of students should collect the following information about its type of energy   * Uses of the type of energy, pros/cons.   3. Have each pair of students share its information with the class. Record the information in a chart at the front or on the board. (See attached sample chart and possible answers.) This data can also serve as formative assessment of students’ understanding of each energy type and its pros/cons. |
| **Assessment** | To assess students’ understanding of the need for a variety of energy sources and the pros/cons, risks/benefits of each, ask students to complete a 3-2-1 activity.Students should write down 3 energy sources and their pros/cons, risks/benefits; 2 reasons why we need multiple types of energy to power our cities, and the 1 most important idea learned from this lesson.To assess this activity, check for accuracy of the 3 energy sources pros/cons, risks/benefits using the sample chart used in the Guided Practice activity above. The 2 reasons for needing multiples of energies should address the ideas of limited resources, different uses of each type of energy, and/or economic and environmental implications. The most important idea reported by students will give you a clear idea of whether students have grasped the concept that many types of energy are needed to power our lives and that all types of energy have pros/cons, risks/benefits, and implications for use. |
| **Critical Vocabulary** | |  |  | | --- | --- | | **Word** | **Definition** | | Power grid | Method of delivering power to users. Includes generators, lines, transformers, loads. | | Renewable energy | Can be replenished quickly (usually in less than 100 years) | | Nonrenewable energy | Cannot be replaced quickly. | |
| **Modifications** | Use one computer and a data projector to complete the online simulation as a whole class activity if computer access is limited.For students with reading disabilities, read aloud text on the computer or partner with a buddy for support.More advanced students can be given more parameters for powering their city such as a certain percentage of coal or nuclear. Advanced students can also research the actual percentage of power used to power their city or state.Students can continue to utilize the simulation at home or at other times during the class to address challenges to powering a city such as modeling the effect of a nuclear reactor meltdown such as in Japan or a drought like the one in Texas. |
| **Alternative Assessments** | The 3-2-1 assessment strategy is still applicable to all modifications above. For limitations on computers or for students who need reading modifications, the strategy does not need to be changed. For more advanced students exploring different parameters or modeling loss of nuclear or hydropower, the questions’ specifications will need to be changed. An example might be: 3 ways that loss of nuclear impacted your city, 2 ways you compensated for the loss, 1 most important idea learned from this activity. |
| **References** | <http://willyoujoinus.com/energyville> (required for the lesson plan)  [www.need.org](http://www.need.org) (for reference only)  <http://www.ncgreenpower.org/about/program_overview_2.html> (for reference only) |
| **Supplemental Information** | Refer to [www.need.org](http://www.need.org) (This is the website for the National Energy Education Development Project) for information on various types of energy sources.  Also refer to <http://www.ncgreenpower.org/about/program_overview_2.html> for a chart that breaks down NC’s sources of electricity. NC GreenPower is a nonprofit organization that encourages renewable energy development and usage. The website provides information about different programs in North Carolina along with carbon offset calculators and other pieces of information. |
| **Author Info** | Melaine Rickard  Turrentine Middle School, Alamance Burlington School System, Burlington, NC 27215  Grade 8 ELA and Science  19 years experience  NBCT in Science, AIG certified  This lesson was developed as a result of an externship experience with Dr. Lisa Grable, Precollege Education Deputy Director of the Science House. Dr. Grable directs the Young Scholars and Research Experience for Teachers program at the FREEDM center at NCSU. This program is sponsored by the NSF and gives students and teachers the opportunity to learn about renewable energy. My experiences included hands on activities at the Science House and FREEDM center, job shadowing of scientists and engineers, field trips to laboratories on NC State’s campus, and visits to industry sites such as Shearon Harris Nuclear Plant, UNC Cogen plant, and Progress Energy.  This lesson represents the fundamental understandings necessary to begin to think critically about energy choices and meet the demands of energy needs in the future.  For more information about the Science House of the FREEDM Center, go to <http://www.science-house.org/index.php/outreach-projects/freedm-outreach> |