Energy Unit Daily Instructional Sequence

The instructional sequence is a recommended instructional sequence. This sequence has been field-tested in 8th grade urban classrooms in three different tracked levels. We recognize that the ability levels of students will range significantly across different locations and some classrooms may complete activities faster or slower than what we have listed as the recommended time frame. We recognize that different teachers may feel the need to provide summative assessment quizzes or additional review activities at specific points during the instructional sequence. Such activities will vary across different teachers and classroom contexts. While we have not included such materials in the instructional sequence, we have provided a sample of such materials used by teachers during the field-testing of the Energy unit in the Teacher Resources section.

We have not recommended specific homework assignments for each day in the instructional sequence. We recognize that the assignment of homework will vary significantly across each classroom based on the philosophy of teachers and school districts. We have noted suggested supplemental readings on specific days that can be assigned for homework. These are PDF documents that can be accessed by students on the Energy Unit Student Resource page or reproduced and distributed as hard copies. The completion of student worksheets may also be assigned as homework. We also encourage teachers to assign journaling activities and additional concept mapping activities as homework to help students review the main unit concepts.

Student instructional handouts and teacher support materials are provided in both MS Word and PDF formats. Student handouts can be modified to provide additional supports and step-by-step instructions by adding text passages from the teacher versions of select handouts.

The pages that follow provide a detailed instructional sequence for each day that includes student resources (My World GIS files, Google Earth files, videos, and images), instructional handouts, and teacher educative curriculum materials.

Although this site is designed to be cross-platform, please use the Mozilla Firefox Web browser because the GIS files do not download properly via the Internet Explorer or Safari Web browsers.

Day 1
Pretests. Introduction to Energy Unit. Students will complete the energy content knowledge and attitude and behavior pretest assessments.

1. Instruct students to complete the **pretest assessments**.

2. After all students have completed the assessments, flip on and off a light switch. Ask students to diagram in their journal how the light comes on. Prompt students to think about the sources of electricity and how the electricity arrives at the light.

3. Ask students aloud "What is energy? Where does it come from?"

4. Discuss aloud student responses. Identify and clarify any misconceptions. Respond to any questions students have.

Materials Needed:

Energy Unit Content Knowledge Pretest (PDF / MS Word)
Energy Unit Science and Technology Pretest (PDF / MS Word)
Energy Unit Attitude and Behavior Pretest (PDF / MS Word)

Assessment Information
Energy Unit Content Knowledge Pretest Key (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics
Electricity Generation

Day 2
Energy Audit. Students will be introduced to different energy terms and conversion factors (joules, watts, kilowatts, kilowatt/hours, and BTUs). They will begin calculating their personal and household energy consumption on an Energy Audit spreadsheet. Students will understand that they use energy for many purposes including: lighting, heating, transportation, entertainment, food preparation, cleaning, and communications.

1. Begin the class by asking students to respond to the following question in their journal: "How is electricity measured? For example, how does the electric company know how much to charge you for your energy use each month?"

2. Show students the **Energy Terms video clip**. We recommend that you download the file (energy_terms.mov) from the Web site and play locally on your computer at double size.

3. Inform students they will learn about uses of energy, energy units, and will calculate their personal energy consumption.

4. Read the Energy Story to the students. Explain to students that different units are used to measure energy. Note that kilowatt-hours are the most commonly used measure of energy consumption.

5. Have students go to the Energy Unit Student Resources Web page. Ask students to download the **Personal Energy Audit** spreadsheet from the student resources page. We recommend that you have students bookmark this Web page since they will revisit it throughout the unit.

6. Distribute the **Personal Energy Audit: The Spreadsheet** handout to each student.

7. Illustrate and have students follow the **Step 2** instructions on their handouts to enter their data for **Row 6 - "Watch TV"** on their **Personal Energy Audit spreadsheet**.

8. Have students go back to the student resources page and click on the **Understanding Electricity** link to learn about energy terms. Instruct students to read these 6 Web pages. Explain and clarify any difficulties that students might have with understanding the energy terms and unit conversions that are presented.
Optional: Have students complete the **Personal Energy Audit Guided Reading** as they read the Web pages.

9. Have students revisit their spreadsheets. Have students follow the **Step 4** instructions on their handouts to change the values in **Row 6 - "Watch TV"** on their spreadsheet. Have students note the change of the **Out of pocket cost per year (dollars)** column on the spreadsheet.

10. Instruct students to begin filling in their spreadsheets based on their own personal energy uses.

11. Have students save their audit spreadsheet files: Save as (**audit_initials**) initials=student's initials. NOTE: Students' spreadsheet files need to be saved so students can continue the activity on the next day.

Materials Needed:

Video
Energy Terms Video Clip (QuickTime video)

Spreadsheet
Personal Energy Audit (Spreadsheet file)

Handouts
(1) Personal Energy Audit Guided Reading (PDF / MS Word)
(2) Personal Energy Audit: The Spreadsheet Teacher Guide (PDF / MS Word)
(3) Personal Energy Audit: The Spreadsheet Student Handout (PDF / MS Word)

Other Resources
Energy Story

Assessment Information
Personal Energy Audit Guided Reading Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Scientific Forms of Energy (PDF)

Teacher Resources/Content Support
Energy Basics
Electricity Generation

Day 3
Energy Audit. Students will complete their energy audit and analyze their energy consumption patterns. Students will describe ways they can reduce both their personal energy use and their household energy use.

1. Begin the class by asking students to respond to the following question in their journal: Why do you think it is important to understand your energy consumption patterns?

2. Inform students they will complete their Personal Energy Audit spreadsheets and analyze their energy consumption patterns.

3. Have students complete their Personal Energy Audit spreadsheets. The **Personal Energy Audit: The Spreadsheet Teacher Guide** contains suggested prompts you may wish to use to help students complete their spreadsheet.

4. Have students answer questions on their Personal Energy Audit: The Spreadsheet worksheet.

5. Discuss aloud students' energy consumption habits and ways they can reduce their personal and household energy use. Respond to any questions students have.

6. Review the concepts covered in the lesson.

7. If at the completion of the activity students do not understand how much energy they use, modify instruction to ensure that students understand their energy consumption patterns.

8. Have students save their audit files. Files need to be saved so they can be referred back to on days 28 and 30.

9. Provide guiding, reflective questions for students to respond in their journals what they learned in the energy audit activity.

Materials Needed:

Spreadsheet
Personal Energy Audit (Spreadsheet file)

Handouts
(1) Personal Energy Audit: The Spreadsheet Teacher Guide (PDF / MS Word)
(2) Personal Energy Audit: The Spreadsheet Student Handout (PDF / MS Word)
(3) Personal Energy Audit: The Spreadsheet Worksheet (PDF / MS Word)

Assessment Information
Personal Energy Audit: The Spreadsheet Assessment (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics
Electricity Generation

Day 4
Concept Map. Students will be introduced to sources of energy (sun, moon, and earth) using a graphical representation. Students will then be introduced to potential and kinetic forms of energy.

1. Ask students to look around the classroom and point out things that are using energy (for example, computer, clock, lights, plants, watch, themselves). Ask students to write in their journals where each item gets its energy and how it uses it. (For example, a computer gets its energy from electricity and uses it to perform computing tasks). Discuss student responses aloud.

2. Inform students that they will learn the main sources and forms of energy.

3. Instruct students to download the **Energy Concept Map** from the student resources page.

4. Use an LCD projector to display the Energy Concept Map at the front of the room.

5. Have students complete what they know on the concept map and submit it electronically. (Alternatively, you may wish to print out the concept map and have students complete it and return a hard copy to you). The concept maps will be compared to the students' final concept maps at the end of the unit. This will serve as an assessment measure of students' understandings of the relationships among energy sources.

Implementation suggestion: You may wish to have students add to this concept map periodically throughout the unit. At the end of the unit, the students' concept maps should be quite detailed with many associations made among different energy concepts. View a completed end-of-the-unit concept map.

6. Using the Energy Concept Map, explain to students the three main sources of energy (sun, moon, and Earth). This serves as a "big picture" overview of the energy sources that will be explored in the unit.

7. Explain to students potential and kinetic forms of energy. Give adequate examples of each.

8. Ask students to give some examples of kinetic and potential energy. Provide feedback.

9. Review the main sources of energy and forms of energy.

Materials Needed:

Energy Concept Map (Inspiration / JPEG)

Supplemental Homework Reading for Students
Electricity (PDF)

Teacher Resources/Content Support
Energy Basics

Day 5

Solar Energy. Students will be introduced to solar energy. Students will understand that most of the energy we use originally came from the sun. Students will observe the transfer of solar energy to different appliances with a solar cell and investigate the effect of using different solar sources to supply energy to appliances.

1. Begin the class by asking students to respond to the following in their journal: What is solar energy?

2. Play the **photovoltaic cells video clip**. We recommend that you download the file (photovoltaic_cell.mov) from the Web site and play locally on your computer at double size.

3. Inform students that they will learn about solar energy.

4. Remind students that the sun is one of the main sources of energy.

5. Explain to students that the existence of nearly all life on earth (plants and animals) is possible because of solar energy. Explain how the sun is the source of energy for most of earth's processes.

Explain how solar energy is collected and converted into other forms of energy, the difference between active and passive solar heating, and what energy efficiency means.

6. Inform students they will use a photovoltaic cell to power a light bulb, fan, and music box. Distribute the **Investigating Solar Energy** handout and worksheet to each student.

7. Divide students into groups of 4.

8. Give 1 parallel circuit and 1 series circuit kit to each team. Review components of kits with students. Instruct students to look at the back of the solar components to view the two circuit patterns.

9. Ask students to predict the effect of using direct artificial light, sunlight, and natural room lighting to power a small bulb, fan, and music box.

10. Have student teams use a photovoltaic cell to power a small bulb, fan, and music box. Ask students the guiding question: What is the effect of using different light sources to power simple appliances?

11. Instruct students to make observations and complete their worksheets.

12. Have students evaluate their explanations then draw conclusions.

13. Ask student groups to share their conclusions with the class and justify them.

14. Ask students to try and power any other simple appliances in the classroom or simple appliances they might have using the solar panel.

15. Review the lesson concepts at the conclusion of the activity. Ensure that students understand that different appliances use different amounts of energy. Changing the wiring in a circuit can maximize the amount of energy needed to power an appliance.

Materials Needed:

Solar Energy Kits
Wires/ photovoltaic cells/ light bulbs/ music box/ fan

Video
Photovoltaic Cells Video Clip (QuickTime video)

Handouts
(1) Investigating Solar Energy Teacher Guide (PDF / MS Word)
(2) Investigating Solar Energy Handout (PDF / MS Word)
(3) Investigating Solar Energy: Observations Worksheet (PDF / MS Word)

Assessment Information
Investigating Solar Energy Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Renewable Energy (PDF)
Solar Energy (PDF)

Teacher Resources/Content Support
Solar Energy

Day 6
Solar Energy. Students will use Google Earth to view solar power plants around the world. Students will take a Google Earth tour of 5 large solar power plant. Students will use the Google Earth measurement tool to determine perimeters of each solar plant.

1. Begin the class by asking students to respond to the following in their journal: Describe a solar power plant.

2. Inform students that they will use Google Earth to explore solar power plants around the world.

3. Distribute the **Exploring Solar Power Plants with Google Earth** handout and worksheet to each student.

4. Use an LCD projector to display Google Earth at the front of the room.

5. Ask students to launch Google Earth on their computers.

6. If needed, provide a brief orientation of Google Earth layout and navigational tool set.

7. Instruct students to download the **Solar Power Plants** KML file and view the file in Google Earth.

8. Show students how to navigate from one solar plant to the next.

9. Model how to use the **Ruler Tool** in Google Earth to measure the perimeter of the first solar plant (Marstal). Have students repeat this task on their computers. Show students possible mistakes they could make while measuring, for example, measuring the fence around the solar power plant.

NOTE: Plataforma Solar de Almeria has three different solar array areas. You can have students measure each individual solar array area then add up the measurements, or measure around all three solar array areas.

10. Have students measure the perimeter of each **solar plant** and answer questions on their worksheets. Provide guidance to students.

11. Review and discuss aloud student responses to key questions. Respond to any questions students have.

12. If students at the completion of the activity do not understand that ideal locations for large solar power plants include a ground cover area that has a flat open area to capture a lot of sunshine, modify instruction as needed to ensure learner understandings.

13. Have students close and not save Google Earth when they finish.

14. Collect the handouts (and worksheets if you have not finished reviewing the activity).

Materials Needed:

Handouts
(1) Exploring Solar Power Plants with Google Earth Teacher Guide (PDF / MS Word)
(2) Exploring Solar Power Plants with Google Earth Student Handout (PDF / MS Word)
(3) Exploring Solar Power Plants with Google Earth Worksheet (PDF / MS Word)

KML File
Solar Power Plants.kml

Assessment Information
Exploring Solar Power Plants with Google Earth Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Solar Energy (PDF)

Teacher Resources/Content Support
Solar Energy

Day 7

Solar Energy. Students will learn the basic tool features of My World GIS including: Construct View, Data Library, Layer List, Visualize View, Cursor Location, Zoom In Tool, Zoom Out Tool, Get Information Tool, Move Map Tool, and Zoom To All. Students will use My World GIS to analyze annual average sunshine data to determine good locations for solar plants.

1. Begin the class by asking students to respond to the following in their journal: What is a Geographic Information System (GIS)?

2. Inform students that they will learn to use My World GIS map tools and examine sunshine data on the Earth.

3. Distribute the **Where is the Best Place to Locate a New Solar Power Plant?** handout and worksheet to each student.

4. Use an LCD projector to display My World GIS at the front of the room.

5. Instruct students to launch My World on their computers.

6. Give an orientation of the **Construct Mode, Visualize Mode, Data Library, Layer List, Map area** and **Cursor Location**.

7. Instruct students to download the **my_world_solar.m3vz** on to their computers.

8. Have students open the **my_world_solar.m3vz** file in My World GIS. The my_world_solar.m3vz file is a packaged file that contains four data layers (countries.shp, states.shp, percent_sunshine.shp, solar plants.shp) that are added to the Layer List.

9. Model the step-by-step instructions on the handout for using the **Zoom In Tool, Zoom Out Tool, Pointer Tool, Get Information Tool, Move Map Tool,** and **Zoom To All**. Have students repeat each task on their computers and complete the table on their worksheets. End at Step 4 on the handout. If time allows, begin Step 5 on the handout.

Implementation suggestion: Tell students not to change the appearance of the data layers. Changing the appearance of the data layers may result in some students having difficulty following instructions on the handout.

10. Review the map tools and discuss aloud student responses. Respond to any questions students have.

11. Instruct students to save and rename their files (**my_world_solar_initials.m3vz**) *initials*=student's initials.

12. Instruct students to move their my_world_solar.m3vz file from the desktop to their server space or to another secure location.

13. Collect the handouts and worksheets.

Materials Needed:

Handouts
(1) Where is the Best Place to Locate a New Solar Power Plant? Teacher Guide (PDF / MS Word)
(2) Where is the Best Place to Locate a New Solar Power Plant? Student Handout (PDF / MS Word)
(3) Where is the Best Place to Locate a New Solar Power Plant? Worksheet (PDF / MS Word)

GIS File
my_world_solar.m3vz

Assessment Information
Where is the Best Place to Locate a New Solar Power Plant? Assessment (PDF / MS Word)

Teacher Resources/Content Support
Solar Energy

Day 8

Solar Energy. Students will continue to use My World GIS to analyze annual average sunshine data to determine good locations for solar plants. Students will investigate sunshine patterns at locations of existing and proposed solar power plants. Students will analyze "newly planned" solar power plant locations in 2009 and will determine optimal locations to build new very large solar power plants.

1. Ask students to respond to the following question in their journal: How would you determine the best place to locate a new solar power plant?

2. Inform students that they will use My World GIS to analyze sunshine data and determine the best place to locate a new solar power plant.

3. Give the **Where is the Best Place to Locate a New Solar Power Plant?** handouts and worksheets back to the students.

4. Use an LCD projector to display My World at the front of the room.

5. Have students access their saved my_world_solar.m3vz file from the previous day. If the file does not load properly, have students download it again from the student resources page. (Note: Hopefully, your students will not have played around with the layers too much, thus, changing the map display).

6. Have students open the **my_world_solar.m3vz** file in My World GIS. If needed, model step-by-step instructions for using **Zoom In Tool, Zoom Out Tool, Pointer Tool, Get Information Tool, Move Map Tool,** and **Zoom To All**.

7. Show students how to use the **Pointer Tool** (cursor) to find the latitudes and longitudes of a solar plant. Show students how to read the **Percent Sunshine bar** at the bottom of the map display.

NOTE: Be sure to show your students that they must click exactly on the solar power plant red dot symbol to get the Layer Information Window to appear. If they do not click exactly on the dot, they will get a Layer Information Window with no data displayed.

8. Have students do the activity and complete the **Solar Power Plants Data Chart** on their worksheets. Provide guidance to students.

9. Instruct students to analyze their completed Solar Power Plants Data Chart and the GIS map to answer the questions on their worksheets.

10. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students save the changes they made to the My World GIS file if additional time is needed to complete the activity.

11. If students at the completion of the activity do not understand that ideal locations for large solar power plants include areas with a large annual average percent sunshine, modify instruction as needed to ensure students understand this concept.

12. Provide guiding, reflective questions for students to respond in their journals what they learned about solar energy.

Materials Needed:

Handouts
(1) Where is the Best Place to Locate a New Solar Power Plant? Teacher Guide (PDF / MS Word)
(2) Where is the Best Place to Locate a New Solar Power Plant? Student Handout (PDF / MS Word)
(3) Where is the Best Place to Locate a New Solar Power Plant? Worksheet (PDF / MS Word)

GIS File
my_world_solar.m3vz

Assessment Information
Where is the Best Place to Locate a New Solar Power Plant? Assessment (PDF / MS Word)

Teacher Resources/Content Support
Solar Energy

Day 9
Wind Energy. Students will be introduced to wind energy and a wind power classification system. Students will learn how electricity generated from wind turbines is transported to the electrical grid, and then to a substation and to their homes for use.

1. Begin the class by asking students to respond to the following question in their journal: What is wind?

2. Show students the **Wind Energy video clip**. We recommend that you download the file (wind_energy.mov) from the Web site and play locally on your computer at double size.

3. Inform students they will learn about wind, how it is formed, and how it can be used to produce electricity.

4. Distribute the **Wind Energy Guided Reading** worksheet to each of the students.

5. Ask students to go to the student resources Web page and click the **About Wind Energy** link.

6. Instruct students to read the content pages about wind energy and answer the questions on their worksheets. Explain and clarify terminology and concepts as needed. Give some relevant examples.

7. Review content and discuss aloud student responses to key questions on their worksheets. Respond to any questions students have. Have students close their Web browser when they finish.

Materials Needed:

Video
Wind Energy Video Clip (QuickTime video)

Handout
Wind Energy Guided Reading Worksheet (PDF / MS Word)

Assessment Information
Wind Energy Guided Reading Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Wind Energy (PDF)

Teacher Resources/Content Support
Wind Energy

Day 10
Wind Energy. Students will use Google Earth to investigate ideal features of wind farms. Students will take a Google Earth tour of 5 large wind farms around the world. Students will use the Google Earth measurement tool to determine the estimated perimeter of each wind farm.

1. Begin the class by asking students to respond to the following in their journal: Describe a wind farm.

2. Inform students that they will use Google Earth to explore wind farms around the world.

3. Distribute the **Exploring Wind Farms with Google Earth** handout and worksheet to each student.

4. Use an LCD projector to display Google Earth at the front of the room.

5. Ask students to launch Google Earth on their computers.

6. Instruct students to download the **Wind Farms** KML file and view the file in Google Earth.

7. Show students how to navigate from one wind farm to the next.

8. At the first wind farm location, zoom-in a bit to show students individual wind turbines.

Implementation suggestion: At the Taff Ely location, show students the dark shadows that are cast from the wind turbines. Inform students that it is helpful to look for these shadows to help identify the locations of the wind turbines.

9. Model how to use the **Ruler Tool** in Google Earth to measure the estimated perimeter of the first wind farm (Taff Ely). Have students repeat this task on their computers.

10. Instruct students visit each wind farm one at a time to complete the entire Wind Farms Data Chart. For example, students should first visit the Taff Ely wind farm and complete the first row of the data chart before moving on to the next wind farm.

11. Provide guidance to students as needed. Instruct students to answer the questions on their worksheets.

Important note: You may note in some locations that wind turbines are currently being constructed. If students notice this, you may wish to tell them not to include those turbines in the perimeter measurement of that particular wind farm.

11. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save Google Earth when they finish.

12. If students at the completion of the activity do not understand that ideal locations for wind farms include areas with good sustained wind speed and land areas that include open, flat areas or hilly areas, modify instruction to ensure students understand this concept.

Materials Needed:

Handouts
(1) Exploring Wind Farms with Google Earth Teacher Guide (PDF / MS Word)
(2) Exploring Wind Farms with Google Earth Student Handout (PDF / MS Word)
(3) Exploring Wind Farms with Google Earth Worksheet (PDF / MS Word)

KML File
Wind Farms.kml

Assessment Information
Exploring Wind Farms with Google Earth Assessment (PDF / MS Word)

Teacher Resources/Content Support
Wind Energy

Day 11
Wind Energy. Students will use My World GIS to examine wind speed and land use patterns in Pennsylvania to determine the best place to locate a new wind farm in the Lehigh Valley and in Pennsylvania.

1. Begin the class by asking students to respond to the following question to respond to in their journal: How would you determine the best place to locate a new wind farm?

2. Inform students that they will use My World GIS to examine wind speed and land use patterns in Pennsylvania to determine the best place to locate a new wind farm.

3. Distribute the **Where is the Best Place to Locate a New Wind Farm?** handout and worksheet to each student.

4. Use an LCD projector to display My World at the front of the room.

5. Instruct students to download the **Wind Map.m3vz** on to their computers.

6. Have students open the **Wind Map.m3vz** file in My World GIS.

7. Show students how to read the wind speed and land use layers keys/legends. Show students how to turn the layers on (click on the small square at the right end of a layer) and off (click on the eye at the top right corner of a layer).

8. Have students do the activity and answer questions on their worksheets. Provide guidance to students.

9. Instruct students to analyze their completed **Wind Farms Data Chart** and the GIS map to answer the questions on their worksheets.

10. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save the changes they made to the My World GIS file when they finish.

11. If students at the completion of the activity do not understand that ideal locations for wind farms include areas with good sustained wind speed, have land areas that include open, flat areas or hilly areas, and have minimal impact on the natural environment, modify instruction to ensure students understand this concept.

12. Provide guiding, reflective questions for students to respond in their journals what they learned about wind energy.

Materials Needed:

Handouts
(1) Where is the Best Place to Locate a New Wind Farm? Teacher Guide (PDF / MS Word)
(2) Where is the Best Place to Locate a New Wind Farm? Student Handout (PDF / MS Word)
(3) Where is the Best Place to Locate a New Wind Farm? Worksheet (PDF / MS Word)

GIS File
Wind Map.m3vz

Assessment Information
Where is the Best Place to Locate a New Wind Farm? Assessment (PDF / MS Word)

Teacher Resources/Content Support
Wind Energy

Day 12

Tidal Energy. Students will be introduced to tide formation and tidal energy. Students will use Google Earth to analyze the shapes of four water bodies to determine if these would be good places to locate a tidal power plant.

1. Begin the class by asking students to respond to the following question in their journal: What is tidal energy?

2. To gain attention, ask students whether they surf when they go to the beach.

3. Inform students that they will learn about tidal energy and examine different water bodies to determine whether they are good locations for tidal power plants.

4. Ask students what they know about tidal energy. Ask students to go to the student resources Web page and click on the About Tidal Energy link.

5. Instruct students to read the tidal energy Web pages. Clarify key terms and explain tidal concepts as needed.

6. Distribute the Exploring Water Bodies with Google Earth handout and worksheet to each student.

7. Use an LCD projector to display Google Earth at the front of the room.

8. Ask students to launch Google Earth on their computers.

9. Instruct students to download the Water Bodies KML file and view the file in Google Earth.

10. Display the Bay of Fundy in Google Earth at the front of the room. Describe the shape of the bay and emphasize that it is funnel shaped, thus, a good location for a tidal power plant. Show students how to read the information about the Bay of Fundy.

11. Have students examine the Bay of Fundy, the Bay of Severn, the Baltic Sea, and the Gulf of Mexico. Instruct students to read information about these water bodies, analyze their shapes, and answer questions on their worksheets.

Implementation Suggestion:

For certain populations of learners, you may wish to have students draw the shape of the water body on the Water Bodies Data Chart. You may need to expand the size of the data chart rows to accommodate student drawings.

12. Provide guidance as students do the activity.

13. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save Google Earth when they finish.

14. If students at the completion of the activity do not understand that areas with high tidal ranges have funnel-like shapes or forced into a narrow channel, modify instruction to ensure students understand this concept.

15. Provide guiding, reflective questions for students to respond in their journals what they learned about tidal energy.

Materials Needed:

Handouts
(1) Exploring Water Bodies with Google Earth Teacher Guide (PDF / MS Word)
(2) Exploring Water Bodies with Google Earth Student Handout (PDF / MS Word)
(3) Exploring Water Bodies with Google Earth Worksheet (PDF / MS Word)

KML File
Water Bodies.kml

Assessment Information
Exploring Water Bodies with Google Earth Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Ocean Energy (PDF)

Teacher Resources/Content Support
Tidal Energy

Day 13
Hydroelectric Energy. Students will be introduced to hydroelectric energy. Students will learn how the depth and width of a "reservoir" affects the potential energy of water to do work.

Prior to class: Set up 3 dam models of different reservoir shape and sizes. Instructions are located in the **Teacher Resource: Hydroelectric Dam Energy Demonstration.**

1. Begin the class by asking students to respond to the following question in their journal: What is hydroelectric energy?

2. Inform students that they will learn about hydroelectric energy. Ask students what they know about hydroelectric energy.

3. Show students the 3 different "dam systems". Have students predict which "dam system" will create the greatest force by observing the movement of an object when the gate is released. The object will be initially placed at each dam's mouth. Each stream table has a dam with different widths and depths. Optional: Distribute the Hydroelectric Dam Energy Prediction Worksheet to each student.

4. Have students describe the size and shape of each reservoir. Ask students which dam provides a reservoir with the greatest potential energy. Release water, one tray at a time. Have students make observations and discuss results. Discuss the energy efficiency of hydroelectric dams.

5. Distribute the **Hydroelectric Energy Guided Reading** worksheet to each student.

6. Instruct students to go to the Student Resources Web page and click on the **About Hydroelectric Energy** link.

7. Instruct students to read the hydroelectric energy content Web pages. Clarify any terms and concepts as needed and give some relevant examples.

8. Instruct students to answer questions on their worksheets as they read.

9. Use the **hydroelectric dam** image to illustrate how power is generated. Emphasize that the water behind the dam spins a turbine that generate electricity. This electricity is transported to the grid.

10. Review content and discuss aloud student responses to the questions on their worksheets. Respond to any questions students have. Have students close their Web browser when they finish.

Materials Needed:

Water Force Demonstration
3 waterproof pans modeling clay (about 5 lbs each tray)
3 small figures (i.e. army men or plastic animals)

Handouts
(1) Hydroelectric Dam Energy Demonstration Teacher Guide (PDF / MS Word)
(2) Optional: Hydroelectric Dam Energy Prediction Worksheet (PDF / MS Word)
(3) Hydroelectric Energy Guided Reading Worksheet (PDF / MS Word)

Assessment Information
Hydroelectric Energy Guided Reading Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Hydropower (PDF)

Teacher Resources/Content Support
Hydropower
Energy Basics

Day 14
Hydroelectric Energy. Students will use Google Earth to examine diverse dams in the world and infer why dams are placed near population centers. Students will use the measurement tool to measure dam widths and the distances from each dam to nearby population centers.

1. Begin the class by asking students to write in their journals the names of any two dams in the USA.

2. Inform students that they will use Google Earth to explore hydroelectric dams around the world.

3. Distribute the **Exploring Hydroelectric Dams with Google Earth** handout and worksheet to each student.

4. Use an LCD projector to display Google Earth to the front of the room.

5. Ask students to launch Google Earth on their computers.

6. Instruct students to download the **Hydroelectric dams** KML file and view the file in Google Earth.

7. Show students how to navigate from one dam to the next.

8. Model how to use the **Ruler Tool** in Google Earth to measure the width and distance of the first dam (Hoover) to the nearby population center.

NOTE: We recommend that you explain to students how they should measure the width of the dams. For example, have students measure from the left riverbank to the right riverbank or across the whole dam structure. The assessment information takes into account these variations.

9. Have students repeat this task on their computers. Have students measure the dam width and distance of each dam to nearby population center. Provide guidance as students do the activity.

10. Ask students to answer questions on their worksheets.

Helpful hint 1: Students will need to zoom out to view a population center near the dam. Have students look for the nearest population center that is marked in the Google Earth 3D viewer with a small red circle.

Helpful hint 2: Some dams have more than one water release gate. Instruct students to measure each one and add the segments together to determine the width of the dam.

11. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save Google Earth when they finish.

12. At the completion of the activity, if students do not observe that most dams have a large upstream reservoir and a more narrow downstream area, modify instruction to ensure students observe this pattern.

Materials Needed:

Handouts
(1) Exploring Hydroelectric Dams with Google Earth Teacher Guide (PDF / MS Word)
(2) Exploring Hydroelectric Dams with Google Earth Student Handout (PDF / MS Word)
(3) Exploring Hydroelectric Dams with Google Earth Worksheet (PDF / MS Word)

KML File
Hydroelectric Dams.kml

Assessment Information
Exploring Hydroelectric Dams with Google Earth Assessment (PDF / MS Word)

Teacher Resources/Content Support
Hydropower
Energy Basics

Day 15
Hydroelectric Energy. Students will use My World GIS to examine and query features of hydroelectric dams in the United States. Students will examine a shape file of 1,184 hydroelectric dams and analyze dams by height of dam, year of completion, river name, state name, watershed, reservoir volume, and capacity.

1. Begin the class by asking students to respond to the following question in their journal: How would you determine the best place to locate a hydroelectric power dam?

2. Inform students that they will use My World GIS to examine and query hydroelectric dams in the USA.

3. Distribute the Investigating Hydroelectric Dams with My World GIS handout and worksheet to each student.

4. Use an LCD projector to display My World GIS at the front of the room.

5. Instruct students to download the Hydro_Map_MW.m3vz on to their computers from the Student Resources Web page.

6. Ask students to open the Hydro_Map_MW.m3vz file in My World GIS on their computers.

7. Model how to use the Analyze Mode to analyze dam features (height of dam, year of completion, river name, state name, watershed, reservoir volume, and capacity). Have students repeat this task on their computers as they answer questions on their worksheets. Provide guidance. End at Step 4 on the handout. If time allows, have students begin Step 5.

8. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and save any changes they made to their My World GIS file when they finish.

9. Instruct students save and rename their file (Hydro_Map_MW_initials.m3vz) initials=student's initials.

10. Instruct students to move their Hydro_Map_MW_initials.m3vz file from the desktop to their server space or to another secure location.

11. Collect the handouts and worksheets.

Materials Needed:

Handouts
(1) Investigating Hydroelectric Dams with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Hydroelectric Dams with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Hydroelectric Dams with My World GIS Worksheet (PDF / MS Word)

GIS File
Hydro_Map_MW.m3vz

Assessment Information
Investigating Hydroelectric Dams with My World GIS Assessment (PDF / MS Word)

Teacher Resources/Content Support
Hydropower
Electricity Generation

Day 16
Hydroelectric Energy. Students will examine the 10 most powerful USA dams. Students will then create and analyze a layer of all Pennsylvania dams. Students will query Pennsylvania dams by height of dam, year of completion, river name, state name, watershed, reservoir volume, and capacity.

1. Inform students that they will continue to use My World GIS to examine and query hydroelectric dams.

2. Distribute the **Investigating Hydroelectric Dams with My World GIS** handouts and worksheets.

3. Use an LCD projector to display My World at the front of the room.

4. Ask students to open their **Hydro_Map_MW.m3vz** file in My World on their computers. (If needed, have students download the file from the Student Resources Web page)

5. Model how to use the **Analyze Mode** to analyze the 10 most powerful dams in the USA, and analyze dam features on PA rivers (height of dam, year of completion, river name, state name, watershed, reservoir volume, and capacity).

6. Show students how to read the data table. Ask students to do task on their computers and provide guidance.

7. Instruct students to answer questions on their worksheets.

8. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save My World GIS when they finish.

Materials Needed:

Handouts
(1) Investigating Hydroelectric Dams with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Hydroelectric Dams with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Hydroelectric Dams with My World GIS Worksheet (PDF / MS Word)

GIS File
Hydro_Map_MW.m3vz

Assessment Information
Investigating Hydroelectric Dams with My World GIS Assessment (PDF / MS Word)

Teacher Resources/Content Support
Hydropower
Electricity Generation

Day 17
Hydroelectric Energy. Students will use Google Earth to view energy-generating facilities on the Allegheny and Susquehanna Rivers. Students will take a Google Earth tour of 5 major hydroelectric facilities in Pennsylvania: Allegheny River (Seneca Pumped Storage Generating Station and Kinzua Dam) and Susquehanna River (Holtwood Dam, Safe Harbor Dam, and York Haven). Students will then explore the Three Mile Island nuclear power plant.

1. Begin the class by asking students to write in their journals the names of any two dams in Pennsylvania.

2. Inform students that they will use Google Earth to examine energy-generating facilities on the Allegheny and Susquehanna Rivers in Pennsylvania.

3. Distribute the Exploring Pennsylvania Energy on the River with Google Earth handout and worksheet to each student.

4. Use an LCD projector to display Google Earth at the front of the room.

5. Ask students to launch Google Earth on their computers.

6. Instruct students to download the PA Energy KML file from the student resources Web page and view the file in Google Earth.

7. Show students how to navigate from one energy-generating facility to the next on the Allegheny and the Susquehanna Rivers.

8. Show students how to measure the width of the dams.

9. Have students complete the activity and answer questions on their worksheets. Provide guidance.

Helpful hint: Tell students they will need to zoom out to view a population center near the dam. The nearest population center is marked with a small circle.

10. Ask students what kind of energy is generated at Three Mile Island.

11. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save Google Earth when they finish.

12. Provide guiding, reflective questions for students to respond in their journals what they learned about hydroelectric energy.

Materials Needed:

Handouts
(1) Exploring Pennsylvania Energy on the River with Google Earth Teacher Guide (PDF / MS Word)
(2) Exploring Pennsylvania Energy on the River with Google Earth Student Handout (PDF / MS Word)
(3) Exploring Pennsylvania Energy on the River with Google Earth Worksheet (PDF / MS Word)

KML File
PA Energy.kml

Assessment Information
Exploring Pennsylvania Energy on the River with Google Earth Assessment (PDF / MS Word)

Teacher Resources/Content Support
Hydropower
Electricity Generation

Day 18
Nuclear Energy. Students will learn how nuclear power is generated and how nuclear chain reactions occur.

1. Begin class by asking students to respond to the following question in their journal: What is nuclear energy?

2. Show the Nuclear Reactors video clip. We recommend that you download the file (nuclear_reactors.mov) from the Web site and play locally on your computer at double size.

3. Inform students that they will learn about nuclear energy.

4. Distribute the **Nuclear Energy Guided Reading** worksheet to each student.

5. Ask students to go to the Student Resources Web page and click on the **About Nuclear Energy** link.

6. Instruct students to read the nuclear energy Web pages. Explain key terms and concepts as needed and provide relevant examples.

7. Ask students to complete the **Nuclear Energy Guided Reading** worksheet.

8. Use an LCD projector to display the last Web page that shows the US night sky image and locations of US nuclear power plants at the front of the room. Prompt students to think about similarities among observed patterns in the two images. Discuss aloud observed patterns.

9. Review content and discuss aloud student responses to the questions on their worksheets. Respond to any questions students have. Have students close their Web browser when they finish.

10. Provide guiding, reflective questions for students to respond in their journals what they learned about nuclear energy.

Materials Needed:

Video
Nuclear Reactors Video Clip (QuickTime video)

Handout
Nuclear Energy Guided Reading Worksheet (PDF / MS Word)

Assessment Information
Nuclear Energy Guided Reading Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Nuclear Energy (PDF)

Teacher Resources/Content Support
Nuclear Energy

Day 19

Geothermal Energy. Students will be introduced to geothermal energy. Using Google Earth, they will explore features of "hot Earth" areas in Iceland and in the United States. They will determine the best place to locate a geothermal power plant in the Northwest United States.

1. Begin the class by asking students to respond to the following question in their journal: What is geothermal energy?

2. Inform students that they will learn about geothermal energy.

3. Use an LCD to display the "**Hot Earth**" video clip. This is a series of Iceland hotspots that include hot spots near power plants in Iceland, the Blue lagoon, bubbling mud, fumaroles, an active volcano area, and a geyser area.

4. Introduce students to concepts related to geothermal energy. Highlight the two main applications of geothermal energy, ambient ground heat and hot Earth spots (areas with high geothermal gradients. Discuss geothermal energy uses from ambient warm ground sources. Emphasize the geological limitations of geothermal energy use.

5. Distribute the **Where is the Best Place to Locate a Geothermal Power Plant?** handout and worksheet to each student.

6. Use an LCD projector to display Google Earth at the front of the room.

7. Ask students to launch Google Earth on their computers.

8. Instruct students to download the **Hot Earth Areas** KML file and view the file in Google Earth. Model how to turn the red overlays off.

9. Illustrate how to describe the features of geothermal areas. Have students investigate where the earth is hot and complete the data chart on their worksheets. Provide guidance.

Helpful hint: Tell students they can use the navigation controls at the top right of the screen to explore features in more detail.

9. Instruct students to download the **Metropolitan Areas** KML file and view the file in Google Earth. Have students answer questions on their worksheets.

10. Review and discuss aloud student responses to key questions. Respond to any questions students have. Have students close and not save Google Earth when they finish.

11. If students at the completion of the activity do not understand that hot Earth areas are needed to locate a geothermal power plant, modify instruction to ensure students understand this concept.

12. Provide guiding, reflective questions for students to respond in their journals what they learned about geothermal energy.

Materials Needed:

Video
Hot Earth Video Clip (QuickTime video)

Handouts
(1) Where is the Best Place to Locate a Geothermal Power Plant? Teacher Guide (PDF / MS Word)
(2) Where is the Best Place to Locate a Geothermal Power Plant? Student Handout (PDF / MS Word)
(3) Where is the Best Place to Locate a Geothermal Power Plant? Worksheet (PDF / MS Word)

KML Files
(1) Hot Earth Areas.kml
(2) Metropolitan Areas.kml

Assessment Information
Exploring Hot Earth Areas with Google Earth Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Geothermal Energy (PDF)

Teacher Resources/Content Support
Geothermal Energy

Day 20
Biofuels/Biomass. Students will be introduced to biofuels and biomass and understand why it is a renewable energy source. They will explore uses of both historic biofuels (wood, whale oil) and current biofuels (biodiesel, ethanol and cellulose). Students will learn about current ethanol production issues (for example, using corn vs. switch grass as a biofuel).

1. Ask students to respond to the following question in their journals: What is biomass?

2. Click here to display an image of wood, straw, a cow patty, corn, and a pond of algae scum.

3. Inform students that they will learn about biomass and biofuels. Ask learners what they know about biomass/biofuels.

4. Distribute the **Exploring Biofuels** worksheet to each student. Have students go to the **About Biofuels/Biomass** link on the students resources page and read about biofuels/biomass.

5. Discuss the following key points with students:

- Highlight that wood has previously been used in the past in developed countries as a fuel source for heating homes and for cooking purposes. Wood is still used today for heating and cooking in developing countries.
- Discuss the use of biomass sources for heating fuel, electricity, and transportation needs. Give adequate examples.

6. Ask students to answer the questions on their worksheets as they read.

7. Review content and discuss aloud student responses to key questions on their worksheets. Respond to any questions students have. Have students close their Web browser when they finish.

Materials Needed:

Handout
Exploring Biofuels Worksheet (PDF / MS Word)

Assessment Information
Exploring Biofuels Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Biomass (PDF)

Teacher Resources/Content Support
Biofuels

Day 21
Biofuels: Cellulose Lab. Students will investigate how to optimally prepare a biofuel source for conversion to a combustible product. In a lab activity, students will break down cellulose from paper pulp to release the sugar component. The "releasing variable" will be tested. These include: water, cellulase, and rubbing alcohol. This activity models how the raw materials are refined to process liquid fuels.

Important: Please read the **Biofuels: Cellulose Teacher Guide** prior to using this laboratory activity. This guide provides you with all information for equipment and set up for this laboratory investigation.

1. Begin the class by asking the driving question: How is biomass processed to become a biofuel?

2. Tell students they will investigate how to prepare a biofuel source for conversion to a product that can be burned.

3. Divide students into groups of 4. Distribute the **Biofuels: Cellulose lab** worksheet to students and instruct students to read through the procedure.

4. Show students how to mark measurements on their test tubes.

5. Ask students to make predictions then have them conduct the laboratory activity.

6. Have students make observations and form their explanations.

7. Have students evaluate their explanations. Instruct students to complete their worksheets.

8. Ask student groups to share their conclusions with the class and explain them.

9. Address any misconceptions students may have. Review and discuss aloud student responses to the analysis and conclusion items on the Biofuels: Cellulose lab worksheet. Respond to any questions students have.

10. If students at the completion of the investigation do not understand that biofuel production may involve an enzymatic reaction to release sugars that are then fermented to create a fuel, modify instruction to ensure students understand this concept.

11. Provide guiding, reflective questions for students to respond in their journals what they learned about biofuels/biomass.

Materials Needed:

Handouts
(1) Biofuels: Cellulose Lab Worksheet (PDF / MS Word)
(2) Biofuels: Cellulose Lab Teacher Guide (PDF / MS Word)

Assessment Information
Biofuels: Cellulose Lab Assessment (PDF / MS Word)

Teacher Resources/Content Support
Biofuels

Day 22
US Energy Production and Consumption. Students will compare and contrast regional energy production of 5 different US regions (California, Illinois, Pennsylvania, Texas, and Washington). Students will also analyze production and consumption data of US energy sources data for both renewable and nonrenewable energy sources.

1. Begin the class by asking students to respond to the following question in their journal: What is the difference between renewable and non-renewable sources of energy?

2. Ask students to name some examples of renewable and non-renewable sources of energy.

3. Inform students that they will examine US energy production and consumption.

4. Distribute the Exploring Energy Production and Consumption handout and worksheet to each student.

5. Ask students to go the student resources Web page and click on the US Energy Production and Consumption link.

6. Use an LCD projector to display the 2006 Regional Energy Production in the United States Web page and show students how to examine the pie charts.

7. Have students examine the pie charts of regions with different energy mixes (California, Illinois, Pennsylvania, Texas, and Washington). Have students fill in the 2006 Regional Energy Production Data Chart and answer questions 1-4 on their worksheets.

8. Display the 2007 Energy Production and Imports in the United States Web page on the LCD projector. Explain the pie charts to the students.

9. Have students examine the 2007 Energy Production and Imports in the United States pie charts and answer questions 5-8 on the their worksheets.

10. Instruct students to next, examine the 2007 Energy Production in the United States pie charts. Have students answer questions 9-12 on the their worksheets.

11. Review and discuss aloud the production and imports data and student responses to key questions. Respond to any questions students have.

12. Collect the student worksheets.

Materials Needed:

Handout
Exploring Energy Production and Consumption Worksheet (PDF / MS Word)

Assessment Information
Exploring Energy Production and Consumption Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Uses of Energy (PDF)

Teacher Resources/Content Support
US Energy Resources

Day 23
US Energy Production and Consumption. Students will analyze energy consumption data across the industrial, transportation, commercial, and residential sectors. Students will analyze electricity distribution data to understand that the current US grid for electricity distribution is not efficient.

1. Inform students that they will continue to examine US energy production and consumption.

2. Give the **Exploring Energy Production and Consumption** worksheets back to the students.

3. Instruct students to next, examine the **2007 Energy Consumption in the United States** pie charts. Have students answer questions 13-15 on the their worksheets.

4. Instruct students to next, examine the pie charts on the **2007 US Energy Consumption by Sector** Web pages. Have students answer questions 16-31 on the their worksheets.

5. Instruct students to next, examine the **2007 Electricity Generation in the United States** pie charts. Have students answer questions 32-37 on the their worksheets.

6. Discuss aloud the consumption and electricity generation data and student responses to key questions. Respond to any questions students have.

7. Review key concepts of US energy production and consumption.

8. Provide guiding, reflective questions for students to respond in their journals what they learned about US energy production and consumption.

Materials Needed:

Handout
Exploring Energy Production and Consumption Worksheet (PDF / MS Word)

Assessment Information
Exploring Energy Production and Consumption Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Uses of Energy (PDF)

Teacher Resources/Content Support
US Energy Resources

Day 24
Fossil Fuels. Students will be introduced to fossil fuels. Students will learn how fossil fuels originate, how long they take to form, how they are transported from their sources, and how they are altered for energy use. Students will understand that fossil fuels are nonrenewable and are altered for energy use.

1. Ask students to respond to the following question in their journals: What are fossil fuels?

2. Display 4 objects that originate from fossil fuels at the front of the room. Ask students where those materials originate. (Examples: Coal - medicine, plastic, paper; Petroleum - ink, crayons, bubble gum, dish washing liquid)

3. Inform students they will learn about fossil fuels. Ask students what they know about how fossil fuels are formed.

4. Use an LCD projector to show the **Fossil Fuels video clip** at the front of the room**.** We recommend that you download the file (fossil_fuels.mov) from the Web site and play locally on your computer at double size.

5. Show students the **Fossil Fuels Formation Animation** and the **Oil and Natural Gas Formation Animation**. Explain these formation processes to students.

6. Distribute the **Fossil Fuels Guided Reading** worksheet to each student. Have students go the student resources Web page and click on the **About Fossil Fuels** link.

7. Instruct students to read the fossil fuels content Web pages and answer questions on their worksheets.

8. Discuss key terms and concepts on the fossil fuels Web pages as needed. Explain the term "nonrenewable energy," emphasize that fossil fuels are nonrenewable, and inform students that coal is the primary source of electricity.

9. Review content and discuss aloud student responses to the questions on their worksheets. Respond to any questions students have. Have students close their Web browser when they finish.

Materials Needed:

Videos
(1) Fossil Fuels Video Clip (QuickTime video)
(2) Fossil Fuels Formation Animation (QuickTime video)
(3) Oil and Natural Gas Formation Animation (Web video)

Handout
Fossil Fuels Guided Reading Worksheet (PDF / MS Word)

Assessment Information
Fossil Fuels Guided Reading Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Nonrenewable Energy (PDF)

Teacher Resources/Content Support
Fossil Fuels

Day 25

Petroleum (crude oil). Students will use My World GIS to investigate countries with petroleum (crude oil) reserves. Students will use My World GIS to analyze petroleum (crude oil) production and consumption for different countries. Students will examine how petroleum (crude oil) consumption and production have changed over a 28-year period, 1980 - 2008, both worldwide and in the US. They will also analyze relationships among countries' petroleum (crude oil) consumption and their populations.

1. Ask students to respond to the following question in their journals. What is petroleum commonly used for?

2. Inform students that they will investigate countries with oil reserves and analyze petroleum (crude oil) production and consumption of countries.

3. Distribute the **Investigating Oil Production and Consumption with My World GIS** handout and worksheet to each student.

4. Instruct students to download the **Oil Map.m3vz** on to their computers from the student resources Web page and open it in My World GIS.

5. Use an LCD projector to display My World at the front of the room. Model how to sort columns in ascending and descending order.

6. Have students examine worldwide oil reserves. Instruct students to answer questions on their worksheets.

7. Model how to use the **Analyze Mode** to analyze oil production, consumption, and population data. Illustrate how to do this with an example.

8. Ask students to use the analyze mode to do the activity as they answer questions on their worksheets. Guide learners as they do the task.

9. Review and discuss student responses to key questions. Respond to any questions students have.

10. If students at the completion of the activity do not understand that in most countries, as population increases so does a country's oil consumption, modify instruction to ensure students understand this concept.

11. Have students close and not save any changes they made to the My World GIS file when they finish (if other students in later classes will use the file).

Materials Needed:

Handouts

(1) Investigating Oil Production and Consumption with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Oil Production and Consumption with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Oil Production and Consumption with My World GIS Worksheet (PDF / MS Word)

GIS File

Oil Map.m3vz

Assessment Information

Investigating Oil Production and Consumption with My World GIS Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Petroleum (PDF)

Teacher Resources/Content Support
Fossil Fuels

Day 26

Natural Gas. Students will use My World GIS to investigate countries with natural gas reserves. Students will use My World GIS to investigate natural gas production and consumption for different countries. Students will examine how natural gas consumption and production have changed over a 28-year period, 1980 - 2008, both worldwide and in the US. They will also analyze relationships among countries' natural gas consumption and their populations.

1. Ask students to respond to the following question in their journals. What is natural gas commonly used for?

2. Inform students that they will investigate countries with natural gas reserves and analyze natural gas production and consumption of countries.

3. Distribute the Investigating Natural Gas Production and Consumption with My World GIS handout and worksheet to each student.

4. Use an LCD projector to display My World at the front of the room.

5. Instruct students to download the Gas Map.m3vz on to their computers from the student resources Web page.

6. Ask students to open the Gas Map.m3vz file in My World GIS.

7. Have students examine worldwide natural reserves. Instruct students to answer questions on their worksheets.

8. Model how to use the Analyze Mode to analyze natural gas production, consumption, and population data. Illustrate how to do this with an example.

9. Have students repeat this task on their computers as they answer questions on their worksheets. Guide the students as they do the task.

10. Review and discuss student responses to key questions. Respond to any questions students have. Have students close and not save any changes they made to the My World GIS file when they finish (if other students in later classes will use the file).

Materials Needed:

Handouts

(1) Investigating Natural Gas Production and Consumption with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Natural Gas Production and Consumption with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Natural Gas Production and Consumption with My World GIS Worksheet (PDF / MS Word)

GIS File

Gas Map.m3vz

Assessment Information

Investigating Natural Gas Production and Consumption with My World GIS Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Natural Gas (PDF)

Teacher Resources/Content Support
Fossil Fuels

Day 27
Coal. Students will use My World GIS to investigate where coal reserves are located in the USA. Students will use My World GIS to investigate coal production and consumption for different countries. Students will examine how coal consumption and production have changed over a 28-year period, 1980 - 2008, both worldwide and in the US. They will also analyze relationships between coal consumption and country populations.

1. Ask students to respond to the following question in their journals. What is coal commonly used for?

2. Inform students that they will investigate US coal reserves and analyze coal production and consumption of countries.

3. Distribute the **Investigating Coal Production and Consumption with My World GIS** handout and worksheet to each student.

4.Instruct students to download the **Coal Map.m3vz** on to their computers from the student resources Web page and open it in My World GIS.

5. Have students examine USA and worldwide coal reserves. Instruct students to answer questions on their worksheets.

6. Use an LCD projector to display My World at the front of the room. Model how to use the **Analyze Mode** to analyze coal production, consumption, and population data. Illustrate how to do this with an example.

7. Have students repeat this task on their computers as they answer questions on their worksheets. Guide the students as they do the task.

8. Review and discuss aloud student responses to key questions. Respond to any questions students have.

9. If students at the completion of the activity do not understand that in many countries, as population increases so does a country's coal consumption, modify instruction to ensure students understand this concept.

10. Have students close and not save any changes they made to the My World GIS file when they finish (if other students in later classes will use the file).

11. Provide guiding, reflective questions for students to respond in their journals what they learned about fossil fuels.

Materials Needed:

Handouts
(1) Investigating Coal Production and Consumption with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Coal Production and Consumption with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Coal Production and Consumption with My World GIS Worksheet (PDF / MS Word)

GIS File
Coal Map.m3vz

Assessment Information
Investigating Coal Production and Consumption with My World GIS Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Coal (PDF)

Teacher Resources/Content Support
Fossil Fuels

Day 28
Energy Sources. Students will investigate different ways that energy can be conserved. They will revisit their energy audit. For each activity in the audit, students will list the main energy use and the main source(s) of the energy for that activity. (for example, turn on light switch -> electricity -> coal; trip to mall -> gas for transportation -> oil; shower -> heating water -> electricity or oil). Students will identify connections among energy use types and energy fuel sources.

1. Begin the class by asking students to respond to the following question in their journal: How can we conserve energy?

2. Inform students that they will investigate ways of conserving energy.

3. Instruct students to open their energy audits and add two new columns to it, "Uses for Energy" and "Energy Source."

4. Illustrate how to complete the two new columns.

5. Ask students to list the main energy use and main energy source(s) for each activity on their energy audits. Guide the students as they do the task.

6. Ask students to write responses to the following questions in their journals.

a. Think about the different energy sources you use for your daily activities. Why are those sources used and not others?
b. How can I use less energy in my daily activities?
c. Why do we need to conserve energy?

7. Review and discuss aloud student responses. Respond to any questions students have.

8. If students at the completion of the activity do not understand that most of their electricity production comes from fossil fuels or nuclear energy sources and their transportation uses rely primarily on fossil fuels, modify instruction to ensure students understand this concept.

Materials Needed:

Handouts
(1) Personal Energy Audit: Sources Teacher Guide (PDF / MS Word)
(2) Personal Energy Audit: Sources Student Handout (PDF / MS Word)

Assessment Information
Personal Energy Audit: Sources Assessment (PDF / MS Word)

Supplemental Homework Readings for Students
Energy Efficiency (PDF)

Teacher Resources/Content Support
Energy Basics

Day 29
Energy Efficiency. Students will investigate concepts about energy efficiency and heat output by measuring the heat emitted from different light bulbs.

Important: Please read the Energy Efficiency Lab Teacher Guide prior to using this laboratory activity. This guide provides you with all information for equipment and set up for this laboratory investigation.

1. Ask students to respond to this question in their journals: What is energy efficiency?

2. Inform students they will investigate the amount of energy used by different light bulb types.

3. Divide the class into groups of 4. Distribute the **Energy Efficient Lab** handout and worksheet to each student.

4. Illustrate how to measure the temperature and record the measurements.

5. Ask students to make predictions. Instruct students to complete observations for one light bulb station at a time for a maximum of 7 minutes. After 5-7 minutes, instruct student groups to rotate to a new light bulb station. Continue until student groups have completed their Light Bulb Activity Data Collection data chart for all four stations.

6. Have students make observations and form explanations.

7. Instruct students to evaluate their explanations and draw conclusions. Ask students to complete the Analysis section on their worksheet.

8. Ask student groups to share their conclusions with the class and explain them.

9. Address any misconceptions students may have. Review and discuss question responses from the students' worksheets. See Energy Efficiency Lab Assessment for sample answers.

10. If students at the completion of the activity do not understand the main concepts of energy efficiency and heat output, modify future instruction to provide time to revisit these concepts.

Optional extension activity - GO Figure:

1. Instruct students to read The Problem on the student instructions handout.

2. Have students use the handout to learn how to read an energy label.

3. If students are using the spreadsheet for their calculations, instruct students to download the GO Figure spreadsheet from the Energy Unit Student Resources Web page. Prompt students to follow the GO Figure Spreadsheet version instructions on their instruction sheet. If students are using the manual table for their calculations, prompt students to follow the GO Figure Manual Table version instructions on their instruction sheet.

4. Instruct students to complete the GO Figure Data Collection Table and the Analysis section on the worksheet.

5. Instruct students to complete the Conclusions section on their worksheet after they have completed the Light Bulb lab and GO Figure data tables and analysis questions.

6. Discuss aloud student findings and conclusions. Respond to any questions students have.

Materials Needed:

Spreadsheet
GO Figure

Handouts
(1) Energy Efficiency Lab Teacher Guide (PDF / MS Word)
(2) Energy Efficiency Lab Student Handout (PDF / MS Word)
(3) Energy Efficiency Lab Student Worksheet (PDF / MS Word)

Assessment Information
Energy Efficiency Lab Assessment (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics

Day 30
Energy Audit. Students will recalculate their personal and household energy audits based on current use practices and compare it to their initial audit. Student will recalculate their energy audit and identify additional energy conservation practices they could implement. Students will reflect on new energy consumption practices and provide reasons for their behavioral changes.

1. Ask students to respond to this question in their journals: What does energy conservation mean?

2. Inform students that they will recalculate their energy audits based on their current consumption.

3. Ask students to open Audit 2 on their energy audit spreadsheet.

4. Illustrate to students how to complete the spreadsheet.

5. Instruct students to recalculate their personal energy audits based on their current practices. Guide the students as they do the task.

6. Instruct students to compare their energy consumption and costs from the two audits.

7. Have students write "YES" or "NO" in the **Energy Reduction** spreadsheet column for each energy use on the spreadsheet.

8. Instruct students to list in the **Conservation Changes** spreadsheet column new conservation practice(s) they did over the past 6 weeks.

9. Review and discuss student responses. Respond to any questions students have.

Materials Needed:

Handouts
(1) Personal Energy Audit: Revisiting Your Use Teacher Guide (PDF / MS Word)
(2) Personal Energy Audit: Revisiting Your Use Student Handout (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics

Day 31
Energy Conservation. Students will justify their conservation practice changes on their energy audit spreadsheets. Students will look at their energy audit and generate a list of "Ways they can conserve energy".

1. Inform the students that they will justify their energy conservation practices.

2. Distribute the **Personal Energy Audit: Revisit** worksheet to each student.

3. Instruct students to respond to the questions on their worksheets. Instruct students to analyze their energy audit spreadsheet.

4. Review worksheet responses with students. Discuss ways students reduced their personal energy consumption, the difficulties they had, and ways their family can reduce their household energy consumption.

5. Prompt students to think about additional ways to conserve energy.

6. If students at the completion of the activity do not understand that utilizing energy conservation practices reduces their energy consumption and costs, modify instruction to ensure students understand this concept.

7. Provide guiding, reflective questions for students to respond in their journals what they learned about energy efficiency and conservation.

Materials Needed:
Students' completed energy audit

Handouts
Personal Energy Audit: Revisit Worksheet (PDF / MS Word)

Assessment Information
Personal Energy Audit: Revisit Assessment (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics

Day 32
Impacts of Energy Sources. Students will explore the advantages and disadvantages of the following energy sources - solar, wind, hydroelectric power, nuclear, geothermal, tidal, biomass, coal, oil, and natural gas.

1. Ask students to name some advantages and disadvantages of different energy sources.

2. Inform students that they will learn about advantages and disadvantages of each energy source.

2. Distribute the **Impacts of Energy Sources** worksheet to each student.

3. Ask students to go to the student resources Web page and click on the **Impacts of Energy Sources** link.

4. Ask students to read the content on the Web pages and complete the **Impacts of Energy Sources table** on their worksheets.

5. Discuss the advantages and disadvantages of the energy sources reviewed during the class period. Respond to any questions students have.

6. Collect student worksheets. This activity will be continued on the next day.

Materials Needed:

Handout
Impacts of Energy Sources Worksheet (PDF / MS Word)

Assessment Information
Impacts of Energy Sources Assessment (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics

Day 33
Impacts of Energy Sources. Students will explore and analyze the advantages and disadvantages of the following energy sources - solar, wind, hydroelectric power, nuclear, geothermal, tidal, biomass, coal, oil, and natural gas.

1. Inform students that they will continue to explore the advantages and disadvantages of each energy source.

2. Distribute the **Impacts of Energy Sources** worksheet to each student.

3. Ask students to go to the student resources Web page and click on the **Impacts of Energy Sources** link.

4. Ask students to read the content on the Web pages and complete the **Impacts of Energy Sources** table on their worksheets.

5. Instruct students to complete the **Analyze your data** section on the worksheet.

6. Review and discuss the advantages of the renewable energy sources and the disadvantages of the nonrenewable energy sources. Respond to any questions students have.

7. If students at the completion of the activity do not understand the main advantages of renewable energy sources or the main disadvantages of nonrenewable energy sources, modify instruction to revisit these concepts.

8. Collect the student worksheets. They will need these worksheets to complete the **Investigating Energy Resources for the Isle of Navitas** activity.

9. Provide guiding, reflective questions for students to respond in their journals what they learned about impacts of energy sources.

Materials Needed:

Handout
Impacts of Energy Sources Worksheet (PDF / MS Word)

Assessment Information
Impacts of Energy Sources Assessment (PDF / MS Word)

Teacher Resources/Content Support
Energy Basics

Day 34

Energy Resources for the Isle of Navitas. Students will explore energy resources for one of three provinces on the Isle of Navitas. They will analyze the benefits, costs, and environmental impacts of each energy source. Students will analyze energy resources for the island and develop an energy policy statement. The policy will recommend an efficient combination of energy sources to provide sufficient power to the province while minimizing environment impacts. Students will apply and use GIS tools and knowledge from past activities to make decisions for the placement of power plants in their province.

IMPORTANT NOTE: Prior to implementing this activity with your students, please refer to the
(1) Investigating Energy Resources for the Isle of Navitas with My World GIS Teacher Guide
(2) Investigating Energy Resources for the Isle of Navitas with My World GIS Assessments for each province
(3) Visual Guides to Assess the Isle of Navitas Activity for each province to assist you with additional content knowledge about this activity.

1. Ask students what factors must be put into consideration when planning for an efficient energy policy? Prompt students to think about issues such as production costs, transportation, and environmental impacts.

2. Inform students that this is a five-day activity in which they will first analyze energy resources for a province on the Isle of Navitas. They will then develop (1) an energy policy that will provide sufficient power for a province while minimizing the environmental impact, and (2) a short 5-minute PowerPoint presentation to present their proposed energy policy. They will present their energy policy and justify why their combination of energy sources will promote energy efficiency for the island population.

3. Introduce the term "**efficient energy policy**" and explain to students that an energy policy is a statement of government policy to address issues of energy development including energy production, distribution and consumption. An energy policy is used to determine from where the future energy sources in a province will come.

4. Present an overview of the Isle of Navitas activity to the students. Explain that they are the chief energy officer (CEO) of one of three provinces on the Isle of Navitas. It has a population of about 7,000,000 people. Their task is to explore the energy resources in their province using My World GIS and to recommend an efficient combination of energy sources that will minimize the impact on the environment. They will

- Explore energy resources for the Isle of Navitas.
- Analyze the benefits and costs of each energy source.
- Analyze the environmental impacts of each energy source.
- Recommend an efficient combination of energy sources for their province.

5. Divide students in groups of 3s. Assign each student team a province in the Isle of Navitas. Provide each student with:

- **Investigating Energy Resources for the Isle of Navitas with My World GIS Student Handout**
- **Investigating Energy Resources for the Isle of Navitas with My World GIS Student Worksheet**

6. Instruct students to write the name of their province on their **worksheet.**

7. Instruct students to download the **Navitas_Isle.m3vz** file from the **Student Resources Web page** and open the it in My World GIS.

8. Display the **Isle of Navitas GIS map** to the front of the room with an LCD projector. Show students where Iberia, Gaul, and Cambria are located on the GIS.

9. Highlight the different data layers on the GIS and model to students how to view the different energy sources.

10. Instruct student groups to explore the energy resources for their province and answer the questions on their worksheets for each energy resource. Guide students as they perform the task.

Implementation suggestion: For classes with students with special needs, you may wish to provide additional modeling, prompts and guidance for each energy source. You may wish to guide students through each question for the first energy source on the worksheet (hydroelectric power) before continuing to the next energy source (tidal energy).

11. Have students close and not save any changes they made to the My World GIS file when they finish (if other students in later classes will use the file).

Materials Needed:

Handouts
(1) Investigating Energy Resources for the Isle of Navitas with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Energy Resources for the Isle of Navitas with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Energy Resources for the Isle of Navitas with My World GIS Worksheet (PDF / MS Word)

GIS File
Navitas_Isle.m3vz

Assessment Information
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Cambria (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Cambria (PDF)
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Gaul (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Gaul (PDF)
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Iberia (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Iberia (PDF)

Day 35
Energy Resources for the Isle of Navitas. Students will explore energy resources for one of three provinces on the Isle of Navitas. They will analyze the benefits, costs, and environmental impacts of each energy source. Students will analyze energy resources for the island and develop an energy policy statement. The policy will recommend an efficient combination of energy sources to provide sufficient power to the province while minimizing environment impacts. Students will apply and use GIS tools and knowledge from past activities to make decisions for the placement of power plants in their province.

IMPORTANT NOTE: Prior to implementing this activity with your students, please refer to the
(1) Investigating Energy Resources for the Isle of Navitas with My World GIS Teacher Guide
(2) Investigating Energy Resources for the Isle of Navitas with My World GIS Assessments for each province
(3) Visual Guides to Assess the Isle of Navitas Activity for each province to assist you with additional content knowledge about this activity.

1. Instruct students to download the **Navitas_Isle.m3vz** file from the Student Resources Web page.

2. Ask students to open the **Navitas_Isle.m3vz** file in My World GIS.

3. Instruct student groups to continue to investigate the energy resources for their province and answer the questions on their worksheets for each energy resource.

Implementation suggestion: For classes with students with special needs, you may wish to provide additional modeling, prompts and guidance for each energy source. You may wish to guide students through each question for the first energy source on the worksheet before continuing to the next energy source.

4. Students should complete questions 2-7 on their worksheet.

5. Have students close and not save any changes they made to the My World GIS file when they finish (if other students in later classes will use the file).

Materials Needed:

Handouts
(1) Investigating Energy Resources for the Isle of Navitas with My World GIS Teacher Guide (PDF / MS Word)
(2) Investigating Energy Resources for the Isle of Navitas with My World GIS Student Handout (PDF / MS Word)
(3) Investigating Energy Resources for the Isle of Navitas with My World GIS Worksheet (PDF / MS Word)

GIS File
Navitas_Isle.m3vz

Assessment Information
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Cambria (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Cambria (PDF)
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Gaul (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Gaul (PDF)
Investigating Energy Resources for the Isle of Navitas with My World GIS Assessment-Province of Iberia

(PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Iberia (PDF)

Day 36

Energy Policy for the Isle of Navitas. Students will write an energy policy statement for their province that is based on the energy needs of their province, available energy sources, and infrastructure for production and distribution. The energy policy should maximize the use of renewable energy sources and minimize environmental impact. Students must justify their combination of energy sources based on benefits, costs, and impact assessments.

1. Inform students that they will write an energy policy statement and on the following day, they will develop a short 5-minute PowerPoint presentation of their policy.

2. Review student responses for questions 2-7 on the **Investigating Energy Resources for the Isle of Navitas with My World GIS** worksheet.

3. Discuss the costs, benefits, and environmental impacts of each energy resource.

4. Distribute the **Energy Policy for the Isle of Navitas** handout to each student.

5. Review the first page of the **Energy Policy for the Isle of Navitas** handout with your students. Be sure that students understand how to interpret the data that is presented in the table.

Emphasize the following:

- The annual energy need for each province is listed in the first row of the table. Cambria requires 7,340 Megawatts (MW), Gaul requires 19,200 MW, and Iberia requires 43,900 MW.
- In each province, different energy resources may contribute different amounts of energy. The maximum annual (yearly) amount of energy that could possibly be obtained from each energy resource that can contribute to a province's total energy need is listed in the table. All values are in Megawatts (MW). For example, the maximum amount of tidal energy that could be developed by Cambria each year is 200 MW. Tidal energy can contribute up to 1,000 MW in Gaul and up to 10,000 MW in Iberia each year.
- Some energy resources contribute 0 MW to a province. This means that this energy type does not have a source in the province. If a province wishes to use that particular energy resource, it must import that resource from a different province.
- Each energy source has an environmental impact. The ***Impact domestic*** column in the table below lists the relative environmental impacts (as related to the potential energy produced) for each energy source if it is acquired and used in the same province. The larger values have greater environmental impacts than smaller numbers in this column.
- The ***Impact imported*** column in the table below lists the relative environmental impacts for each energy source if it is acquired in one province and transported for use in a different province. These relative impact values are slightly larger that the values in the Impact domestic column. This is due to the fact that additional environmental impacts occur with transporting energy across provinces. Furthermore, additional infrastructure is also needed to move energy across provinces.

6. Instruct students to write an energy policy statement that recommends the most efficient energy mix that will have the minimal environmental impact for their province and to justify their selections. The energy policy statement should include:

- efficient combination of energy sources.
- the locations in the province to locate new energy-generating plants.
- major infrastructure (such as building facilities) required to develop the recommended energy sources.
- major transportation infrastructure (such as existing highways, railroad tracks, pipelines, and grid) required for the recommended energy sources.

- major benefits (such as free and unlimited supply, no/little pollution) of the recommended energy sources.
- the environmental impacts of the recommended energy sources.

Tell students that they will need to provide a justification for each part of their energy policy statement. You may wish to have students reference the resources on the Student Resources Web page to support their justifications.

7. Distribute the **Energy Policy for the Isle of Navitas Rubric** to each group. Have students read the rubric. Tell students that their energy policy statement needs to address each rubric criteria.

8. Have students begin to work on their policy statements.

9. Have students self-assess their policy statements with the **Energy Policy for the Isle of Navitas Rubric.**

Implementation Note: If you have curriculum time constraints, you may wish to have students use the **Energy Policy Presentation PowerPoint template** to construct the presentation. You may also wish to have students use the **Energy Policy Presentation PowerPoint template** to outline their energy policy statement.

Materials Needed:

Handouts
(1) Energy Policy for the Isle of Navitas Handout (PDF / MS Word)
(2) Energy Policy for the Isle of Navitas Rubric (PDF / MS Word)

GIS File
Navitas_Isle.m3vz

Energy Policy Presentation PowerPoint Template
Energy_policy_template.ppt

Day 37

Energy Policy for the Isle of Navitas. Students will write an energy policy statement for their province that is based on the energy needs of their province, available energy sources, and infrastructure for production and distribution. The energy policy should maximize the use of renewable energy sources and minimize environmental impact. Students must justify their combination of energy sources based on benefits, costs, and impact assessments. Students will develop their energy policy presentation.

1. Inform students that they will complete the writing of their energy policy statement and develop a short 5-minute PowerPoint presentation of their policy.

2. Review the guidelines for the energy policy presentation with the students.

Emphasize the following:

- The PowerPoint presentation can contain no more than 5 slides.
- Include at least one graphic of your province in your presentation. It is recommended that students take a screenshot from My World GIS and talk about locations for their proposed energy-generating plants during the presentation.
- Describe the recommended energy sources and the proposed energy-generating plant locations.
- Discuss the major infrastructure (such as building facilities) required to develop the recommended energy sources.
- Discuss the major transportation infrastructure (such as existing highways, railroad tracks, pipelines, and grid) required for the recommended energy sources.
- Discuss the major benefits (such as free and unlimited supply, no/little pollution) of the recommended energy sources.
- Discuss how the recommended energy sources will impact the environment.
- Recommend energy conservation ideas for the citizens of the Isle of Navitas.

3. Distribute the **Energy Policy for the Isle of Navitas Presentation Rubric** to each student.

4. Have students begin to work on their presentations.

5. Have students self-assess their presentations with the **Energy Policy for the Isle of Navitas Presentation Rubric.**

Materials Needed:

Handouts
(1) Energy Policy for the Isle of Navitas Handout (PDF / MS Word)
(2) Energy Policy for the Isle of Navitas Rubric (PDF / MS Word)
(3) Energy Policy for the Isle of Navitas Presentation Rubric (PDF / MS Word)

Energy Policy Presentation PowerPoint Template
Energy_policy_template.ppt

Day 38
Energy Policy for the Isle of Navitas Presentations. Students will present their energy policy for the island. Students will describe how their proposed combination of energy sources is efficient and has minimal environmental impact.

1. Inform students that they will present and explain their proposed energy policy to the island inhabitants. Remind students that their combination of energy sources must be efficient and have minimal environmental impact.

2. Give each student group 5 minutes to present their energy policy to the class.

3. Review and discuss students' energy policies for each province. Discuss key factors that contribute to efficient energy policies. You may wish to discuss the following energy source and distribution issues about the Isle of Navitas:

- Biofuels are an option for all provinces. Iberia and Cambria are better options for the use of biofuels as a power source because productive farmland is concentrated in those provinces. However, since Gaul is dominated by a wet climate and forested area, it is not well suited for farming.
- The Isle of Navitas can not allocate all biofuel resources to energy production because a percentage of agricultural crops need to be used for food.
- Cambria is the only province with uranium mines. It would be quite costly for Iberia and Gaul to develop required infrastructure to transport and process uranium.
- Iberia does not contain geothermal sources. Energy from geothermal sources must be transported via the grid from Cambria or Gaul.
- Iberia is the only province that contains fossil fuels (coal, oil, and natural gas). Significant infrastructure would be needed to transport energy from fossil fuels to Cambria and Gaul and would not be practical to undertake.
- There are some areas in Gaul that are not connected to the main grid of the Isle of Navitas. Such areas could develop localized power from renewable resources such as hydropower.
- While wind energy is a viable energy option in all provinces, one must take into account that some significant wind power areas are located in places of national significance.

Additional points for discussion are described in the Visual Guides.

Materials Needed:

Assessment Information
Energy Policy for the Isle of Navitas Presentation Rubric (PDF / MS Word)
Visual Guide to Assess the Isle of Navitas Activity-Province of Cambria (PDF)
Visual Guide to Assess the Isle of Navitas Activity-Province of Gaul (PDF)
Visual Guide to Assess the Isle of Navitas Activity-Province of Iberia (PDF)

Day 39
Unit Review. Students will review the whole unit. Students will revisit their concept maps and revise it as well as add what they have learned.

1. Inform students that they will review what they have learned and update their concept maps.

2. Review key concepts of the energy unit. Respond to any questions students have.

3. Instruct students to revise and add what they have learned to their concept maps. Provide guiding, reflective questions for students to think about the sources of energy, whether the energy sources are renewable or non-renewable, and environmental impacts.

4. Have students submit their completed concept maps.

Materials Needed:

Assessment Information
Concept Map Assessment (Inspiration / JPEG)

Teacher Resources/Content Support
Concepts in the Energy Unit

Day 40
Posttests. Students will take energy content knowledge and attitude and behavior posttests.

1. Instruct students to complete the **posttest assessments**.

Materials Needed:

Energy Unit Content Knowledge Posttest (PDF / MS Word)
Energy Unit Science and Technology Posttest (PDF / MS Word)
Energy Unit Attitude and Behavior Posttest (PDF / MS Word)

Assessment Information
Energy Unit Content Knowledge Posttest Key (PDF / MS Word)