imagination STATION

pure science. pure fun.

Energy Factory

Grades 1 - 4

Exhibit Guide

Presented by:

bp

First Solar

imaginationstationtoledo.org

Educators

Energy Factory

Grades 1 - 4

Dear Educator,

Welcome to the Imagination Station's field trip resource! With the assistance of area K-12 educators, the Imagination Station has created learning guides to help structure a field trip that aligns directly to the concepts you are teaching in the classroom.

Students will explore renewable and non-renewable energy in our newest Learning World, Energy Factory!

Your Energy Factory Exhibit Guide contains:

- Introduction- suggestions for using the guide, with key concepts included
- State Standards Alignment for both Ohio and Michigan
- Chaperone Page(s)- tips for facilitating exhibit explorations with students
- A Student Data Recording Page that will guide your class through exhibit-based explorations
- Extension Activities to do back in the classroom

How to Use This Guide:

- Review the guide.
- Customize the guide for your needs. You can have your students complete the entire guide or just a particular component, depending on your field trip objectives.
- Print off sufficient copies of the Student Data Recording Pages for each student.
- Print off copies of the Chaperone Pages for each of the chaperones. Divide your class into groups of 5-7 students and assign a chaperone to each group.
- Review the guide and your expectations with your students and prepare for a day of fun science learning at Imagination Station!
- **Science Suggestion:** Use this guide in combination with a science notebook so students can record observations and data throughout the day.
- **Teacher Tip:** Divide the guide into sections and have different groups complete different components. Each group can then report their findings to the class back at school.

Energy Factory

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Content Standards

Ohio's New Learning Standards

Grade 1 ESS:
Topic: Sun, Energy and Weather
The sun is the principal source of energy.
Sunlight warms Earth's land, air and water. The amount of exposure to sunlight affects the amount of warming or cooling of air, water and land.

GRADE 3 ESS:
Topic: Earth's Resources
Earth's nonliving resources have specific properties.
Soil is composed of pieces of rock, organic material, water and air and has characteristics that can be measured and observed. Rocks have unique characteristics that allow them to be sorted and classified. Rocks form in different ways. Air and water are nonliving resources.

Earth's resources can be used for energy.
Many of Earth's resources can be used for the energy they contain. Renewable energy is an energy resource, such as wind, water or solar energy, that is replenished within a short amount of time by natural processes. Nonrenewable energy is an energy resource, such as coal or oil, that is a finite energy source that cannot be replenished in a short amount of time.

Some of Earth's resources are limited.
Some of Earth's resources become limited due to overuse and/or contamination. Reducing resource use, decreasing waste and/or pollution, recycling and reusing can help conserve these resources.

GRADE 3 PS:
Topic: Matter and Forms of Energy
Heat, electrical energy, light, sound and magnetic energy are forms of energy.
There are many different forms of energy. Energy is the ability to cause motion or create change.

GRADE 3 LS:
Topic: Behavior, Growth and Changes
Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

GRADE 4 PS:
Topic: Electricity, Heat and Matter
Energy can be transformed from one form to another or can be transferred from one location to another.
Energy transfers from hot objects to cold objects as heat, resulting in a temperature change.

INQUIRY PRE K - 3

- *Observe and ask questions about the natural environment.*
- *Plan and conduct simple investigations.*
- *Employ simple equipment and tools to gather data and extend the senses.*
- *Use appropriate mathematics with data to construct reasonable explanations.*
- *Communicate about observations, investigations and explanations.*
- *Review and ask questions about the observations and explanations of others.*

Content Standards

Energy Factory

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Michigan Grade Level Content Expectations

Science Processes:

S.IP.E.1 and S.IP.M.1 Inquiry involves generating questions, conducting investigations and developing solutions to problems through reasoning and observation.

S.IA.E.1 and S.IA.M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research and investigations.

Physical Science:

P.EN.E.1 Forms of Energy: Heat, electricity, light and sound are forms of energy.

P.PM.E.3 Magnets: Magnets can repel or attract other magnets. Magnets can also attract magnetic objects. Magnets can attract and repel at a distance. *

P.PM.E.5 Conductive and Reflective Properties: Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.

Earth Science:

E.ES.E.1 Solar Energy: The sun warms the land, air and water and helps plants grow.

E.ES.E.4 Natural Resources: The supply of many natural resources is limited. Humans have devised methods for extending their use of natural resources through recycling, reuse and renewal.

E.ES.E.5 Human Impact: Humans depend on their natural and constructed environment. Humans change environments in ways that are helpful or harmful for themselves and other organisms.

E.SE.E.3 Using Earth Materials: Some Earth materials have properties that make them useful either in their present form or by being designed and modified to solve human problems. They can enhance the quality of life as in the case of materials used for building or fuels used for heating and transportation.

* Revised expectations.

Pre-Activity

Energy Factory

Student Handout *Grades 1 - 4*

Oil Origins

This formative assessment probe is designed to determine what your students know about fossils fuels and reveal how students trace oil back to its original source. *This activity has been adapted from a National Science Teacher Association resource.*

Read the following statements about oil. Circle the response that you most agree with.

Julie: "It came mostly from fossil remains of giant ferns and trees that lived millions of years ago."

Ross: "It came mostly from inside ancient rocks that melted inside the Earth millions of years ago."

Delores: "It came mostly from shallow ocean waters that changed into oil after millions of years."

Edie: "It came mostly from a gooey liquid that was inside ancient volcanoes millions of years ago."

Nathan: "It came mostly from the remains of dinosaurs that decayed millions of years ago."

Seth: "It came mostly from microscopic and other ocean organisms millions of years ago."

Justine: "It came mostly from ancient mud, sand and soil that eventually turned to liquid inside the Earth millions of years ago."

Malia: "It came mostly from gasoline that was trapped inside the Earth's crust for millions of years."

Cecelia: "It came mostly from the rotting blubber of ancient whales that lived millions of years ago."

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Oil Origins

Answer:
Seth has the best answer- "It came mostly from microscopic and other ocean organism millions of years ago."

Petroleum oil is generally thought to come from the fossil remains of tiny animals and plant-like marine organisms, such as phytoplankton and zooplankton. As the tiny organisms died, their bodies were collected on the seafloor and gradually buried under layers of sediment and rock. As the layers created pressure and heat, the organisms chemically changed into oil over millions of years. Julie's response applies to coal, which is formed from the remains of land vegetation, such as trees and giant ferns.

Note: *When you are delivering the assessment, make sure that you clarify that you are discussing petroleum oil, not other types of oil. For younger students, you may want to reduce the number of choices and remove the responses where the difference in response is much subtler.*

Curricular Relevance:
By understanding the source of oil, students are better able to make the distinction between renewable and nonrenewable resources. It may also help students to make the connection between fossil fuels and fossils. This will help them to understand why fossil fuels are considered to be nonrenewable. (However, note the potential misconceptions below).

Possible Student Misconceptions:
Students often think of the term 'fossils' to be synonymous with dinosaurs. This can lead to confusion about the source of fossil fuels. Additionally, popular culture often reinforces the idea that petroleum comes from dinosaurs by making this erroneous connection in advertisements and programming. Some students may also think that petroleum comes from whale blubber because whale oil was burned for energy before petroleum was discovered.

In a study comparing gifted students with their classmates, gifted students had similar misconceptions to their classmates and there was little difference in the number of students that held these misconceptions in both groups.

Suggestions for Instruction:
Some students believe that the Earth today is the same as it was in the past. Talking about what life was like millions of years ago helps students understand the long geological scale that it takes to create petroleum.

Challenge students to figure out why we cannot produce more oil as our supply runs low. If all we need to create petroleum is time, heat and pressure, why is it still a nonrenewable resource?

Misconceptions about fossil fuels often carry into adulthood. It is important that students understand the origins of fossil fuels so they can see that they are nonrenewable and that this has social, economic and political implications.

This activity has been adapted from a National Science Teacher Association publication- Uncovering Student Ideas in Science, Vol. 4: 25 New Formative Assessment Probes by Page Keeley and Joyce Tugel, NSTA Press Book, 2009.

Student Recording

Energy Factory

Grades 1 - 4

Welcome to Imagination Station's newest exhibit, Energy Factory!

You are the President of Science Games, a company that makes the most popular video game in the United States, Copernicus's Challenge.

Currently, you have two factories where you manufacture video games; Toledo, Ohio and Phoenix, Arizona.

You are visiting Energy Factory today to learn more about solar energy and energy production and conservation. The questions below will help you learn about these topics.

When you get back to your classroom, you will be asked to make recommendations to determine which factory should get new solar panels. You will also be asked to make suggestions about ways to reduce energy usage at your factories.

Good luck and have fun exploring!

Ⓐ Voice of the Visitor

1. Listen to the Question of the Day. Write the question below:

_____

_____

_____

2. Listen to three answers from other visitors. Circle whether their answers were mostly fact or opinion.

   Visitor #1: Fact or Opinion

   Visitor #2: Fact or Opinion

   Visitor #3: Fact or Opinion

3. Did you hear more facts or opinions from other visitors?

4. Now it's your turn - record your thoughts!

Student Recording

Energy Factory

Grades 1 - 4

B Discover Energy Story Wall

1. Looking at the story wall, what are the seven parts of the display? Use the Word Bank to write in your answers.

Word Bank:

Using Extracting Creating Finding Reducing Drilling Refining

1._____ 5._____

2._____ 6._____

3._____ 7._____

4._____

2. What are three ways to reduce energy usage?

1._____

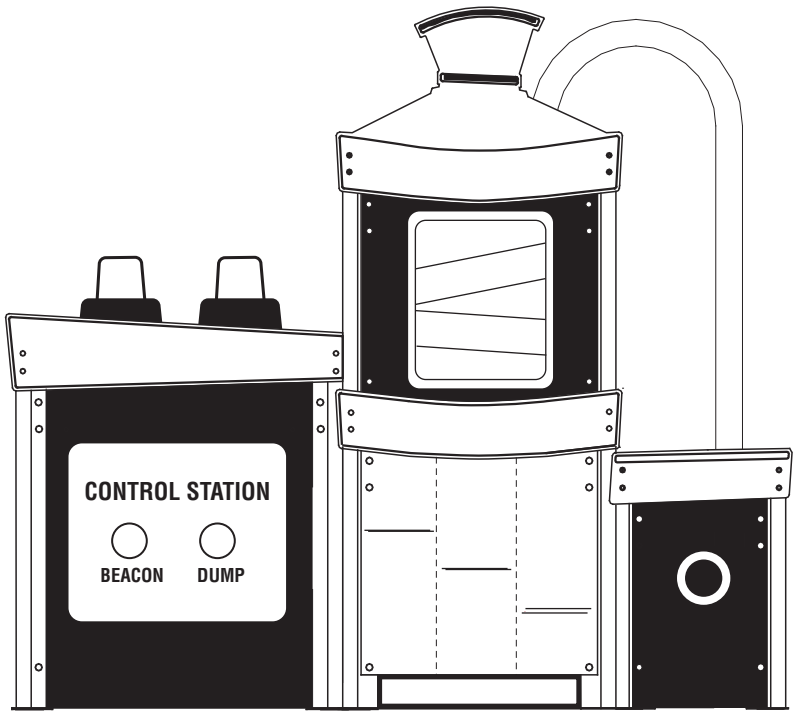
2._____

3._____

C Ball Refinery

The ball refinery is a model of the process of refining oil. The balls represent the different types of products that we get from crude oil, the unprocessed oil that comes from the ground.

1. What happens to the balls as they move through the refinery? Draw arrows to indicate how the balls move through the exhibit and label the final three products.



Student Recording

Energy Factory

Grades 1 - 4

ⓓ PV Panel Power

1. Color in the area that was lit up before anyone blocked the solar panel.

PERCENT OUTPUT
O 91 - 100%
O 81 - 99%
O 71 - 89%
O 61 - 79%
O 51 - 69%
O 41 - 59%
O 31 - 49%
O 21 - 39%
O 11 - 29%
O 0 - 19%

2. Color in the area that was lit up when you were blocking the solar panel.

PERCENT OUTPUT
O 91 - 100%
O 81 - 99%
O 71 - 89%
O 61 - 79%
O 51 - 69%
O 41 - 59%
O 31 - 49%
O 21 - 39%
O 11 - 29%
O 0 - 19%

3. In the solar panels below, draw in the area you blocked to get the lowest energy output.

4. Does a solar panel work as well on a cloudy day? Why or why not?

_____

_____

ⓔ Follow the Sun

The goal at this exhibit is to get a really high number. **Remember to read the sign first!*

1. What is the highest number you can score?_____

2. What do you need to do to get a high number?

_____

3. What is the lowest number you can get?_____

4. What do you need to do to get the lowest possible number?

_____

Student Recording

Energy Factory

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Back in the Classroom

Energy Recommendations

Now that you have explored Energy Factory, it is time to make your energy recommendations. Remember you have a factory in both Toledo, OH. and Phoenix, Arizona.

The average number of sunny days in Toledo, Ohio is 180 days.

The average number of sunny days in Phoenix, Arizona is 310 days.

1. If you could only choose one location to place solar panels, would you choose the factory in Toledo, Ohio or Phoenix, Arizona? Why?

2. What recommendations would you make to reduce energy usage in your factories?

3. What changes can you make at school and at home to reduce energy usage?

Chaperone

Energy Factory

Grades 1 - 4

Dear Chaperone,

We're glad you're here! Thank you for volunteering to be a chaperone on your school's visit to the Imagination Station. This page explains field trip procedures and offer tips on how to facilitate an Imagination Station Exhibit Guide.

The Imagination Station requires students and chaperones to remain together at all times. Group size should be 7 students or less per one adult.

Student Names:

1.

2.

3.

4.

5.

6.

7.

Schedule for the day:

Lunch Time:

Demonstration Time(s):

Departure Time:

Imagination Station Exhibit Guides:

- Students should fill out the their Data Recording pages while at the science center. The 'Back in the Classroom' section of the Data Recording pages can be completed when the students return to school. For younger groups, it may be easier for you to be the official recorder and have students dictate their response to you.
- Have fun! Encourage exploration! Students may ask, "What will happen if…?". Encourage them to experiment and find out!
- Ask open-ended questions that will elicit more than 'yes' or 'no' responses. Ask questions that begin "Tell me about…", "What…" or "Why do you think…".You don't have to be the science expert! Tell students to look up information when they return to the classroom or ask an Imagination Station Team Member about a specific exhibit.
- Don't worry about completing the guide in order! You can visit the different exhibits in a manner that is most convenient for your group.
- Check with your head teacher to see if your group needs to complete all of the guide or only a portion.

Visitor Guide

Attractions

High Wire Cycle – This thrill ride hovers over 18 feet above the ground, suspended on a 1-inch cable with a 275 pound counterweight that enables any person to defy gravity.
• You must be 54" to ride

Simulator Theater – Over The Edge!
Experience every turn, jolt, twist and drop. With HD visuals, surround sound and a responsive platform, you have an adventure without leaving your seat!

- *Imagination Station members ride FREE! You must have a token to ride. Tokens are $2 and available at Simulator entrance or Visitor Service.*
- *You must be 42" to ride.*
- *Elevator available. Please contact a team member.*

Demonstrations

Extreme Science Theater
Interactive demonstrations with an exciting EXTREME twist! Check monitors located at Visitor Service or at elevators for times.

Learning Worlds

Eat It Up! – This Learning World is focused on nutrition and exercise and tells the story of how the choices you make affect your body. Eat Smart. Play Hard. Have Fun.

Energy Factory – Get a glimpse into the abstract world of oil refining and solar energy.

Flex Space – This ever-changing space features some of the best exhibitions from North America and great experiences that we've created right here at Imagination Station.

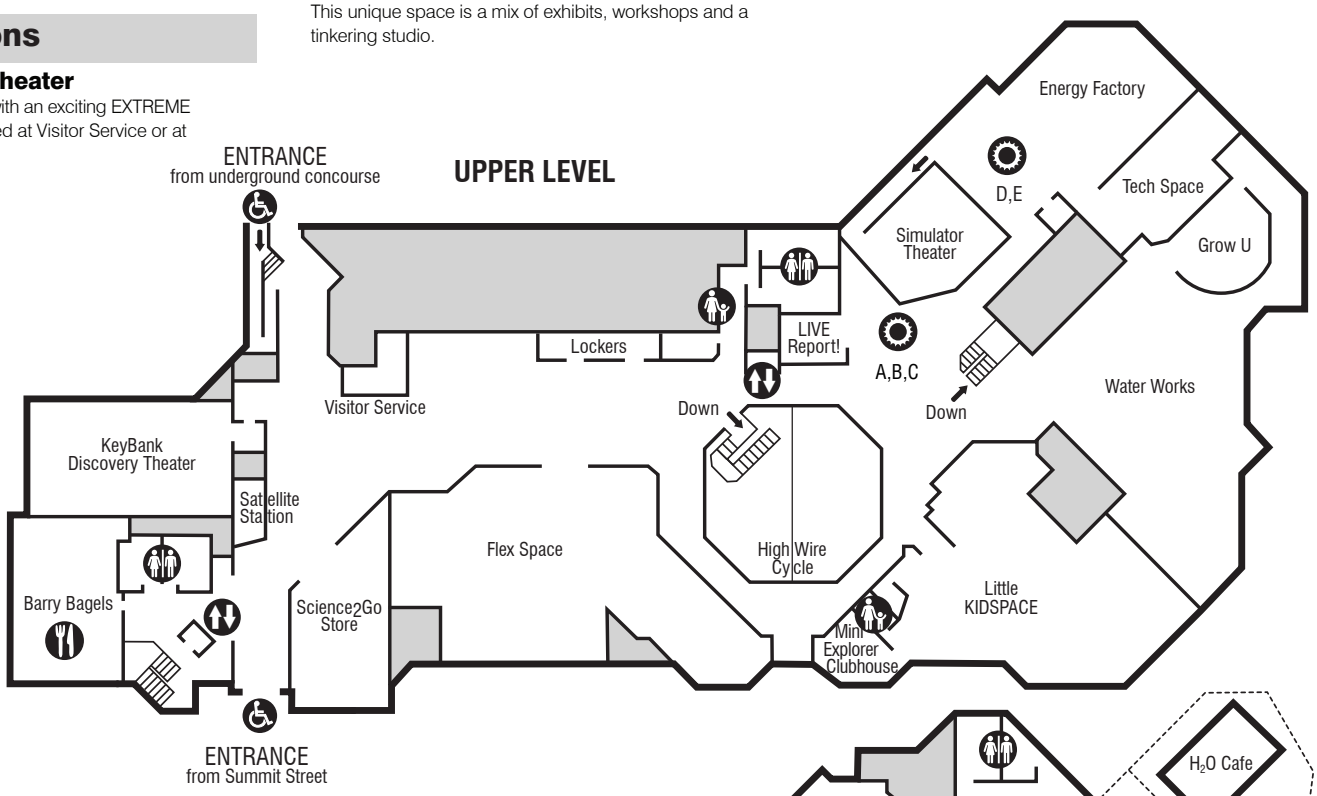
Grow U – Let Mother Nature be your guide as you take on FARM 101: Know It to Grow It.

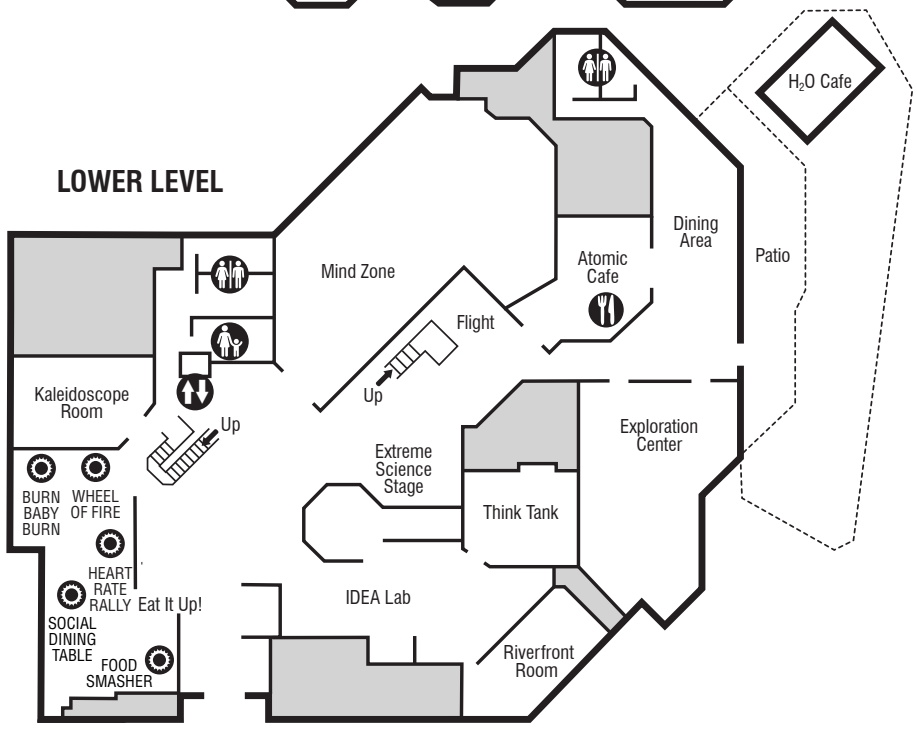
IDEA Lab – This Learning World combines science, art, engineering and design to allow for open-ended exploration. This unique space is a mix of exhibits, workshops and a tinkering studio.

Little KIDSPACE™ – Our littlest adventurers (kindergarten and under) can hop aboard our fire truck, shop in the grocery store or climb on our favorite tree house while learning science fundamentals.

Mind Zone – Home to the Distorted Gravity Room, discover how the mind processes, interprets and creates illusions and perceptions.

Water Works – Discover the slippery science of water and explore nature's most powerful resource.





- Energy Factory Exhibits
- Wheelchair Accessible
- Elevator
- Restaurant/Vending
  Food & beverages permitted only in Atomic/H2O Cafe.
- Men's & Women's Restroom
- Family Restroom
  Special needs accessible & baby changing facilities.

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Chaperone

Energy Factory

Grades 1 - 4

Ⓐ Voice of the Visitor:

Student Data Recording Page Questions:

1. Listen to the Question of the Day. Write the question below:

2. Listen to three answers from other visitors. Circle whether their answers were mostly fact or opinion.

3. Did you hear more facts or opinions from other visitors?

4. Now it's your turn - record your thoughts!

IN THE KNOW

Students, especially at this age, often have a difficult time distinguishing between fact and fiction. Help them look for keywords in an opinion response, such as 'I think' or 'In my opinion'.

Ⓑ Discover Energy Story Wall:

Student Data Recording Page Questions:

1. Looking at the story wall, what are the seven parts of the display?
   Use the Word Bank to write in your answers.

2. What are three ways to reduce energy usage?

IN THE KNOW

The three ways to reduce energy usage are listed in the final step of the story wall. Talk about the three ways to reduce energy usage and how students think that they could implement these behaviors at home.

Chaperone

Energy Factory

Grades 1 - 4

© Ball Refinery

Student Data Recording Page Questions:

The ball refinery is a model of the process of refining oil. The balls represent the different types of products that we get from crude oil, the unprocessed oil that comes from the ground.

1. What happens to the balls as they move through the refinery?
   Draw arrows to indicate how the balls move through the exhibit and label the final three products.

IN THE KNOW

The refining process can be complicated- even for adults! Talk with the students about how fossil fuels are processed to form different types of products- heavy, medium and light.

Quick Review- Oil Refining
Fossil fuels are used to produce petroleum products. Fossil fuels were formed millions of years ago from animal and plant remains. Today, unprocessed oil known as crude oil is extracted from the earth and sent to refineries by pipeline or ships to be processed into different products. Crude oil is composed of hydrocarbons, which provide the incredible stored energy that makes oil such a valuable resource to humans. From crude oil, the refining process will extract petroleum gas, gasoline, oil, tar and asphalt.

In the refinery, crude oil is heated until it evaporates. At this point, it enters the fractioning tower as a vapor. The fractioning tower is a huge vessel which is hot at the bottom and cooler at the top. The result is that larger hydrocarbons, which have higher boiling points, turn back into liquids nearer the bottom of the tower. In this part of the tower, where the temperatures are very hot, the smaller hydrocarbons remain as gases. These gases move up the tower and condense at different points depending upon their length and the temperature in the tower.

Chaperone

Energy Factory

Grades 1 - 4

D PV Panel Power

Student Data Recording Page Questions:

1. Color in the area that was lit up before anyone tried to block the solar panel.
2. Color in the area that was lit up when you were blocking the solar panel.
3. In the solar panels below, color in the amount of area you blocked to get the lowest energy output.
4. Does a solar panel work as well on a cloudy day? Why or why not?

IN THE KNOW

Students may want to work in teams and mark the area of the solar panel that they cover for each other (as it may be difficult for students at this age to determine the area they are covering without seeing themselves in a mirror).

Quick Review- Solar Energy

Solar energy can be converted directly or indirectly into other forms of energy, such as heat and electricity. The major issues to overcome when utilzing solar energy are: (1) the intermittent and variable manner in which it arrives at the earth's surface and, (2) the large area required to collect it at a useful rate.

The simplest photovoltaic systems power many of the small calculators and wristwatches used everyday. More complicated systems provide electricity to pump water, power communications equipment, and even provide electricity to our homes.

Solar cells are also known as photovoltaic cells. Photovoltaic cells can turn the energy of the sun into electrical energy, which can be stored in batteries. When light strikes the cell, electrons are excited and travel along wires in the cell. The electrons flow through the wire and power whatever is connected and needs electricity to work, for example a motor. The flow of electrons is called electricity. Photovoltaic systems are quiet, clean, and non-polluting, but they are currently relatively expensive.

E Follow the Sun

Student Data Recording Page Questions:

1. What is the highest number you can score?
2. What do you need to do to get a high number?
3. What is the lowest number you can get?
4. What do you need to do to get the lowest possible number?

IN THE KNOW

When the solar panel is facing a light source directly, it is able to capture more energy than when the light source is hitting the panel at an angle. If students are having trouble understanding this concept, encourage them to think about how bright the sun is when it is directly overhead in the afternoon versus when it is rising or setting in the sky.

When students return to the classroom, they will be asked to make decisions based on what they learned in Energy Factory. Encourage your group to discuss ways they can help to reduce energy usage.