

Power the Future: A Program about Engineering, Climate Change and Renewable Energy Presented by the Sciencenter in Ithaca, NY

Program Overview

Power the Future uses models and hands-on activities to explore engineering principles, climate science and renewable energy. Each program runs approximately 45 minutes to one hour, and is held in the Sciencenter classroom.

Students will have the chance to learn about climate science and renewable energy in a brief, interactive discussion. Students will then work with their buddy in a hands-on inquiry-based engineering project exploring how to capture the energy of the wind. Buddy groups will build and test a windmill made from simple materials to see how wind energy can be turned into rotational motion and do work for us. The program ends with a discussion of the techniques students used to create working windmills.

Pre-program activities are included in this packet and are highly recommended to help students gain more from their KDT experience. Also included here are post-program activities, which can further reinforce learning and help broaden understanding of energy use.

In order for your students to get the most from their field trip, please review the Power from the Wind slideshow, which can be found at <http://sciencenter.org/programs/musvisitprog.asp>.

Program Learning Objectives

Students will be able to:

- Use and demonstrate basic engineering skills and principles in building their windmills
- Explain where energy comes from, and how we can use the wind to do work
- Understand why there is a need to use renewable energy sources to mitigate the effects of climate change

Field Trip Schedule

Introduction (entire group + chaperones in Sciencenter amphitheater):

- Welcome, orientation to Sciencenter and rules
- Go over program and lunch times
- Check with teachers to get numbers of students and chaperones
- Split into two groups

Program (half group in Sciencenter classroom):

- Children sit on carpet squares up front with buddies

- Interactive discussion of climate change, energy, and renewable resources
- Explain what engineering is and introduce engineering challenge
- Buddy groups work on windmills together, test them out to see how many pennies they can lift, and redesign to lift more pennies
- Clean up
- Interactive discussion of what worked well in windmills and what did not

Websites

Teacher Resources

Teacher Guide to High Quality Educational Materials on Climate Change and Global Warming

<http://hdgc.epp.cmu.edu/teachersguide/teachersguide.htm>

Great teacher resource guide with climate change basics and links to a lot of great additional resources

Climate Discovery Teacher's Guide

<http://eo.ucar.edu/educators/climatediscovery>

The University Center for Atmospheric Resources Climate Guide with links to lessons and activities

Kid Wind

<http://www.kidwind.org>

A great resource for educational materials and activities related to wind energy

Student Resources

Energy Information Administration: Energy Kids

<http://www.eia.gov/kids>

Department of Energy site with kid-friendly energy information and puzzles and games

EPA Climate Change Kids Site

<http://www.epa.gov/climatechange/kids/index.html>

Kid-friendly background about climate change with fun activities

Children's Books

Switch On, Switch Off by Melvin Berger

Why Should I Save Energy by Jen Green

Our Earth Clean Energy by Peggy Hock

Who Likes the Wind? by Etta Kaner

When the Wind Stops by Charlotte Zolotow

Greenhouse Gas Model Building: Activity Guide

Summary

Students will work with gumdrops and toothpicks to model and sketch three greenhouse gases. By investigating carbon dioxide (CO_2), water vapor (H_2O), and methane (CH_4), students will see how atoms can combine to create gases in our atmosphere.

Please adjust this activity to meet the needs of your class and your students. It may be completed as a whole-class activity on the board, or as a work-center activity, which students can do individually, or it may be done in small groups.

Background Information

When we burn carbon based fossil fuels such as coal and oil large amounts of carbon are released into the atmosphere. This carbon combines, or bonds with oxygen atoms to create carbon dioxide. In the past hundred years we have seen a significant increase in atmospheric carbon dioxide that scientists believe is the primary cause of global warming and climate change.

Our atmosphere is composed of primarily Nitrogen and Oxygen with small amounts of greenhouse gases. Greenhouse gases absorb infrared energy and trap heat within the Earth's atmosphere. Although carbon dioxide is the most common greenhouse gas water vapor and methane are also important contributors to the global Earth's temperature.

Most greenhouse gas molecules are comprised of three or more atoms and have the ability to absorb infrared energy. By contrast, molecules that are comprised of the same two atoms each, such as molecular oxygen (O_2) or molecular hydrogen (H_2) do not absorb infrared energy and are not greenhouse gases.

Materials

Gumdrops (per group or individual)

3 red gumdrops

6 green gumdrops

2 black or purple gumdrops

Toothpicks (10 per group or individual, the models are more accurate if the toothpicks are broken in half)

Greenhouse Gas Model Building Student Sheet (with or without pictures)

Procedure

Black or purple gumdrops represent **carbon** atoms

Red gumdrops represent **oxygen** atoms

Green gumdrops represent **hydrogen** atoms

Toothpicks represent **bonds** between atoms

To correctly build the model students may follow the description or pictures on the student sheet. For carbon dioxide the oxygen atoms are double bonded to the carbon atom in the center so two toothpicks are used for each side.

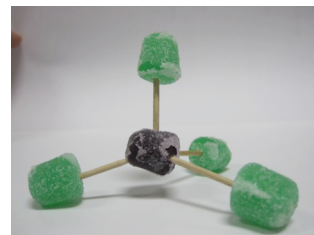
Carbon Dioxide (CO₂)



Water Vapor (H₂O)



Methane (CH₄)



Hint: Methane's Tetrahedron

If students are having a hard time visualizing the arrangement of atoms in methane ask students to imagine that their body is the carbon atom and their hands and feet represent the hydrogen atoms. Tell students that the hydrogen atoms want to be as far apart as possible. How do you stand so your hands and feet are as far apart as possible? The answer is one hand over your head in front of you and one hand over your head back of you and your feet spread apart to the left and right. This forms the corner of a tetrahedron.



Name: _____

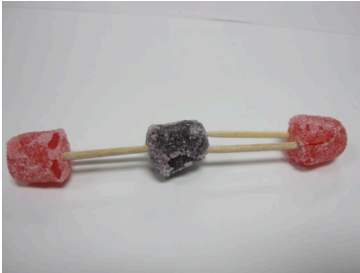
A **greenhouse gas** is a gas that traps heat in the air around us!

Greenhouse Gas Model Building Student Sheet

Use the toothpicks to join together, or bond different atoms (gumdrops) which represent atoms. Then sketch a drawing of the molecule. Carbon dioxide (CO_2), water vapor (H_2O), and methane (CH_4) are all gases that trap heat in the air around us and are called greenhouse gases.

Carbon Dioxide (CO_2)

- 1 BLACK or PURPLE carbon (C) gumdrop
- 2 RED oxygen (O) gumdrops



Water Vapor (H_2O)

- 2 GREEN hydrogen (H) gumdrop
- 1 RED oxygen (O) gumdrops



Methane (CH_4)

- 1 BLACK or PURPLE carbon (C) gumdrop
- 4 GREEN hydrogen (H) gumdrops



A **greenhouse gas** is a gas that traps heat in the air around us!

Name: _____

Greenhouse Gas Model Building Student Sheet

Use the toothpicks to bond, or join together different atoms (gumdrops). Follow the description to create a model of carbon dioxide (CO_2), water vapor (H_2O), and methane (CH_4). Then sketch a drawing of the molecule. These gases all trap heat in the air around us and are called greenhouse gases.

Carbon Dioxide (CO_2)

Description: The two oxygen atoms are double bonded to the carbon atom. Use two toothpicks on each side to connect the atoms. They should make form a straight line

- 1 BLACK or PURPLE carbon (C) gumdrop
- 2 RED oxygen (O) gumdrops

Water Vapor (H_2O)

Description: The two hydrogen atoms are bonded to the red oxygen atom. Use one toothpick one each side of the oxygen atom to connect the atoms. They are not in a straight line but come out in an angle.

- 2 GREEN hydrogen (H) gumdrop
- 1 RED oxygen (O) gumdrops

Methane (CH_4)

Description: The four hydrogen atoms are bonded to the carbon atom. Use one toothpick each to connect the atoms. The atoms should be as far apart from each other as possible.

- 1 BLACK or PURPLE carbon (C) gumdrop
- 4 GREEN hydrogen (H) gumdrops

Remember the best thing we can do is to CONSERVE, or save energy!

Name: _____

Energy Detectives

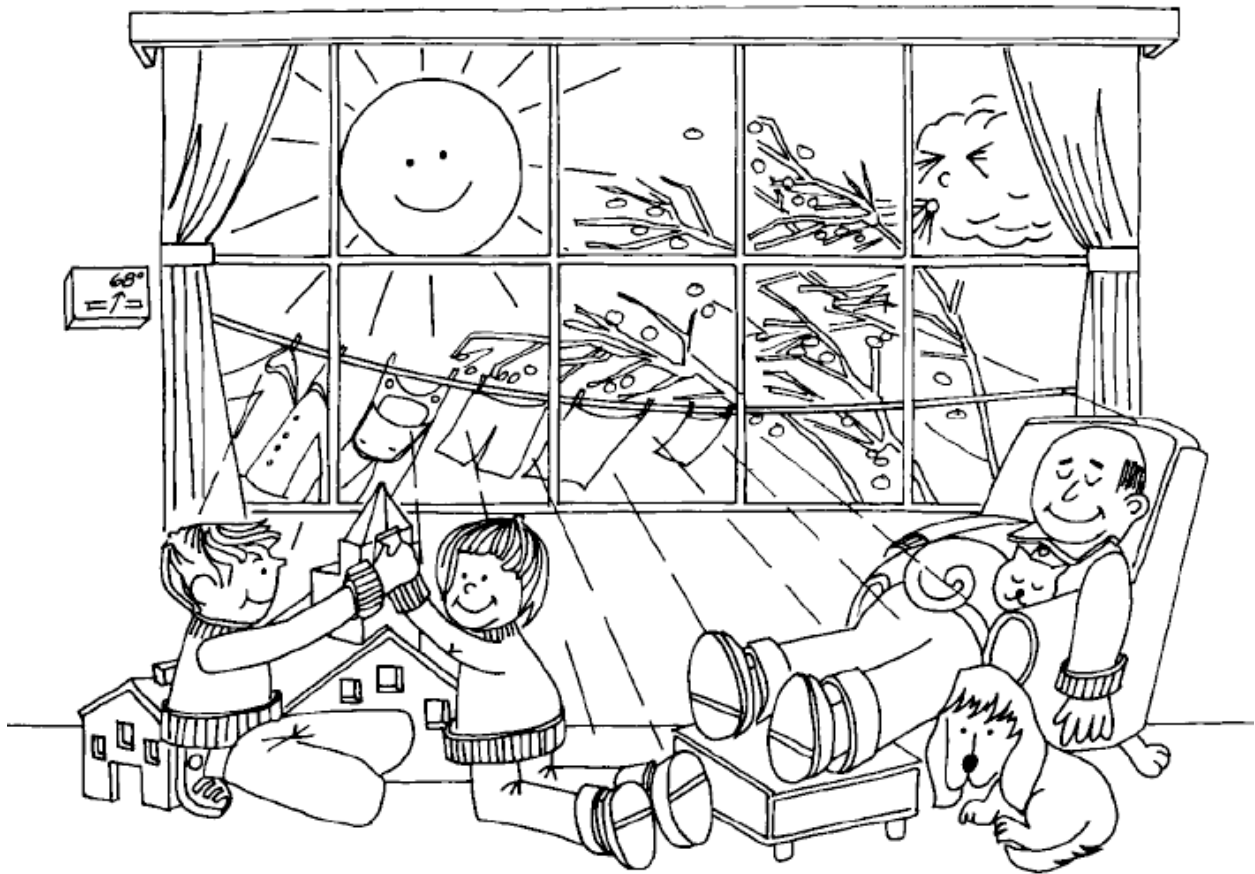
There are places in your home or school where hot or cold air can escape. These are called **ENERGY WASTERS** because they use too much energy.

**What is one potential Energy Waster in your home? _____

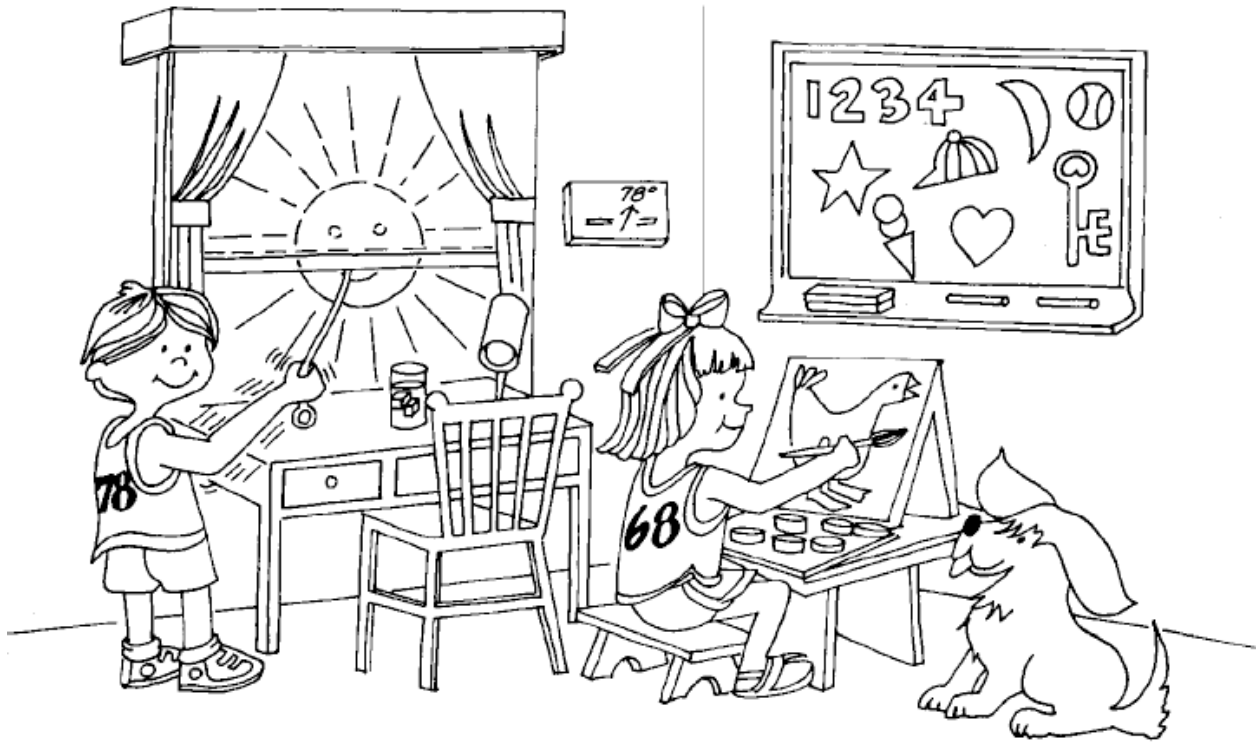
There are also places where we can conserve, or save energy. These are called **ENERGY SAVERS** because they reduce the amount of energy we need.

**What is one potential Energy Saver in your home? _____

Use the following pictures to help you prepare for your job as an Energy Detective in your own home. Identify the ENERGY WASTERS and ENERGY SAVERS



Find 3 or more energy savers.

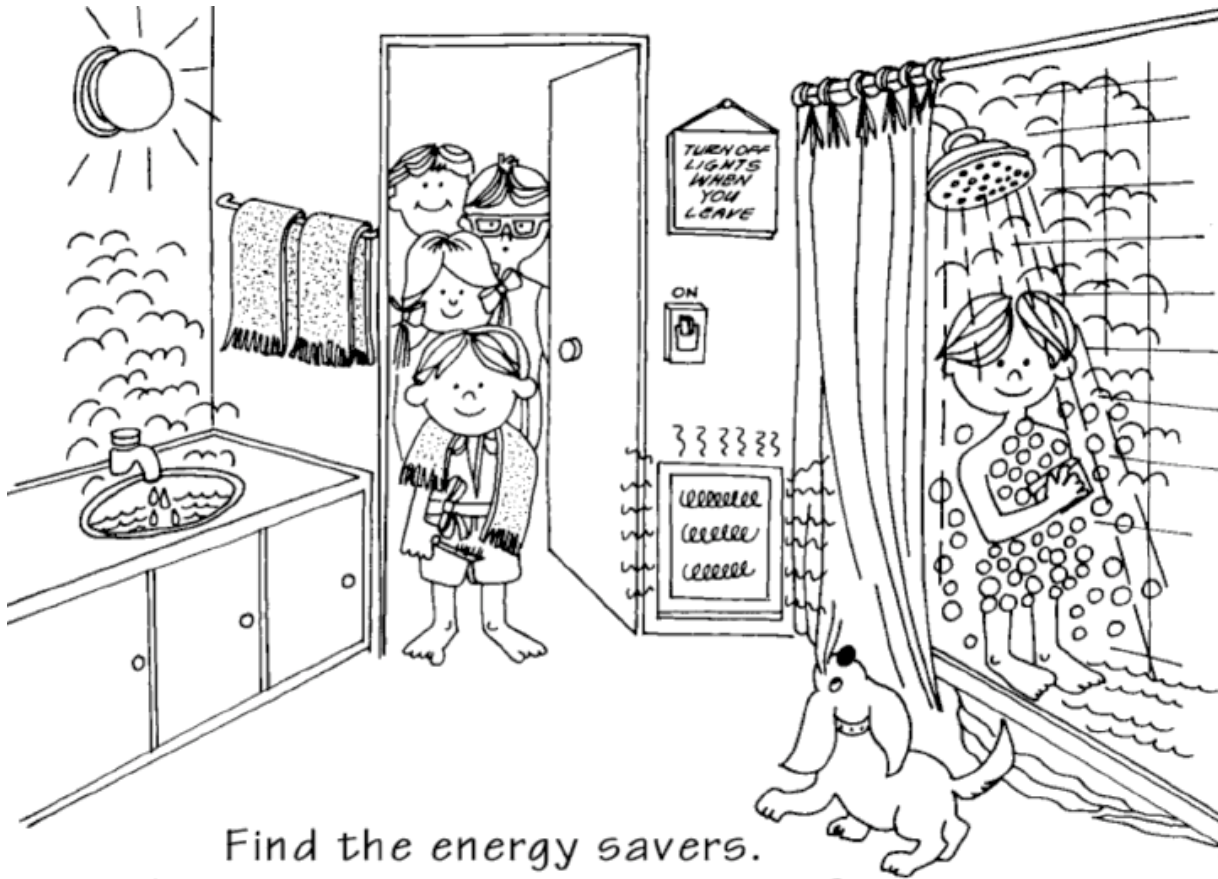


Find 4 energy savers.



Find 5 energy wasters.





Find the energy savers.
Are there any energy wasters?



Find 4 energy wasters.