



Cool Globes and Climate Change

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INTRODUCTION

This lesson plan will introduce high school science classes to the greenhouse effect and examine the connection between the greenhouse effect and climate change. Students will focus on identifying the causes and solutions to climate change and reducing greenhouse gas emissions, and will brainstorm solutions and ways to raise awareness of environmental issues. In the final activity, students will use public art as a medium to raise awareness about climate change and environmental issues.

LESSON OVERVIEW

Grade Level and Subject: 9-12: Environmental Science, Earth Science, Biology

Length: 1-2 class periods.

Objectives:

After completing this lesson, students will be able to:

- Explain how the greenhouse effect works.
- Recognize the connection between the greenhouse effect and climate change.
- Identify the causes of and ways to reduce greenhouse gas emissions.
- Use public art to raise awareness of climate change.

National Standards Addressed¹:

- **Content Standard: [NS.9-12.2 PHYSICAL SCIENCE](#)**
As a result of their activities in grades 9-12, all students should develop an understanding of
 - Conservation of energy and increase in disorder
 - Interactions of energy and matter
- **Content Standard: [NS.9-12.3 LIFE SCIENCE](#)**
As a result of their activities in grades 9-12, all students should develop understanding of
 - Interdependence of organisms
 - Matter, energy, and organization in living systems
- **Content Standard: [NS.9-12.4 EARTH AND SPACE SCIENCE](#)**
As a result of their activities in grades 9-12, all students should develop an understanding of
 - Energy in the earth system
 - Geochemical cycles

¹ Education World. (2008). *National Standards*. Retrieved June 12, 2008 from, <http://www.educationworld.com/standards/national/toc/index.shtml>.

- Origin and evolution of the earth system
- **Content Standard:** [NS.9-12.6 PERSONAL AND SOCIAL PERSPECTIVES](#)
As a result of activities in grades 9-12, all students should develop understanding of
 - Personal and community health
 - Population growth
 - Natural resources
 - Environmental quality
 - Natural and human-induced hazards
 - Science and technology in local, national, and global challenges
- **Content Standard:** [NM-REP.PK-12.3 Use Representations to Model and Interpret Physical, Social, and Mathematical Phenomena](#)
- **Content Standard:** [NSS-G.K-12.3 PHYSICAL SYSTEMS](#)
As a result of their activities in grades K-12, all students should
 - Understand the physical processes that shape the patterns of Earth's surface.
 - Understand the characteristics and spatial distribution of ecosystems on Earth's surface.

Materials Needed:

- **Reproducible #1: Introduction to the Greenhouse Effect Diagrams.**
- **Reproducible #2: CO₂ Emissions Chart.**
- **Reproducible #3: Examples of Climate Change Effects.**
- **Reproducible #4: Cool Map** (one per student).
- **Reproducible #5: Cool Map Cut-outs** (optional- 6 sheets of environmental and renewable technology graphics).
- Computers with Internet access or way to project website for class:
<http://ww2.earthday.net/node/11016>
- Scissors and glue for students to share.
- Crayons, markers, or colored pencils for students to share.
- Chalkboard and/or overhead projector.

Assessment: Students will be assessed through the following activities:

- Completion of notes
- Participation in class discussion
- Completion of **Reproducible #4: Cool Map**

LESSON BACKGROUND

Relevant Vocabulary:

(Activity 1-2: The Greenhouse Effect, Climate Change, and Their Connections)

- **Greenhouse Effect:**
 - An atmospheric heating phenomenon, caused by short-wave solar radiation being readily transmitted inward through the earth's atmosphere but longer-wavelength heat radiation less readily transmitted outward, owing to its absorption by atmospheric carbon dioxide, water vapor, methane, and other gases; thus, the rising level of carbon dioxide is viewed with concern.

- Just like a greenhouse that houses plants and keeps them warm in the winter, the greenhouse effect keeps our Earth warm enough for things to survive on Earth. This process allows rays from the sun (solar radiation) to enter the Earth's atmosphere, but does not allow the outgoing rays to escape into outer space. This means that more energy (and heat) is kept in the atmosphere. We like the greenhouse effect because we rely on it to keep the Earth warm. Without it the Earth would always be 60 degrees Fahrenheit colder! However, the greenhouse effect is becoming stronger as we create more greenhouse gases that trap heat in the atmosphere.
- **Solar Radiation:** Energy from the sun that warms the Earth.
- **Atmosphere:** The mixture of gases around the Earth that make up a layer between Earth and outer space.
- **Greenhouse Gases:** These are gases that trap heat in the earth's atmosphere. The main greenhouse gases include: water vapor droplets, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs)².
- **Fossil Fuel:** Fossil fuels are a source of energy taken from ancient dead materials that over thousands of years decomposed into oil, coal, and natural gas. These are taken from deep underground and used by people to power electrical devices like cars and machines. Unfortunately, there is only a limited amount of these types of fuels and burning them to create energy puts a lot of pollution into the atmosphere.
- **Climate Change:** Climate includes average temperature, rainfall, wind and storms, and climate change alters the long-term patterns of any of these areas.

Relevant Vocabulary:
(Activity 3-4: Solutions)

- **Consumption:** Buying or taking products that result in using up natural resources like trees, fossil fuels, minerals, and water.
- **Energy:** Energy is what gives power to things and to us to do work. Example: "Do you have energy to take out the trash?"
- **Renewable energy:** Energy that comes from a never-ending supply, like solar radiation, wind, waves, etc. These sources can be used without causing the supply to run out.
- **Non-renewable energy:** Non-renewable energy is energy taken from finite resources (ones that eventually run out) like oil, coal, and natural gas.
- **Reduce:** To decrease in size, amount, or number (used in terms of consumption). Example: "I reduce the amount of paper I use by printing on both sides of the sheet."
- **Reuse:** To use something again, often in an especially different way. Example: "He reuses plastic bags several times instead of just throwing them out".
- **Recycle:** To make something new from a used product. The used material can be broken down, processed, and created into something new for people to use. Example: "My cousin creates mosaic art by recycling plastic bottle caps."
- **Public Art:** Art that is available for everyone in a community to see.

Resources:

² Environmental Protection Agency. (2008). *Greenhouse Effect*. Retrieved June 3, 2008 from, <http://www.epa.gov/climatechange/kids/greenhouse.html>.

- <http://www.coolglobes.org>
- <http://ww2.earthday.net/coolglobes>

LESSON STEPS

Warm Up: *Greenhouses*

1. You may start this mini-unit by asking the students if they have ever seen a greenhouse, if they can explain what a greenhouse is used for and how it works. Greenhouses are used to grow plants by creating a (micro) climate that is warm enough for them to thrive in. Greenhouses are made of glass and/or plastic so that light can enter but the heat that is produced cannot escape. The walls and roof of a greenhouse trap the warming air inside of the building.
2. Transition into Activity 1 by highlighting how the roof and walls of a greenhouse are similar to the Earth's atmosphere.

Activity One: *Introduction to the Greenhouse Effect*

1. Using **Reproducible #1: Introduction to the Greenhouse Effect Diagrams** as your guide, draw a diagram on the board of the Earth, atmosphere, the Sun, and greenhouse gases. Explain that the Earth receives the majority of its energy and warmth from the Sun in rays called solar radiation. Define the atmosphere. Label and define greenhouse gases and explain that in addition to oxygen, which we breathe, these are the other gases that naturally exist in our atmosphere because they come out of volcanoes and ocean vents. Explain the greenhouse effect to the class while drawing arrows to demonstrate the role of solar radiation.
2. Show how the greenhouse effect naturally warms the Earth by trapping solar radiation. Clarify that when everything is in balance the greenhouse effect keeps Earth at a stable warm temperature. Without this effect, the Earth would be exceedingly hot and cold from day to night, like Mercury, and would not be able to support life.
3. Define fossil fuel energy. Explain to students that things we use everyday like cars, planes, lights, and water from showers and sinks, use up great amounts of energy, most of which comes from fossil fuels that release greenhouse gases into the atmosphere. Ask the students to help you create a list of everyday activities that use energy and contribute to greenhouse gases. Save this list, as you will add solutions to it later in the lesson.
4. Draw arrows that show a lot of infrared radiation getting trapped between the atmosphere and the Earth's surface because of the extra greenhouse gases from human activities like the ones on the class list. Explain that CO₂ and other greenhouse gases are not bad when there are small amounts, since plants can convert them into Oxygen and other things which enable life to survive. When there are too many greenhouse gases, however, plants cannot handle the amount and cannot process them into Oxygen fast enough. An example of a planet with a "runaway" greenhouse effect is Venus, which is too hot to support life. Make clear that only when there are too many greenhouse gases in the atmosphere does the greenhouse effect become harmful and contribute to climate change.

5. Students can now copy the diagram on the board into a notebook or white paper with markers or colored pencils. Tell them they can draw their diagram with fewer arrows showing radiation being reflected back into the earth by the greenhouse gases.

Activity Two: *Discuss trend of rising CO₂ in the Atmosphere*

1. Now that students understand that global climate change is caused by heat trapping greenhouse gases, either display **Reproducible #2- CO₂ Emissions Chart** on an overhead or pass out copies to the students. The graph illustrates rising CO₂ levels in the atmosphere in past decades. Make clear that this is due to our rise in energy use as people have become more technologically advanced. Give examples like before the 1900s people used horse drawn carriages, but after the early 1900s technological advances like the automobile made CO₂ levels start to rise in addition to other inventions. Explain that CO₂ is one of the most prevalent greenhouse gases and is preventing heat from escaping into space.
2. Define climate change. Discuss the effects of climate change like drought, rising sea levels due to melting glaciers, floods, and erratic weather like hurricanes. On an overhead, you can show visual examples of these effects using **Reproducible #3 Examples of Climate Change Effects**.

Activity Three: *Discuss methods of solving climate change*

1. The next step to understanding the climate change crisis is to introduce students to solutions. Now that students understand that extra greenhouse gases come from fossil fuel energy use, teach them about clean, renewable energy by defining renewable energy and non-renewable energy. Next, give examples of renewable energy technologies such as: solar panels, wind turbines, geothermal, and hydropower.
2. Discuss other ways of decreasing energy use by introducing the “The 3 R’s”: Reduce, Reuse, and Recycle. Define and explain how every person can reduce their consumption, reuse products, and recycle. Ask if they recycle at home and give examples of how they can reuse (reusable lunch box instead of brown and plastic bags) and reduce (only take as much paper and food as you will use).

Activity Four: *Proposing Solutions through Art*

1. Introduce students to the Cool Globes project (<http://ww2.earthday.net/coolglobes>). Display the Cool Globes website so students can view the globes in the “Globe Gallery”. Describe the project and define public art. Display some of the different globes and discuss why each theme is a good solution to reducing greenhouse gas emissions.
2. Revisit the list made at the beginning of class of actions that create greenhouse gases. Complete this list by adding solutions to climate change.
3. After seeing the Cool Globes, students can then make their own *Cool Map* (a flat Cool Globe!) by drawing their own solution to global climate change with crayons, markers or colored pencils on the blank **Reproducible #4: Cool Map**, which you will hand out to the class. Have students draw solutions to climate change on their maps, thinking about the lessons learned and what message they would like to send about prevention and solutions. Give them ideas and get their creative juices going. **Reproducible #5: Cool Map Cut-outs** contains six sheets of environmental and renewable technology graphics that students may cut out and glue on their map in addition to their own drawing.

4. If there is enough time, give students the option to present their Cool Map and solution to the class.

Wrap-up: *Raising Public Awareness through Public Art*

Let the class know that their Cool Maps will become public art. If possible try and get the artwork displayed in a hallway or somewhere else in the school where others may view it. Also, you may be able to find a business or public center that would be willing to display the artwork. Otherwise, be sure to display the finished products in the classroom for some time.

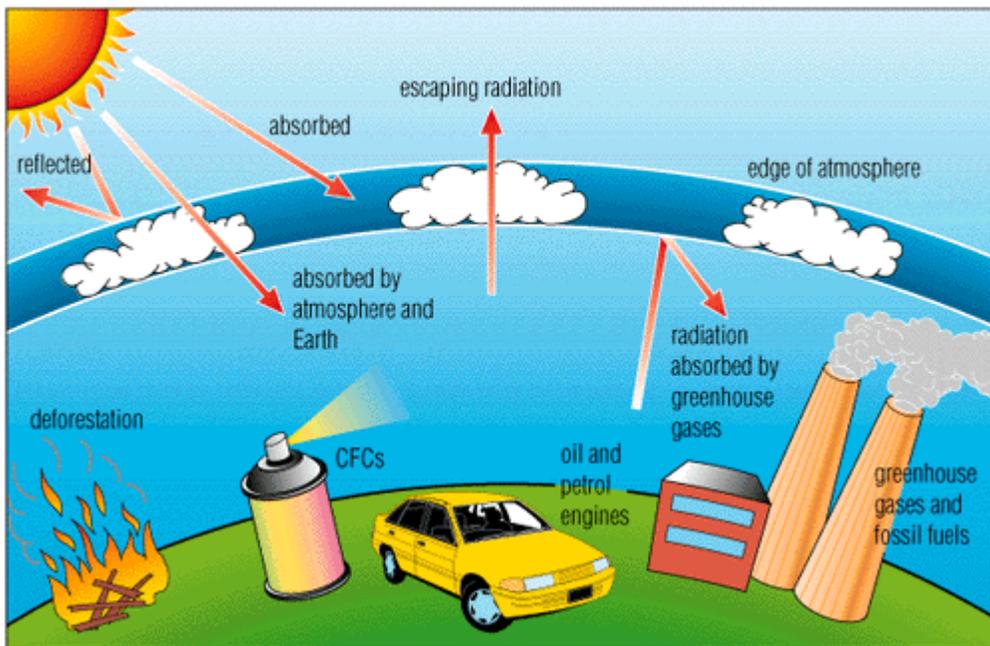
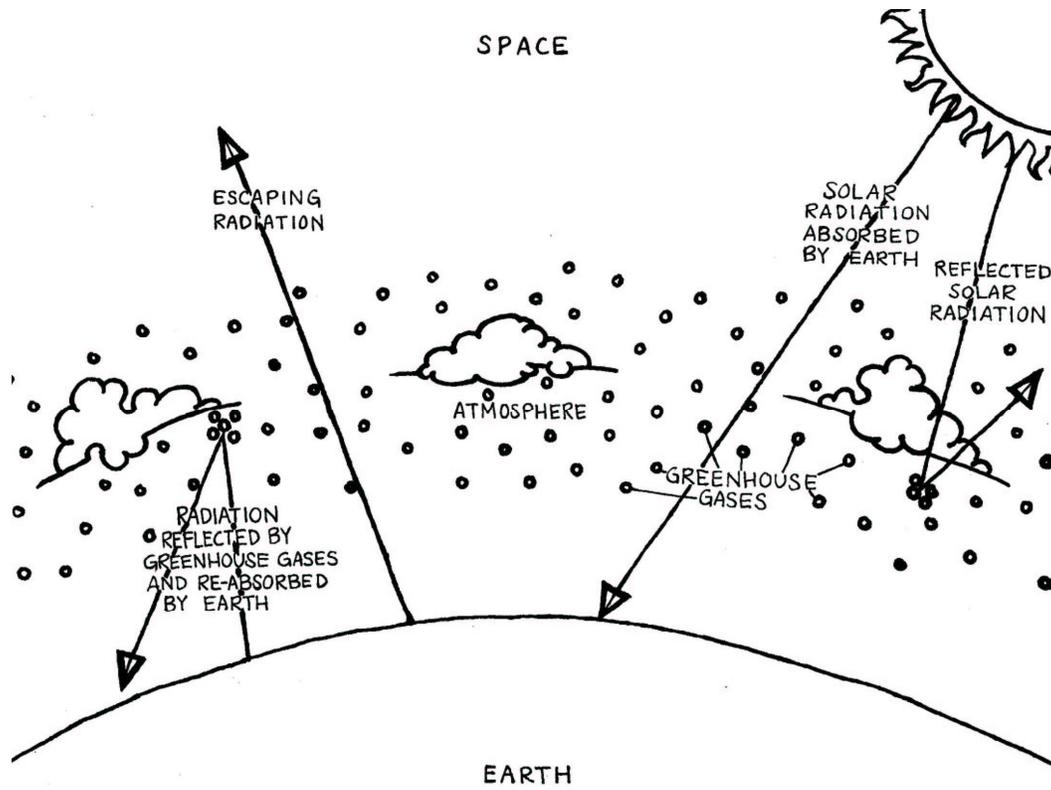
Extension: *Calculate Your Carbon Footprint!*

Have students visit the interactive measuring tool at <http://www.earthday.net/footprint/index.html> to determine how much CO₂ they produce and what they can do to reduce their impact. Ask them to come up with some goals for how they are going to reduce their emissions, and have them write out a plan for how they are going to accomplish those goals.

CONCLUSION

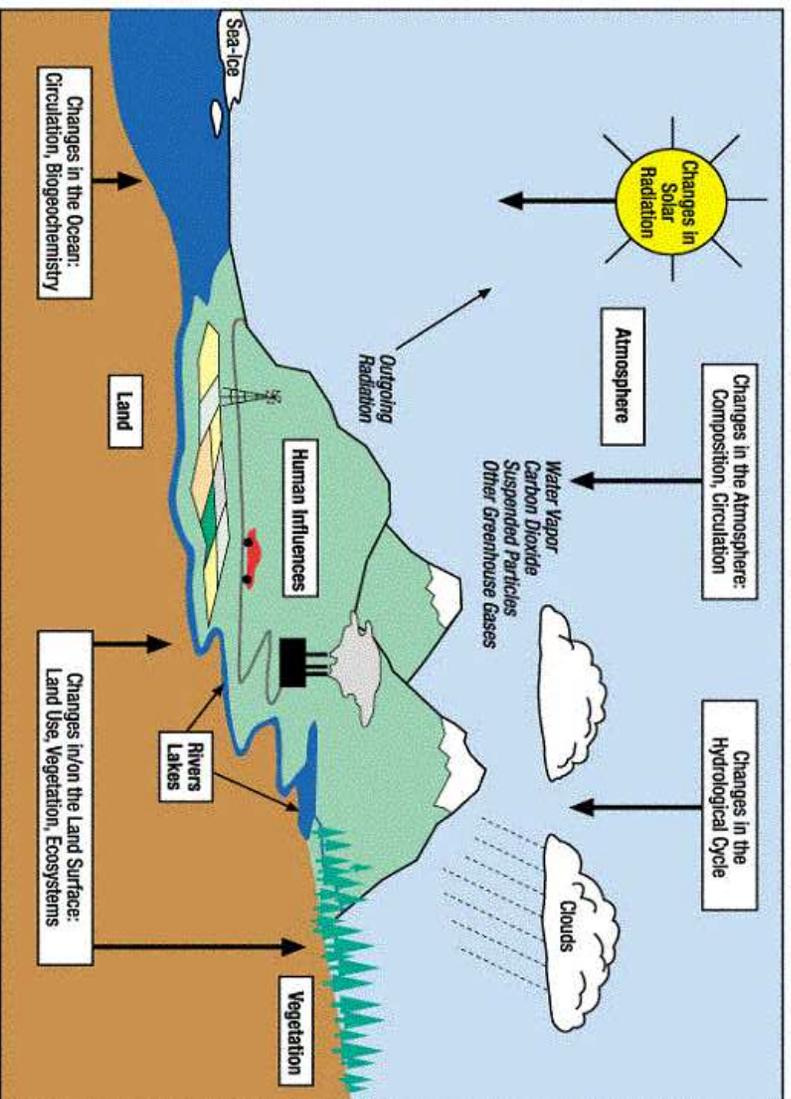
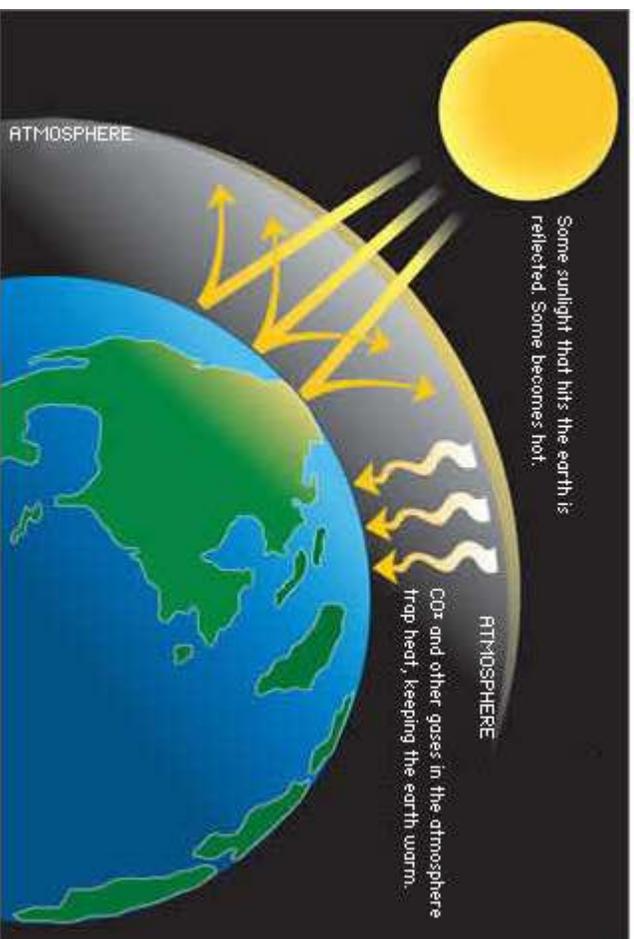
In this lesson, students were introduced to carbon's role in the greenhouse effect, and its connection to climate change. After identifying the causes and solutions to climate change and reducing greenhouse gas emissions, they brainstormed solutions and ways to raise awareness of environmental issues. In the final activity, students designed public art to raise awareness about climate change and environmental issues.

Reproducible #1: Introduction to the Greenhouse Effect Diagrams



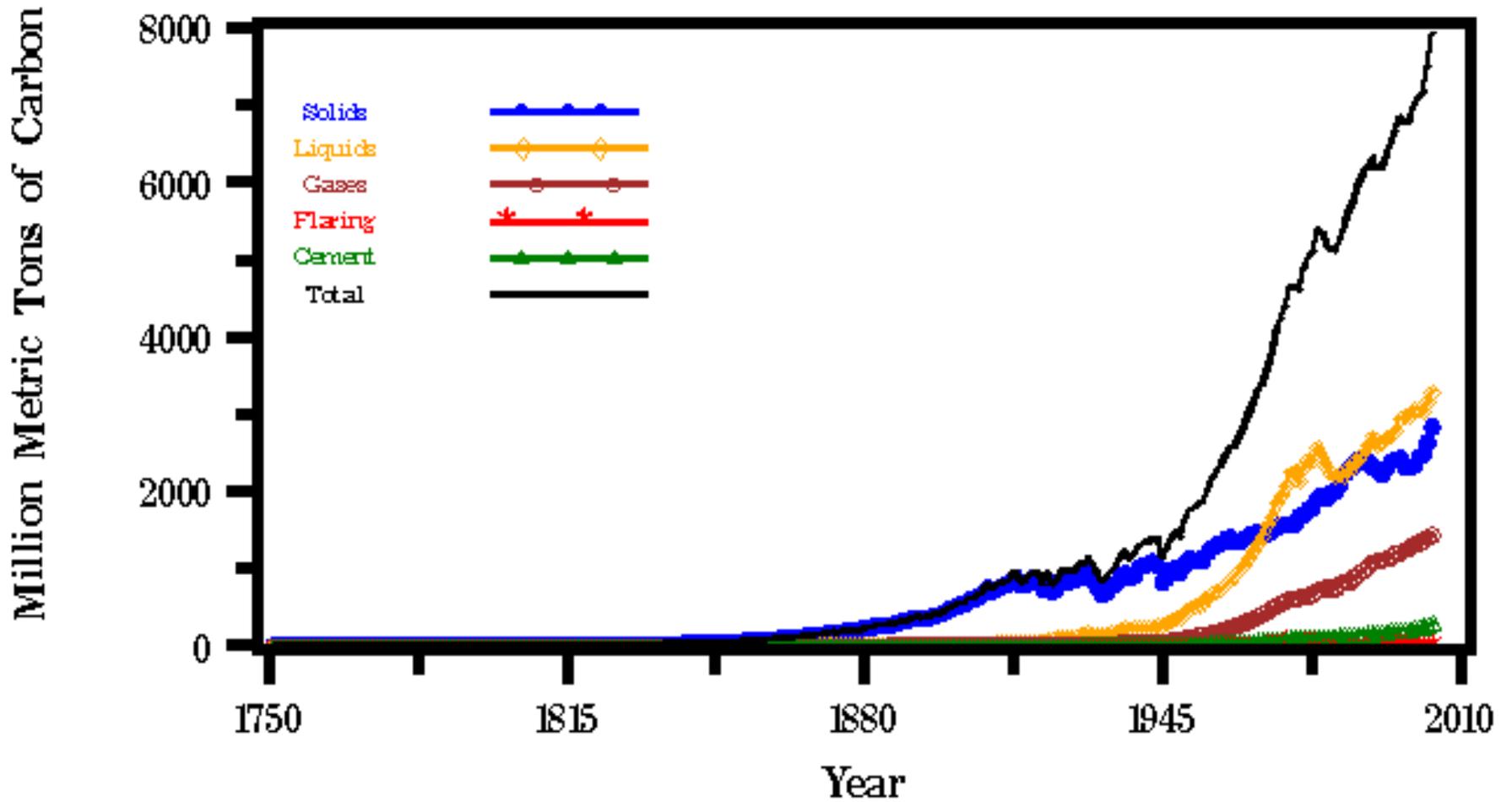
Reproducible # 1: Introduction to the Greenhouse Effect Diagrams

The Greenhouse Effect



Reproducible #2: CO₂ Emissions Chart

6



Reproducible #3: Examples of Climate Change Effects

Drought

Drought happens when all the water evaporates out of the land because of heat.



<http://www.j2fi.net/wp-content/uploads/2007/11/drought.jpg>

Melting Ice Caps

Ice caps cover the earth's poles and when they melt extra water is added to the oceans.



<http://www.blog.thesietch.org/wp-content/uploads/2007/08/meltingglaciers.jpg>

Reproducible #3: Examples of Climate Change Effects

Hurricanes

Dangerous storms like hurricanes happen when warm air and cold water mix.



http://www.abc.net.au/reslib/200708/r170693_640606.jpg

Flooding

Too much rain can cause rivers to overflow their banks and cause floods.



http://i.usatoday.net/weather/_photos/2007/07/23/flood-topper.jpg

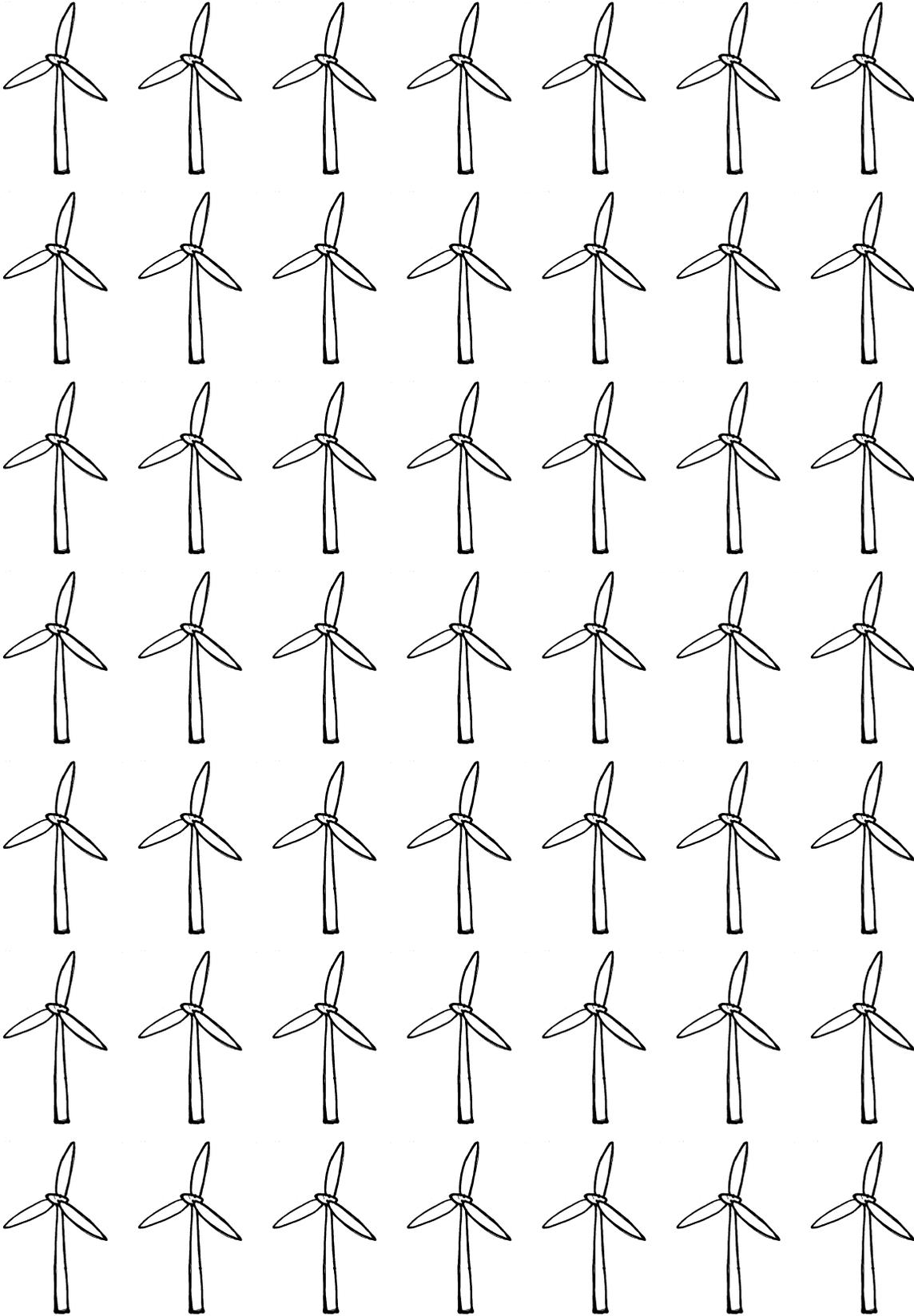
Reproducible #4:
Cool Map



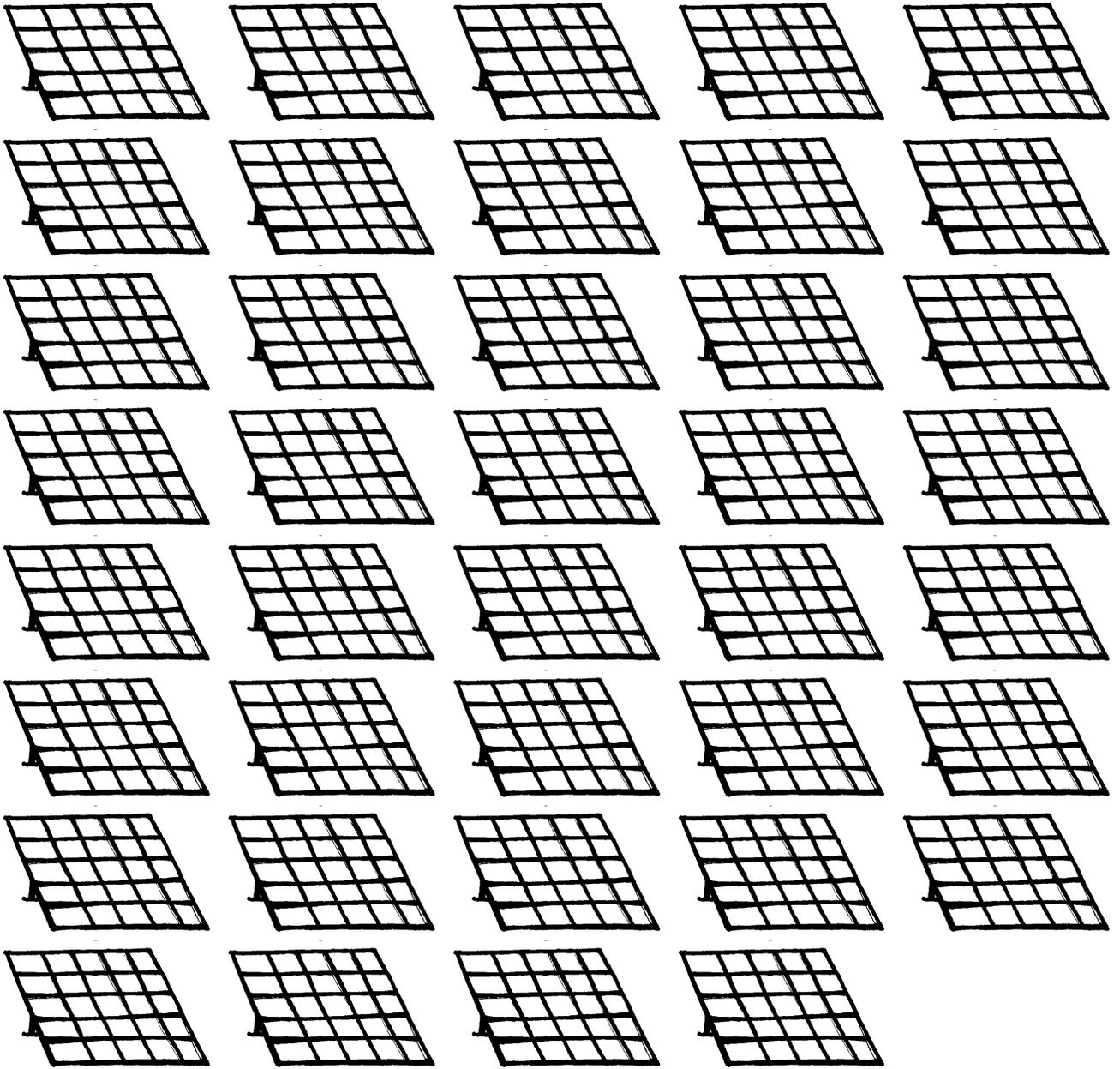
Name _____ Date _____

Reproducible 5:
Cool Map
Cut-outs

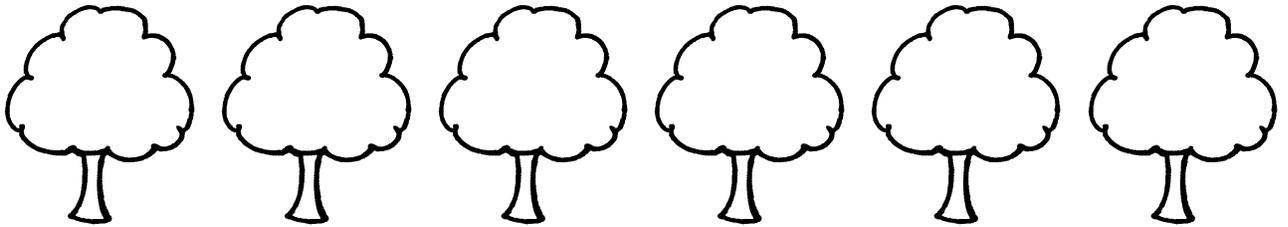
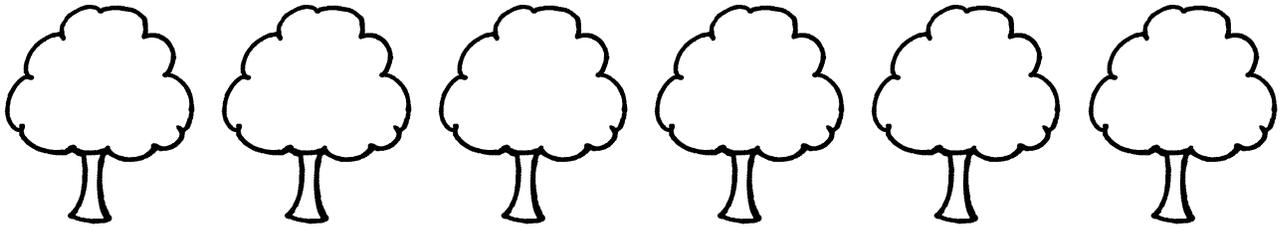
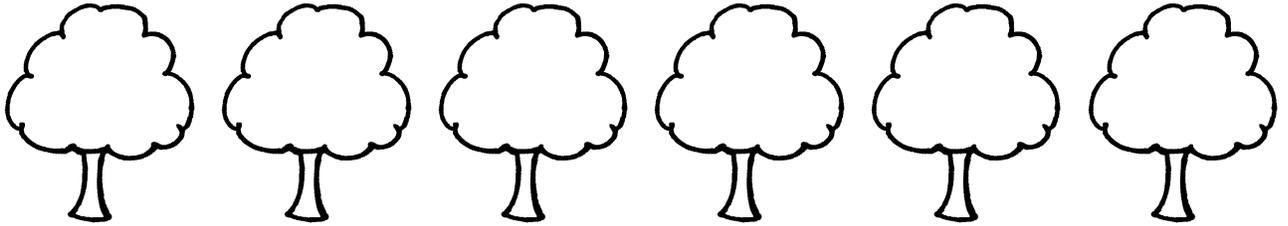
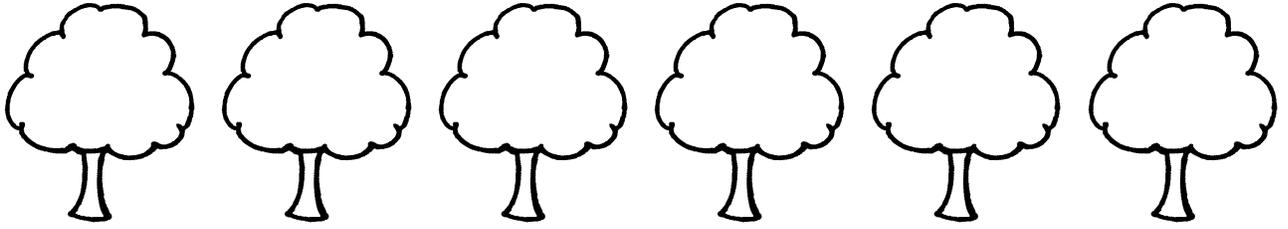
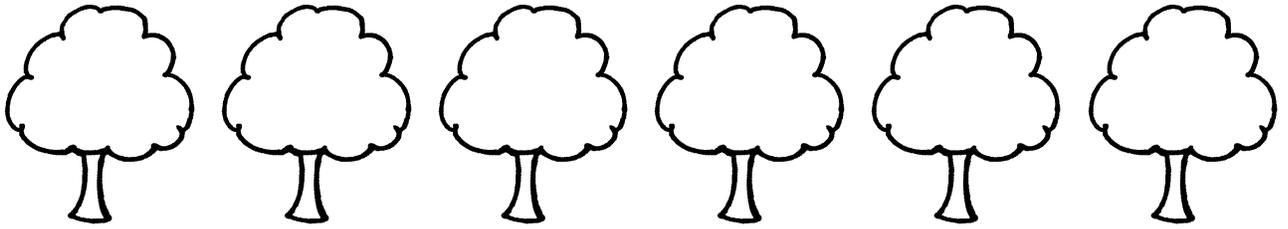
Windmills for Renewable Wind Energy



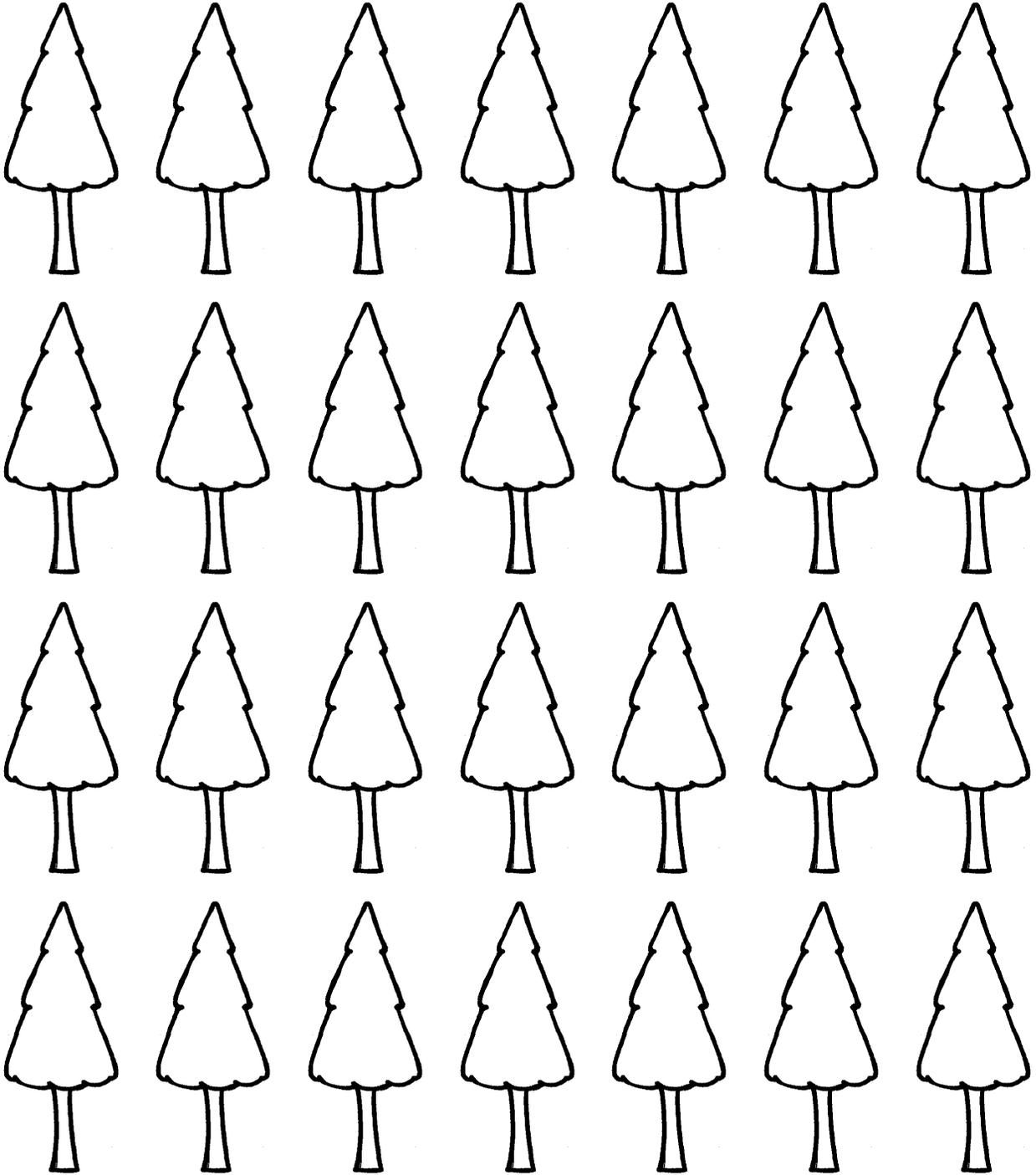
Solar Panels for Renewable Solar Energy



Trees for taking in Carbon Dioxide



Trees for Taking in Carbon Dioxide



Water Droplets for Conservation

