

## TRANSPORTATION

### BACKGROUND

Transportation plays a sizeable role in our greenhouse gas emissions with transportation contributing over 33% of CO<sub>2</sub> emissions. Electricity generation is the other major contributor to CO<sub>2</sub> emissions, with over 36%. A person's transportation and day to day electrical consumption decisions make up a big part of their carbon footprint, due to the burning of fossil fuels to supply electricity and transportation fuels. In this activity, students will consider their own choices in transportation and can calculate their overall carbon footprint in order to consider their personal impacts and make informed changes.

### OBJECTIVES

- Students will be able to explain individual carbon footprints.
- Students will be able to list means for reducing carbon footprints.

### TIME

One to two class periods

### MATERIALS

- |   |  |
|---|--|
| <input type="checkbox"/> 5 lb. bag of charcoal briquettes | <input type="checkbox"/> All-purpose cleaner               |
| <input type="checkbox"/> 1 Tall, white kitchen trash bag  | <input type="checkbox"/> White 8½" x 11" paper             |
| <input type="checkbox"/> 1 Plastic grocery bag            | <input type="checkbox"/> <i>Road Trip</i> worksheet        |
| <input type="checkbox"/> Paper towels                     | <input type="checkbox"/> <i>Carbon Footprint</i> worksheet |

### PREPARATION

1. Prior to this activity, have students research uses for CO<sub>2</sub> as homework. Encourage students to find ways CO<sub>2</sub> is used in residential, industrial, and medical settings. Students should make a list and bring the list with them to class.
2. Make copies of the worksheets for students.

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# Carbon Footprint

## TRANSPORTATION

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### PROCEDURE

1. Break students into small groups to brainstorm a list of uses for CO<sub>2</sub> based on their findings from the homework assignment.
2. Based on the previous activities, students should understand that CO<sub>2</sub> is released into the atmosphere during fossil fuel combustion. This includes combustion from fossil-fueled power plants generating electricity, from manufacturing processes, and from the burning of fossil fuels as a fuel in vehicles.
3. Review that CO<sub>2</sub> is usually found in a gas form. It is colorless and transparent to light. Even though we know CO<sub>2</sub> impacts the environment, we do not always think about it because we cannot see it. Show students the bag of charcoal briquettes. The briquettes are made almost completely of carbon. The bag of briquettes will represent the amount of carbon in one gallon of gas. The average gallon of gasoline contains about five pounds of carbon. There are typically about 100 briquettes in the bag. By dividing five pounds of carbon by 100 briquettes, that means there are about 0.05 pounds of carbon per briquette.
4. Discuss how many miles each student drives (or is driven) to and from school each day. Calculate how many briquettes represent the carbon dioxide emissions from their transportation to and from school. Use the bags to cover the workspace and hold individual briquettes. Students can use the *Carbon Footprint* worksheet for calculations.
5. Pass out the *Road Trip* worksheet. Students will plan a road trip and calculate the CO<sub>2</sub> emitted on their trip.  
**NOTE:** If students do not know the fuel economy of their vehicles, direct them to the website [www.fueleconomy.gov](http://www.fueleconomy.gov). Selecting a vehicle can also be assigned as homework the night before.
6. When students are done calculating their *Road Trip* carbon footprint, give them each a separate piece of paper. Have students write a letter or article citing at least three suggestions for reducing carbon footprints. Students should also reflect on why it is important to understand their carbon footprint and why it matters.

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Presented by  
Society of Petroleum Engineers



Activity adapted with courtesy from The NEED Project  
[www.need.org](http://www.need.org)

## CLIMATE WEB

### BACKGROUND

This activity helps students to visualize climate as a system with many items feeding into it and relying on its function.

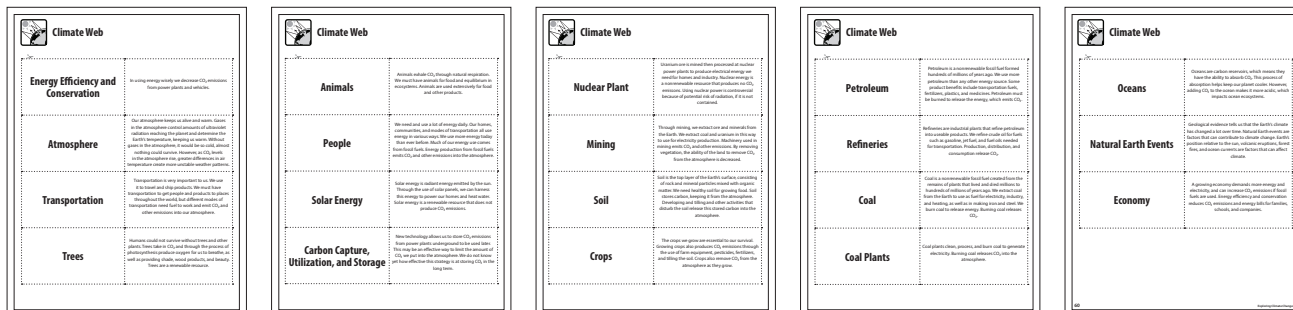
### OBJECTIVES

- Students will be able to identify components in the climate system and describe their functions.
- Students will be able to describe the connections between each component in the climate system.

**TIME** — One class period

### MATERIALS

- Ball of yarn or string
- Hole punch
- Climate web hang tags, below
- Scissors
- Cardstock



### PREPARATION

- Copy the climate hang tags onto cardstock for durability and laminate for reuse.
- Cut apart the hang tags and use a single hole punch to make two holes in the top corner of each.
- Lace one length of yarn or string through each hang tag and tie off, creating a necklace.

### PROCEDURE

- Hand out the hang tag necklaces and ask students to read the backs of their cards aloud so other students in the group know the roles in the activity. Give students a chance to ask any questions they have about what is written on their cards.
- Direct students to put on their hang tags and stand in a circle.
- Hand the ball of yarn to one of the students. Explain that he or she should look around the circle and identify another student representing a component of the system that is related to his or her role. Some of these relationships are spelled out in the descriptions on the backs of the hang tags.
- Holding on to the end of the yarn, the first student passes the ball of yarn to that student, explaining how that part of the system relates to him or her. That student then repeats the process, holding onto the yarn and passing the ball on.

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# Carbon Footprint

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- The average gallon of gas contains about 5 lbs. of carbon.
- One five-pound bag of charcoal briquettes contains approximately 100 briquettes.
- 5 lbs. of carbon/100 briquettes = 0.05 lbs. carbon per briquette

## SAMPLE PROBLEMS

1. If you drive or ride in a vehicle that averages 25 mpg, how many briquettes per mile would you be emitting?
2. If each briquette contains 0.05 lbs. of carbon, how many lbs. of carbon are emitted each mile?

## QUESTIONS

1. How many miles per gallon does your car (or your family car) average?
2. How many briquettes per mile would be emitted while traveling in your vehicle?
3. If each briquette contains 0.05 lbs. of carbon, how many lbs. of carbon are you emitting per mile?
- 4a. How many miles do you travel to school?
- 4b. Calculate how much carbon dioxide you are emitting as you travel to school.
- 5a. How many miles do you travel on the average day? Think about everywhere you go.
- 5b. Calculate how much carbon dioxide you are emitting as you travel on an average day.

## CONCLUSIONS

1. Do you think people would change their behavior if carbon dioxide was emitted in a visible way, such as charcoal briquettes, rather than as a gas? Why or why not?
2. What are challenges in decreasing carbon dioxide emitted from our vehicles?
3. What might be some options for reducing the amount of carbon dioxide emitted from the transportation sector?





# Climate Web



## Energy Efficiency and Conservation

In using energy wisely we decrease CO<sub>2</sub> emissions from power plants and vehicles.

## Atmosphere

Our atmosphere keeps us alive and warm. Gases in the atmosphere control amounts of ultraviolet radiation reaching the planet and determine the Earth's temperature, keeping us warm. Without gases in the atmosphere, it would be so cold, almost nothing could survive. However, as CO<sub>2</sub> levels in the atmosphere rise, greater differences in air temperature create more unstable weather patterns.

## Transportation

Transportation is very important to us. We use it to travel and ship products. We must have transportation to get people and products to places throughout the world, but different modes of transportation need fuel to work and emit CO<sub>2</sub> and other emissions into our atmosphere.

## Trees

Humans could not survive without trees and other plants. Trees take in CO<sub>2</sub> and through the process of photosynthesis produce oxygen for us to breathe, as well as providing shade, wood products, and beauty. Trees are a renewable resource.



# Climate Web



## Animals

Animals exhale CO<sub>2</sub> through natural respiration. We must have animals for food and equilibrium in ecosystems. Animals are used extensively for food and other products.

## People

We need and use a lot of energy daily. Our homes, communities, and modes of transportation all use energy in various ways. We use more energy today than ever before. Much of our energy use comes from fossil fuels. Energy production from fossil fuels emits CO<sub>2</sub> and other emissions into the atmosphere.

## Solar Energy

Solar energy is radiant energy emitted by the sun. Through the use of solar panels, we can harness this energy to power our homes and heat water. Solar energy is a renewable resource that does not produce CO<sub>2</sub> emissions.

## Carbon Capture, Utilization, and Storage

New technology allows us to store CO<sub>2</sub> emissions from power plants underground to be used later. This may be an effective way to limit the amount of CO<sub>2</sub> we put into the atmosphere. We do not know yet how effective this strategy is at storing CO<sub>2</sub> in the long term.



# Climate Web



## Nuclear Plant

Uranium ore is mined then processed at nuclear power plants to produce electrical energy we need for homes and industry. Nuclear energy is a nonrenewable resource that produces no CO<sub>2</sub> emissions. Using nuclear power is controversial because of potential risk of radiation, if it is not contained.

## Mining

Through mining, we extract ore and minerals from the Earth. We extract coal and uranium in this way to use for electricity production. Machinery used in mining emits CO<sub>2</sub> and other emissions. By removing vegetation, the ability of the land to remove CO<sub>2</sub> from the atmosphere is decreased.

## Soil

Soil is the top layer of the Earth's surface, consisting of rock and mineral particles mixed with organic matter. We need healthy soil for growing food. Soil stores carbon, keeping it from the atmosphere. Developing and tilling and other activities that disturb the soil release this stored carbon into the atmosphere.

## Crops

The crops we grow are essential to our survival. Growing crops also produces CO<sub>2</sub> emissions through the use of farm equipment, pesticides, fertilizers, and tilling the soil. Crops also remove CO<sub>2</sub> from the atmosphere as they grow.



# Climate Web



## Petroleum

Petroleum is a nonrenewable fossil fuel formed hundreds of millions of years ago. We use more petroleum than any other energy source. Some product benefits include transportation fuels, fertilizers, plastics, and medicines. Petroleum must be burned to release the energy, which emits CO<sub>2</sub>.

## Refineries

Refineries are industrial plants that refine petroleum into useable products. We refine crude oil for fuels such as gasoline, jet fuel, and fuel oils needed for transportation. Production, distribution, and consumption release CO<sub>2</sub>.

## Coal

Coal is a nonrenewable fossil fuel created from the remains of plants that lived and died millions to hundreds of millions of years ago. We extract coal from the Earth to use as fuel for electricity, industry, and heating, as well as in making iron and steel. We burn coal to release energy. Burning coal releases CO<sub>2</sub>.

## Coal Plants

Coal plants clean, process, and burn coal to generate electricity. Burning coal releases CO<sub>2</sub> into the atmosphere.





# Climate Web



## Oceans

Oceans are carbon reservoirs, which means they have the ability to absorb CO<sub>2</sub>. This process of absorption helps keep our planet cooler. However, adding CO<sub>2</sub> to the ocean makes it more acidic, which impacts ocean ecosystems.

## Natural Earth Events

Geological evidence tells us that the Earth's climate has changed a lot over time. Natural Earth events are factors that can contribute to climate change. Earth's position relative to the sun, volcanic eruptions, forest fires, and ocean currents are factors that can affect climate.

## Economy

A growing economy demands more energy and electricity, and can increase CO<sub>2</sub> emissions if fossil fuels are used. Energy efficiency and conservation reduces CO<sub>2</sub> emissions and energy bills for families, schools, and companies.