# Lesson 5: Consequences of our Lifestyles

## *Tab 1: Overview*

Students examine ways humans use carbon as individuals and compare how people around the globe use carbon for transportation, food, housing, and electricity.

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### Guiding Question

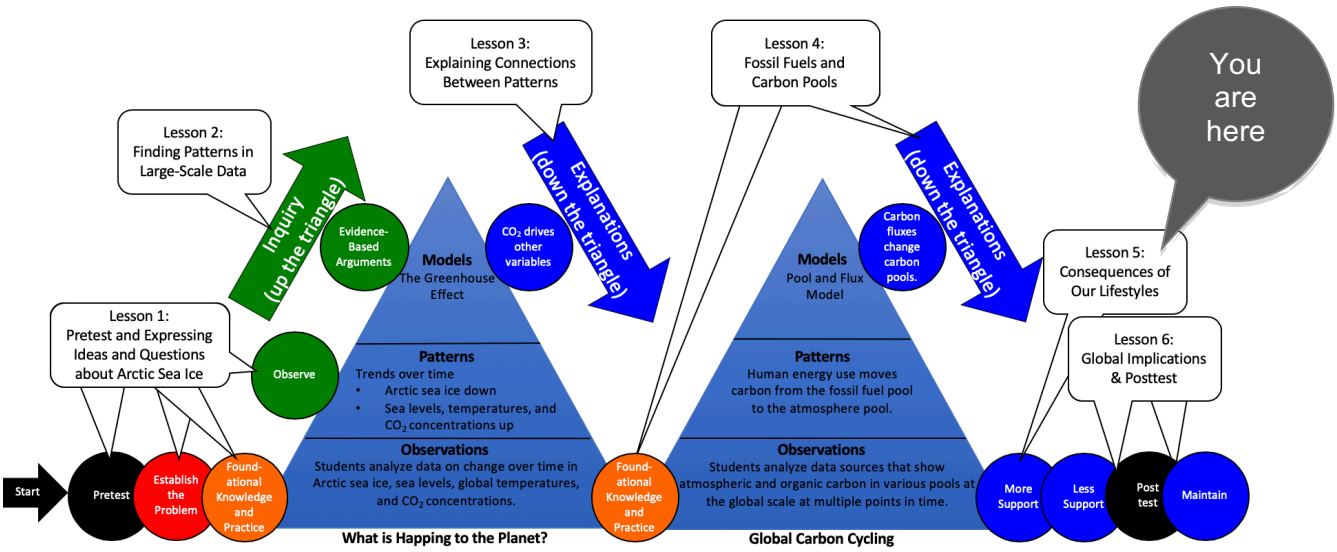
How do we use organic carbon and emit $CO_2$ in our lives?

### Activities in this Lesson

- Activity 5.1: Extreme Makeover: Lifestyle Edition (45 min)
- Activity 5.2: Carbon Emissions Jigsaw (60 min)
- Activity 5.3: Energy Scenarios (30 min)
- Activity 5.4: Strategies for Lowering Carbon Emissions (45 min)

### Unit Map

The *Human Energy Systems* Unit




## *Tab 2: Learning Goals*

### Target Performances

| *Lesson 5 – Consequences of Our Lifestyles (students as explainers)* | |
|---|---|
| ***Activity*** | ***Target Performance*** |
| Activity 5.1 Extreme Makeover: Lifestyle Edition (45 min) | Students choose preferred lifestyles based on data about four countries (United States, France, China, Ethiopia) and compare $CO_2$ emissions based on those lifestyles. |

| | |
|---|---|
| Activity 5.2 Carbon Emissions Jigsaw (60 min) | Students explain the mechanisms through which human activities and technologies in four different areas (electricity, transportation, buildings, food) lead to $CO_2$ emissions. |
| Activity 5.3 Energy Scenarios (30 min) | Students explain how different personal activities (energy scenarios) lead to $CO_2$ emissions. |
| Activity 5.4 Strategies for Lowering Carbon Emissions (45 min) | Students create and share posters explaining strategies for reducing $CO_2$ emissions. |

### NGSS Performance Expectations

#### High School

- Ecosystems: Interactions, Energy, and Dynamics. HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- Earth and Human Activity. HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

#### Middle School

- Human Impacts. MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capital consumption of natural resources impact Earth's systems.
- Earth and Human Activity. MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

## *Tab 3: Background Information*

### Three-dimensional Learning Progression (accordion)

In Lessons 3 and 4 students studied the fluxes that affect $CO_2$ concentrations in the atmosphere, including the key role that human-caused emissions play as an unbalanced flux. In Lesson 5 students study the nature of the unbalanced $CO_2$ flux. Most students will see that some activities, such as driving cars, cause $CO_2$ to go into the atmosphere because they depend on combustion of fossil fuels. But what about other activities? Does driving a "zero emissions" electric car contribute to the $CO_2$ flux? What about making the car? Paving a road? Eating a hamburger?

Each of these activities also contributes to the $CO_2$ flux, but in more indirect ways. In Lesson 5 students study the consequences of our lifestyles and the technologies that support them. In particular, they learn that it is important to trace matter and energy through human technological systems in order to understand how combustion of fossil fuels often drives the transformations and movements of matter and energy. In this way they come to appreciate the many ways in which our daily activities and the technological systems that support those activities contribute to the unbalanced $CO_2$ flux.

### Key Ideas and Practices for Each Activity (accordion)

In this lesson, students explore in greater depth how we rely on combustion of fossil fuels for our lifestyles and daily activities. They explain how we use energy in four important sectors of our economy—electricity, housing, food, and transportation—and how our energy use is related to both direct and indirect emissions of carbon dioxide.

This Lesson focuses on the many ways that our lifestyles depend on carbon-transforming processes that oxidize organic carbon and therefore increase the amount of carbon dioxide in the atmosphere. Again, we can use the Large-scale Four Questions to organize the key points.

- The Carbon Pools Question: Most students are aware of the foods and fuels that we use directly; we oxidize food when we need energy for body functions, and we oxidize fuels when we drive cars, burn wood, etc. Many students are less aware of the fossil fuels we use indirectly, when we build and heat buildings, buy food and other goods that have been manufactured and transported, or use electricity from fossil fuel power plants.
- The Carbon Cycling Question: In order to understand the many ways that our lifestyles and activities lead to $CO_2$ emissions, students need to learn how to engage in "life cycle analysis," becoming aware of the many ways that producing goods and services for our economy requires combustion of fossil fuels.
- The Energy Flow Question: Chemical energy stored in biomass and fossil fuels is transformed into the energy we use for our lifestyles. This is radiated into the atmosphere, where some of it is trapped in greenhouse gases, warming the planet. Ultimately this heat is radiated out into space. Note that the heat energy is radiated into space in the form of infrared light. This is also the process that cools off our planet at night. Greenhouse gases cause global warming by absorbing some of the infrared light that the Earth radiates into space.
- The Stability and Change Question: The $CO_2$ emissions associated with our lifestyles are increasing the concentration of $CO_2$ in the atmosphere. Through the Greenhouse Effect, this causes global climate change, including changes in global temperatures, Arctic sea ice, and sea levels.

Major lifestyle choices within the sectors of transportation, food, housing and electricity use contribute greatly to carbon emissions. Average lifestyles for individuals in different countries vary greatly; per capita carbon emissions are particularly high in developed countries --- especially the United States.

You may notice that Activity 5.4 is similar to many of the carbon footprint calculators that are available online. This Activity is offered here as an alternative for a few reasons. For one, many of the online calculators focus on individual consumer choices without considering how our geographical locations can influence how we use carbon (e.g., political systems, energy infrastructures, access to public transportation, agriculture, etc.). Second, individual carbon footprint calculators often give students a result that is reflective of their socioeconomic status and/or the lifestyles of their parents. Having a lower carbon footprint can be a sign of poverty, while having a high carbon footprint can be a sign of wealth. Subsequently, low socio-economic communities and developing countries are the most affected groups by the consequences of high carbon emissions. Instead of asking students to reveal this information to the class, this Activity focuses on how average citizens of different countries use carbon, which reduces the risk of stigmatizing students based on choices that are largely out of their control. Third, online carbon footprint calculators often mask the mechanisms they use to calculate the results. Having students calculate the pounds of carbon dioxide associated with the lifestyle choices of these various countries is designed to make this calculation more visible to students.

**Key Carbon-Transforming Processes:** Combustion, Photosynthesis, Fossil Fuel Formation, Cellular Respiration

# Activity 5.1: Extreme Makeover: Lifestyle Edition (50 min)

## *Tab 1: Overview and Preparation*

### Target Student Performance

Students choose preferred lifestyles based on data about four countries (United States, France, China, Ethiopia) and compare $CO_2$ emissions based on those lifestyles.

### Resources You Provide

- (optional) Calculator (1 per group of four students)

### Resources Provided

- 5.1 Lifestyle Cards (1-2 sets per class)
- 5.1 Extreme Makeover: Lifestyle Edition Worksheet (1 per student)
- 5.1 Secrets Revealed! Worksheet (1 per student)
- 5.1 Extreme Makeover: Lifestyle Edition PPT

### Setup

Print the 5.1 Lifestyle Cards. You may choose to laminate them in order to re-use them another time. Prepare four stations. Set up one transportation station with all four transportation cards, one food station with all four food cards, etc. Print one copy each of 5.1 Extreme Makeover: Lifestyle Edition Worksheet and 5.1 Secrets Revealed! Worksheet for each student. Note: do not hand out the 5.1 Secrets Revealed! Worksheet until after students make their first lifestyle choices.

## *Tab 2: Directions (accordion for individual steps in directions)*

**1. Use the instructional model to show students where they are in the course of the unit.**

Show slide 2 of the 5.1 Extreme Makeover: Lifestyle Edition PPT.

**2. Make connections to the previous activities.**

Display slide 3 of the PPT. Tell students in the last activities we examined how carbon cycles around the globe. In this activity, we will examine how people from all parts of the world use carbon and energy, and how our personal choices and also where we live impacts how we use organic carbon.

- Place the 5.1 Lifestyle Cards around the room.
- Introduce the students to the four different stations around the room: food, electricity, transportation, and buildings.

**3. Have students visit the stations and make lifestyle choices.**

Display slide 4 of the PPT. Give each student a copy of 5.1 Extreme Makeover: Lifestyle Edition Worksheet.

- Tell students that each station contains four different options and that it is their job to select one at each station.
- They should visit each station, read each lifestyle card at each station, and select a lifestyle from each station (they should record their choices in Table A). *They should not make choices in Table B. Table B is for Activity 5.2.*

- Give students 10-20 minutes to visit all four stations.
- Students may ask you "How should I decide what to choose?" They should make their decision based on what they see as their ideal lifestyle.

**4. Calculate carbon emissions associated with the students' chosen lifestyles.**

Pass out 5.1 Secrets Revealed! Worksheet to each student and tell students to use the information in the top table to calculate how much carbon emissions are associated with their lifestyle choices. Give them time to make calculations and share with their neighbor.

- Note: students may have a difficult time realizing that the $CO_2$ levels they record on their 5.1 Secrets Revealed! Worksheet is measured in pounds of $CO_2$, whereas electricity is measured in kilowatt hours (a different unit of measurement). Help them understand that different amounts of kilowatt hours (the unit for measuring electricity) might not produce the same amount of $CO_2$ depending on how the energy was produced. For example: using 13,000 kilowatt hours of electricity in a place that uses wind and solar to generate electricity will result in fewer pounds of $CO_2$ than using 1,000 kilowatt hours of electricity in a place that uses coal to generate electricity.

**5. Have students share their results with a partner or group.**

Display slide 5 of the PPT. Ask students to look at their individual carbon emissions based on their choices and share their results with their partners.

- Encourage students to notice which lifestyle choices lead to the highest emissions and to look for similarities and differences in the choices they made.
- Ask for a raise of hands: *"How many people would use more than 5,000 pounds of carbon?"*
- *"Keep your hand up if you would use more than 10,000 pounds."*
- Continue with this trend so students get a sense of how the range and variation in results.

Ask students who had the highest and lowest emissions to share their choices, and any others who are willing to share their choices and why they made the choices they made.

**6. Ask for reflections on the activity as a whole class.**

Display slide 6 of the PPT. Ask students to share any reflections they have on their choices for each station. Ask:

- *"Who would like to share the choice they made for each station?"*
- *"To what extent do your choices affect the planet's climate?"*
- *"How do carbon emissions impact the global climate?"*

Students are likely to have chosen various lifestyles for a variety of reasons. Answers will vary at this point. Use the discussion to highlight the fact that different people use carbon in different ways depending on their needs, wants, where they live, and what kinds of resources are available to them. Also, have them think about how our individual practices might reflect the lifestyle of the society we live in, and how those practices impact the climate with the carbon emission we produce.

**7. Save the worksheets for Activity 5.2**

Collect 5.1 Extreme Makeover: Lifestyle Edition Worksheet and 5.1 Secrets Revealed! Worksheet or have students save them for use in Activity 5.2.

You may choose to leave the stations set up around the classroom for use in Activity 5.2.

## *Tab 3: Assessment*

The worksheets in this Activity do not come with accompanying annotated worksheets. This is because the choices students make in this Activity will vary from student to student, and there are no correct or incorrect answers. The purpose of the Activity is to show that there is variation in how we use carbon, not that there is a correct or incorrect way to use carbon.

### Tips

Point out to students that the unit of measurement for $CO_2$ is pounds, whereas the unit of measurement for electricity is kilowatt hours. These are different units of measurement! One kilowatt hour does not always produce the same amount of $CO_2$.

## *Tab 4: Differentiation & Extending the Learning*

### Differentiation (Accordion)

- Have students work in pairs. Have them make the lifestyle decision together and work on the calculations as a pair.

### Modifications (Accordion)

Have students visit the stations as pairs and see if their choices change when they have to make compromises with another person about their lifestyle.

### Extending the Learning (Accordion)

Have students research the carbon use of countries per capita on the internet to make informed guesses about which countries are represented in each choice.

# Activity 5.2 Carbon Emissions Jigsaw (60 min)

## *Tab 1: Overview and Preparation*

### Target Student Performance

Students explain the mechanisms through which human activities and technologies in four different areas (electricity, transportation, buildings, food) lead to $CO_2$ emissions.

### Resources You Provide

- (From previous lesson) 5.1 Lifestyle Cards (1-2 sets per class)
- (From previous lesson) 5.1 Extreme Makeover: Lifestyle Edition Worksheet (1 per student)
- (From previous lesson) 5.1 Secrets Revealed! Worksheet (1 per student)

### Resources Provided

- 5.2 Carbon Emissions Jigsaw PPT
- 5.2 Group A Electricity Handout (1 per student in Group A)
- 5.2 Group A Electricity Worksheet (1 per student in Group A)
- 5.2 Group B Transportation Handout (1 per student in Group B)
- 5.2 Group B Transportation Worksheet (1 per student in Group B)
- 5.2 Group C Buildings Handout (1 per student in Group C)
- 5.2 Group C Buildings Worksheet (1 per student in Group C)
- 5.2 Group D Food Handout (1 per student in Group D)
- 5.2 Group D Food Worksheet (1 per student in Group D)

### Recurring Resources

- Jigsaw Cards (1 per class)
- Four Questions Large Scale Handout

### Setup

Print enough copies of the worksheets and handouts so each student has one that aligns with his/her group. Print the Jigsaw Cards. You will need to cut these apart before class. You may want to laminate them first in order to make them last for longer. See instructions on the first slide of the cards for how to prepare cards for classes of different sizes.

If you took down the stations from Activity 5.1, re-set up each of the stations. That is, set up one transportation station with all four transportation cards, one food station with all four food cards, etc.

## *Tab 2: Directions (accordion for individual steps in directions)*

1. **Use the instructional model to show students where they are in the course of the unit.**

   Show slide 2 of the 5.2 Carbon Emissions Jigsaw PPT.

2. **Activate prior knowledge about The Energy Flow Question.**

   Display slide 3 of the PPT. Remind students of the third rule: Energy flows! Invite students to share what they think this means.

   - You may want to recall the Four Questions Large Scale Handout from Lesson 4.

3. **Recall the difference between organic and inorganic carbon.**

Display slide 4 of the PPT. As a review, ask students to explain the difference between organic and inorganic carbon.

- This should serve as a reminder that organic carbon stores useful chemical energy in C-C or C-H bonds.

**4. Brainstorm about how humans use organic carbon in everyday life.**

Display slide 5 of the PPT. Have students think of organic carbon they use in everyday life.

- If students are having a difficult time coming up with ideas, have them look around the classroom or think about things they have done or used during the day for more ideas and think back to Activity 5.1.

**5. Introduce the jigsaw to the students.**

Tell students they are going to participate in a jigsaw to discuss how we use fossil fuels to give us energy.

- First, they will divide into **home** groups to discuss the task for the day.
- Then, they will divide into **expert** groups. In their expert group, they will read a handout and complete a worksheet. They will have 30 minutes to read and complete the worksheet. They should also prepare a summary of their discussion from their expert group to share in their home group.
- Then, they will return to **home** groups. In their home groups, they will have 15 minutes to share their expertise with the members of their home group.

**6. Pass out jigsaw cards and divide students into home groups.**

Display slide 6 of the PPT. Distribute one jigsaw card to each student. See instructions on the first page of the cards for how to work with different class sizes.

- Tell students to divide into their home groups based on the image on their cards. For example, all gas cans should find other gas cans to form a home group.
- Once students have found their home groups, introduce the different topics for the jigsaw readings.
- Tell students that if they have a…
  - Letter A on their cards, they are going to become experts in how electricity use emits carbon emissions.
  - Letter B on their cards, they will become experts in how transportation emits carbon emissions.
  - Letter C on their cards, they will become experts in how buildings create carbon emissions.
  - Letter D on their cards, they will become experts in how food adds carbon in the atmosphere.

Give the home groups a few minutes to ask any questions they may have about the jigsaw.

**7. Divide students into expert groups.**

Display slide 7 of the PPT. Tell students to divide by letter to form **expert** groups (i.e., all students with the same letter and number on their cards should group together, etc.). They should hold onto their jigsaw cards for later.

- Distribute 5.2 Group Handouts and 5.2 Group Worksheets (which will vary by group) to each expert group.
- They can use the bottom of the 5.2 Group Worksheets to help them remember the ideas from their expert groups in their summary to the home groups.

- Give students 30 minutes to work in their groups.
- Tell students to think about how to summarize the main ideas from the handouts as they prepare to share their expertise in the next round.

**8. Reorganize students into expert groups.**

Display slide 8 of the PPT. Instruct students to regroup according to the image on their jigsaw cards to form **home** groups (i.e., students with gas tanks should all form one group, etc.).

- In their home groups, it is each student's job to provide an expert summary or report of what s/he discussed in his/her expert group (i.e., share his/her expertise).
- Give students 15 minutes to share their expertise.

**9. Recall the lifestyle choices game.**

Tell students that in the last activity, we learned that people who live in different geographical regions in the world use carbon in different ways, and that the way we use carbon can depend on both our individual choices and also where we live. Now students are going to make another set of lifestyle choices based on what they have learned about carbon.

**10. Have students visit the stations and make lifestyle choices.**

Display slide 9 of the PPT. Return or have each student take out their copy of 5.1 Extreme Makeover: Lifestyle Edition Worksheet.

- Tell students that each station contains four different options and that it is their job to select one at each station.
- They should visit each station, read each lifestyle card at each station, and select a lifestyle from each station (they should record their choices in the table)
- Give students 10 minutes to visit all four stations.
- Students may ask you "How should I decide what to choose?" This time they should make their decision based on what they would do to lower their carbon emissions.

**11. Calculate carbon emissions associated with the students' chosen lifestyles.**

Return or have each student take out their copy of 5.1 Secrets Revealed! Worksheet to each student and tell students to use the information in Table 3 to calculate how much carbon emissions are associated with their lifestyle choices. Give them time to make calculations and share with their neighbor.

- Have a class discussion about what students would need to change in their lives to live out these new lifestyles. Discuss what is possible and impossible to do based on where they live.

**12. Ask students which countries are represented in the Activity.**

Display slide 10 of the PPT.

- Ask students: *Which countries do you think are represented by lifestyles A, B, C, and D?*
- Give students an opportunity to suggest ideas about this question. You may need to remind them of the characteristics for each lifestyle.
- Ask them what information or experience they used to guess the way that they did. For example: *"What information did you use to guess that Lifestyle A is the United States?"*

**13. Reveal the answers!**

Use Slide 11 to show which country is associated with which lifestyle.

- Ask students if this is what they were expecting.

- Use Slide 12 of the presentation to ask, *"Why do you think these countries have different carbon emissions?"*
- Invite students to share ideas with the class.
- Students may notice that France has a very low emission rate associated with its electricity use, even though citizens from that country use a lot of electricity per capita. If this comes up, tell students that France generates a lot of electricity using nuclear power generators, which do not emit carbon.

**14. Think-pair-share discussion.**

Display Slide 13 of the PPT.

- Tell students to find partners.
- Display the first question. Give students 30 seconds to think about their answer, and then 1 minute to exchange their ideas with a partner.
- Invite a few pairs to share their ideas for this question with the class.
- Display the next question and repeat the process.
- Go through the questions on the slide until you have answered all six questions.

Try to make connections between how our individual lifestyles choices can affect others around the world even though some effects of climate change (e.g. sea level) might not affect us directly.

**15. Have students complete an exit ticket.**

- Show Slide 14 of the 5.2 Carbon Emissions Jigsaw PPT.
- Conclusions: How do lifestyles in the United State affect the size of the Earth's atmospheric $CO_2$ pool?
- Predictions: How can we choose to change our lifestyles?
- On a sheet of paper or a sticky note, have students individually answer the exit ticket questions. Depending on time, you may have students answer both questions, assign students to answer a particular question, or let students choose one question to answer. Collect and review the answers.
- The conclusions question will provide you with information about what your students are taking away from the activity. Student answers to the conclusions question can be used on the Driving Question Board (if you are using one). The predictions question allows students to begin thinking about the next activity and allows you to assess their current ideas as you prepare for the next activity. Student answers to the predictions question can be used as a lead into the next activity.

## *Tab 3: Assessment*

Circulate the room during both home and expert group discussions to listen to the group conversations. Note if students are drawing on the main points from the handouts or if they have questions.

### Tips

Encourage students to practice literacy and reading skills during their home groups by reading aloud to each other.

## *Tab 4: Differentiation & Extending the Learning*

### Differentiation (Accordion)

- Strategically assign groups.

### Modifications (Accordion)

Assign students the reading for homework and discuss as a class the following period.

### Extending the Learning (Accordion)

Have students keep a personal log about how they use energy in the four sections discussed in the jigsaw discussion: food, transportation, buildings, and electricity.

Have students do research on how electricity is generated in each of the countries in the Activity. They may be surprised that France produces less carbon than some other countries because they generate a lot of electricity with nuclear power!

# Activity 5.3: Energy Scenarios (30 min)

## *Tab 1: Overview and Preparation*

### Target Student Performance

Students explain how different personal activities (energy scenarios) lead to $CO_2$ emissions.

### Resources Provided

- 5.3 Energy Scenarios Cards (1 per class)
- 5.3 Energy Scenarios Placemat (1 per pair of students)
- 5.3 Energy Scenarios PPT
- Large Scale Four Questions Handout

### Setup

Print the 5.3 Energy Scenarios Cards. You will need to cut these apart before class. You may want to laminate them first in order to make them last longer. Prepare one copy of 5.3 Energy Scenarios Placemat for each pair of students. Prepare a computer and projector for the 5.3 Energy Scenarios PPT.

## *Tab 2: Directions (accordion for individual steps in directions)*

**1. Use the instructional model to show students where they are in the course of the unit.**

Show slide 2 of the 5.3 Energy Scenarios PPT.

**2. Activate prior knowledge.**

Show Slide 3 of the PPT. Remind students of the rules column in the Large Scale Four Questions Handout. Tell them it is their job today to tell stories about how energy use causes carbon atoms to move. Their stories will be expected to follow the rules!

**3. Divide students into pairs.**

Tell students to find a partner. Pass out 5.3 Energy Scenarios Placemat to each pair of students. Tell them to use the placemat to help them tell their story—they can draw arrows to help illustrate their story.

**4. Play the energy scenario game.**

Pass out one card from 5.3 Energy Scenarios Cards to each pair. Give the students five minutes to discuss how the energy use on their card causes carbon atoms to move between pools.

- Ask each pair to select a “spokesperson” to share their story with the class. The spokesperson should read the energy use to the class and use the handout to tell the story of how carbon moves and is transformed.
- For each story that is told, invite the rest of the class to “fact check:” Do their stories follow the rules and answer the Carbon Pools Question, the Carbon Cycling Question, and the Energy Flow Question?

**5. Play another round: new scenarios.**

This time tell students to come up with a form of energy use that has not already been mentioned in class and to determine how carbon atoms move from between pools as a result of this energy use.

- Have the other students in each pair act as spokespeople and share their stories.
- Discuss how the stories follow the rules and answer Carbon Pools Question, the Carbon Cycling Question, and the Energy Flow Question.

**6. Discuss the increasing atmosphere pool and the Stability and Change Question.**

Show Slide 4. Ask students to think about how carbon atoms moved as a result of all of these energy uses.

- Which pool is getting bigger as a result of these energy uses?
- Pose the question: "*What will happen to the climate if we continue to burn fossil fuels at the same rate that we are now?*" (Business as usual)

## *Tab 3: Assessment*

During the presentation of the energy scenarios, help the students identify any instances of "rule breaking." Do the students confuse matter and energy? Do they ever suggest that matter can turn into energy? Do they suggest that energy can disappear? If so, remind them to have a look at the rules and see how their accounts of energy in their scenarios match or don't match.

## *Tab 4: Differentiation & Extending the Learning*

### Differentiation (Accordion)

- Have a pre-made list of forms of energy that students can pick from.
- Strategically form groups.

### Modifications (Accordion)

Read and explain the energy scenarios as a class instead of in groups.

### Extending the Learning (Accordion)

Have students develop their own energy scenarios and share their interpretations of them with the class.

# Activity 5.4: Strategies for Lowering Carbon Emissions (45 min)

## *Tab 1: Overview and Preparation*

### Target Student Performance

Students create and share posters explaining strategies for reducing $CO_2$ emissions.

### Resources You Provide

- Chart paper (1 per group of four students)

### Resources Provided

- 5.4 Strategy Cards
- 5.4 Strategies for Lowering Carbon Emissions PPT

### Recurring Resources

- Learning Tracking Tool for Human Energy Systems (1 per student)
- Assessing the Learning Tracking Tool for Human Energy Systems

### Setup

Prepare a computer and projector to display 5.4 Strategies for Lowering Carbon Emissions PPT. Cut apart the 5.4 Strategy Cards.

## *Tab 2: Directions (accordion for individual steps in directions)*

**1. Use the instructional model to show students where they are in the course of the unit.**

Show slide 2 of the 5.4 Strategies for Lowering Carbon Emissions PPT.

**2. Introduce the lesson.**

Display slide 3 of the PPT. Tell students that they will be thinking about how to lower carbon emissions.

**3. Draw a class representation.**

Display slide 4 of the PPT. Have a class discussion about how walking or riding a bike would reduce carbon emissions. Work as a class to draw a representation of this on the board.

**4. Pass out the strategy cards.**

Display slide 5 of the PPT. Give each student one of the 5.4 Strategy Cards. In groups of four, have students discuss how the strategies in these cards would lead to lower carbon emissions.

- Give them 15 minutes to draw a representation on chart paper of how one of the strategies on their cards would reduce carbon emissions.

**5. Have a gallery walk of representations.**

Display slide 6 of the PPT. Display the representations around the room. Have students walk around the room and look at each of the representations. Ask students to discuss how each representation shows how the strategy would reduce carbon emissions. Also, have students

discuss how the strategies are similar and different with regards to how they lower carbon emissions.

- Display slide 7 of the PPT. Have a full class discussion about which of the carbon emission reducing strategies students would be willing and able to do.

**6. Have a class discussion about larger scale strategies.**

Show slide 8 of the PPT. Tell students that the strategy cards they just read were mainly things they could do as individuals. However, solving climate change will take cooperation from communities, governments, organizations, and countries around the planet.

- Tell students to consider the list on the board and also the strategies they have on their cards and brainstorm about actions that society could take together to work for bigger change.
- Give students 1-2 minutes to think to themselves.
- Record their ideas on the PPT slide.
- Also, ask them why is important to adopt some of these strategies and how these strategies can be implemented in their communities at a larger scale.

**7. Have a discussion to complete the Learning Tracking Tool for this activity.**

Show Slide 9 of the 5.4 Strategies for Lowering Carbon Emissions PPT.

- Have students take out their Learning Tracking Tool from the previous lesson.
- Have students write the activity name in the first column, "5.4 Strategies for Lowering Carbon Emissions."
- Have a class discussion about what students figured out during the activity that will help them in answering the lesson driving questions:
  - What causes the annual cycle: $CO_2$ concentrations in Hawaii to go down every summer and up every winter?
  - What causes the long-term trend: $CO_2$ concentrations to go up every year?
  - How can we predict what will happen to $CO_2$ concentrations in the future?
- When you come to consensus as a class, have students record the answer in the second column of the tool.
- Have a class discussion about what students are wondering now that will help them move towards answering the unit driving question. Have students record the questions in the third column of the tool.
- Have students keep their Learning Tracking Tool for future activities.
- Example Learning Tracking Tool

| Activity | What We Figured Out | What We are Asking Now |
|---|---|---|
| 5.4 Strategies for Lowering Carbon Emissions | *Our lifestyles contribute to $CO_2$ emissions in many ways.* | *What does increasing $CO_2$ in the atmosphere mean for the future of our planet?* |

**8.**

## *Tab 3: Assessment*

Check to see which strategies students can easily explain and which strategies students have a more difficult time with. For the strategies that are difficult to connect to lowered carbon dioxide emissions, pause and discuss.

## *Tab 4: Differentiation & Extending the Learning*

### Differentiation (Accordion)

- Allow students to pair up with a partner or group before sharing thoughts about how walking or riding a bike would reduce emissions.
- Strategically form groups for the activity.
- Have sentence stems to aid in conversation at each of the stations around the room.

### Modifications (Accordion)

After you complete all six questions in the Think-Pair-Share, invite students to think of their own questions for the class.

### Extending the Learning (Accordion)

Have students to share these strategies with their families, and encourage them to make changes at home.