



## Table of Contents

### Introduction

|                     |   |
|---------------------|---|
| Whole Picture ..... | 2 |
| Vocabulary .....    | 4 |

### Activity MS.2.1: Ask an Expert

|   |   |
|---|---|
| MS.2.1 Lesson Plan .....                                  | 5 |
| Worksheet: Ask an Expert about Environmental Cycles ..... | 8 |

### Activity MS.2.2: Environmental Cycles Vocabulary

|   |    |
|---|----|
| MS.2.2 Lesson Plan .....                          | 10 |
| Template: Vocabulary Cards .....                  | 13 |
| Information Sheet: Word Games Instructions .....  | 17 |
| Worksheet: Environmental Cycles Vocabulary .....  | 18 |
| Answer Key: Environmental Cycles Vocabulary ..... | 20 |

### Activity MS.2.3: You are a Carbon Atom!

|   |    |
|---|----|
| MS.2.3 Lesson Plan .....  | 22 |
| Information Sheet: Carbon Reservoir Station Cards .....                 | 25 |
| Template: Carbon Reservoir Station Signs (for MS.2.3 and MS. 2.4) ..... | 32 |
| Template: Carbon Reservoir Station Signs (for MS.2.3 only) .....        | 37 |
| Worksheet: You are a Carbon Atom! .....                                 | 39 |
| Answer Key: You are a Carbon Atom! .....                                | 42 |

### Activity MS.2.4: The Carbon Cycle Game

|  |    |
|--|----|
| MS.2.4 Lesson Plan .....   | 45 |
| Information Sheet: Dice Number Charts .....                                  | 51 |
| Template: Carbon Reservoir Station Signs (additional for MS.2.4. only) ..... | 62 |
| Worksheet: The Carbon Cycle Game .....                                       | 68 |
| Answer Key: The Carbon Cycle Game .....                                      | 71 |
| Worksheet: The Carbon Cycle Review .....                                     | 74 |

### Activity MS.2.5: Does Ice Prevent High Waves?

|  |    |
|--|----|
| MS.2.5 Lesson Plan .....                       | 77 |
| Worksheet: Does Ice Prevent High Waves? .....  | 81 |
| Answer Key: Does Ice Prevent High Waves? ..... | 83 |



# CHANGING CLIMATE

## Environmental Cycles

### MIDDLE SCHOOL TEACHER GUIDE



### Introduction

Thank you for using this Raising Educational Achievement through Cultural Heritage Up (REACH Up) unit in your classroom! The lessons are designed to address the Alaska Science Standards and Grade Level Expectations, Alaska Cultural Standards and the Bering Strait School District Scope and Sequence goals. All of the activities focus on environmental cycles from Alaska Native cultural, physical and earth and life science perspectives. This supplemental unit addresses the place-based question: How is climate change affecting our area and why are these changes important to our community?

The REACH Up Environmental Cycles unit consists of a total of five activities, Ask an Expert, Environmental Cycles Vocabulary, You are a Carbon Atom, the Carbon Cycle Game, and Does Sea Ice Prevent High Waves. Each activity will require a 45-minute class period. Discussion could easily be extended into multiple class periods. The Carbon Cycle Game activity may take longer as it has two components: The Carbon Cycle Game and The Carbon Cycle Review.

You may also want to repeat sections of an activity during subsequent class meetings, such as reviewing the Environmental Cycles video or having your students practice the vocabulary card games multiple times. If you are utilizing the entire Environmental Cycles unit, you should introduce the activities in the order they are presented. However, if time is short, any of the activities could be presented independently.

The accompanying student guide is intended for use with multiple groups of students and you should not allow students to write in them. You can either have students record their work on a separate sheet of paper, or create copies of the corresponding worksheets that are included in this teacher's guide.

### Whole Picture

Residents across the Bering Strait region are witnessing changes, caused by the warming of our global climate. Carbon dioxide (CO<sub>2</sub>) is one of the greenhouse gasses that contribute to global warming. Carbon is essential for life, part of a complex system called the carbon cycle, but excess amounts of carbon contribute to warming the Earth beyond optimal levels.

The ocean is crucial to weather and climate as it dominates the carbon cycle of the Earth. The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing and moving heat, carbon and water.

People in the North have experienced climate change in their surroundings, from increasing permafrost thaw and coastal erosion, vegetation changes, to changes in timing and length of the seasons. They also report changes in the ocean, including less ice, thinner ice, and changes in timing of the sea ice formation. They have had to adjust their hunting and gathering practices due to those changes. The National Oceanic and Atmospheric Administration's Arctic



# CHANGING CLIMATE

## Environmental Cycles

### MIDDLE SCHOOL TEACHER GUIDE



Report Card 2017, a peer-reviewed annual update of environmental conditions in the Arctic, attributes the striking changes in the Arctic environment to increasing greenhouse gasses in the atmosphere.

The Arctic Report Card 2017 describes that the sea ice cover continues to be young and thin, the current decline of Arctic sea ice is unprecedented, and the surface sea temperatures in the Arctic are rising at an incomparable speed. Another study shows that summer sea ice is predicted to disappear in the Chukchi Sea by 2050, and winter sea ice could decrease by 50% in the Bering and Chukchi Seas by the end of the 21st century. Because sea ice keeps large ocean waves from forming, diminishing sea ice contributes significantly to increased coastal erosion.

Ongoing climate change also has potential health impacts, as a newly published report by the Alaska Department of Health and Social Services states, including increased accidents and injuries, poorer mental health and wellbeing, compromised access to water and sanitation, and decreased food security.

Alaska is warming at a rate two to three times faster than the mainland United States. Environmental changes are increasingly forcing communities to adapt more quickly than expected. Thriving communities in Alaska will benefit from young people who can help adapt to rapid climate change by learning about the carbon cycle and effects of greenhouse gasses such as CO<sub>2</sub> on the environment. Their innovative thinking of how to reduce the amount of CO<sub>2</sub> released, as individuals and as a community, will be a tremendous asset to solving these problems associated with global warming.

### References

*Arctic Report Card 2017*, National Oceanic and Atmospheric Administration.  
<http://www.arctic.noaa.gov/Report-Card>

*Assessment of the Potential Health Impacts of Climate Change in Alaska*. 2018. Alaska Department of Health and Social Services.  
[http://www.epi.alaska.gov/bulletins/docs/rr2018\\_01.pdf](http://www.epi.alaska.gov/bulletins/docs/rr2018_01.pdf)





### Unit Vocabulary

| Science Terms to Define   |   |
|---------------------------|---|
| <b>carbon cycle</b>       | the circulation or exchange of carbon between the environment and living things   |
| <b>carbon sink</b>        | carbon is constantly moving between different stores such as forests, soil, oceans, atmosphere, and fossil fuels, that act as either sinks or sources -- a sink absorbs more carbon than it gives off |
| <b>carbon source</b>      | carbon is constantly moving between different stores such as forests, soil, oceans, atmosphere, and fossil fuels, that act as either sinks or sources -- a source emits more carbon than it absorbs   |
| <b>decomposition</b>      | the process of rotting; decay   |
| <b>first-year sea ice</b> | floating ice of no more than one year's growth developing from young ice, thickness from 0.3 to 2 meters (1 to 6.6 feet)  |
| <b>photosynthesis</b>     | a series of chemical reactions that convert light energy, water, and carbon dioxide into the food-energy molecule glucose, and give off oxygen as a byproduct   |
| <b>reservoir</b>          | a place where matter, such as carbon atoms, are stored  |
| <b>respiration</b>        | the action of breathing; a process in living organisms involving the production of energy, with the intake of oxygen and the release of carbon dioxide  |
| <b>multiyear sea ice</b>  | ice that has survived at least one melt season; it is typically 2 to 4 meters (6.6 to 13.1 feet) thick and thickens as more ice grows on its underside  |

| Terms for Incorporating Local Indigenous Language |                |         |                |                   |
|---|----------------|---------|----------------|-------------------|
| English   | Iñupiaq        | Yup'ik  | Siberian Yupik | Local Translation |
| atmosphere  | silam simigvia | ella    | eslavut        |                   |
| land animal                                       | uqquq          | puqla   | puqla          |                   |
| marine animal                                     | ini            | ena     | mangteghaq     |                   |
| ocean   | uquqsaun       | umcigun | maqaasghaq     |                   |
| plant   | inim           | ellvik  | iiaq           |                   |
| respiration                                       | igaliq         | egaleq  | gergesek       |                   |
| sea ice   | tagium sikua   | cikuq   | qelughtaaq     |                   |
| soil  | nuna           | nevuq   | sunu           |                   |
| waves   | qailiq         | qaiq    | nengulghat     |                   |





# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.1

#### TEACHER GUIDE



### Activity MS.2.1: Ask an Expert

#### Overview

In this activity, students will interview an elder or cultural knowledge bearer.

#### Objectives

On successful completion of the lesson, students will be able to:

- demonstrate effective interviewing techniques
- interpret qualitative data from interviews
- compare and contrast the carbon cycle with the water cycle
- explain how climate change is affecting sea ice in the local community

#### Alaska Standards

##### Alaska Science Standards / Grade Level Expectations

[6-8] **SA1.1** The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] **SA3.1** The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion).

#### Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.4] gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance.

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them.



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.1

#### TEACHER GUIDE



Students who meet this cultural standard are able to:

[E.4] determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems.

### Bering Strait School District Scope & Sequence

- 6.3 Name and describe the processes involved in the water cycle, carbon and oxygen cycles.
- 7.7A Understands composition and structure of the atmosphere (gases present and layers)
- 7.7C Knows that atmosphere is warmed through heat retention (greenhouse effect). (SD3.2)
- 7.7D Understand that the atmosphere protects life on earth by absorbing ultraviolet solar radiation.

### Materials

- REACH Up Middle School Student Guide: *Environmental Cycles*
- Student Worksheet: *Ask an Expert about Environmental Cycles*
- Internet access and projector

### Activity Preparations

1. Identify adults within your school who have lived year-round in the community for many years. This might include teachers, administrators, secretaries, teacher aides, lunchroom/kitchen staff, recess duties, maintenance and custodial staff, etc. Ask these local knowledge bearers if they would be willing to speak with a group of your students about environmental changes and how those changes have affected the community. Make sure that the volunteers you have identified will be available during the time that your class will be completing this activity.
2. Ask the volunteers if they speak an Alaska Native Language, and if so, which language(s) and dialect(s) they are familiar with. If applicable, have them translate the written words on the student worksheet, so you have an answer key. Also, ask them to teach you the pronunciation of the terms.

### Activity Procedure

1. Pre-Teaching: Distribute the REACH Up Middle School Student Guide: Environmental Cycles. Read and discuss pages 1-5 as a class. Review the water cycle if necessary, expanding on the elementary understanding of a “circle” between precipitation, evaporation, and condensation to more complex understanding of the water cycle. Ask students to compare and contrast the carbon cycle with the water cycle.



## CHANGING CLIMATE Environmental Cycles

### Activity MS.2.1 TEACHER GUIDE



2. Show the video, Environmental Cycles, available at [www.k12reach.org/videos.php](http://www.k12reach.org/videos.php). Videos are located under the Multimedia tab. Allow time for students to share comments and ask questions.
3. Explain that students will interview a few community members about environmental changes. Separate students into small groups according to how many local knowledge bearers are available to share information with your class. Explain if the appointed interviewees speak an Alaska Native Language, so students know whether or not they should pursue that portion of the interview.
4. Review expectations for student behavior while conducting the interview, including introductions and thanking the interviewee at the end of the interview. Discuss suggestions or effective interviewing techniques, such as allowing ample time for the interviewee to answer, and asking follow-up questions.
5. Distribute one Student Worksheet: Ask an Expert about Environmental Cycles to each group and assign each group one local knowledge bearer to interview. Provide 15-20 minutes for students to locate and interview the knowledge bearer.
6. Reconvene in the classroom and ask groups to share their findings. How is sea ice changing? What impacts might the changes have on local lifestyles? If your students learned local indigenous words for the vocabulary terms, compare their translations with the translations found on page 5.



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.1

### WORKSHEET



#### **STUDENT WORKSHEET: *Ask an Expert about Environmental Cycles***

**Names of Group Members:** \_\_\_\_\_

Interview a long-term community member to learn more about environmental changes in your area. Take notes about what you learn.

Who did you interview? \_\_\_\_\_

#### **Ask:**

Could you tell me about changes you have noticed in the environment over the years?

For example:

- the ocean (sea ice conditions, waves)
- weather (more or less snow/rain/wind in different seasons)
- vegetation (types and area of vegetation, height of trees, amount of shrubs)

Have people in our community made any changes to their lifestyles due to the environmental changes you have described?

Other notes:



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.1

### WORKSHEET



#### For Alaska Native Language Speakers:

What language(s) do you speak? \_\_\_\_\_

What dialect(s)? \_\_\_\_\_

Could you please translate the following words?

atmosphere: \_\_\_\_\_

land animal: \_\_\_\_\_

marine animal: \_\_\_\_\_

ocean: \_\_\_\_\_

plant: \_\_\_\_\_

respiration: \_\_\_\_\_

sea ice: \_\_\_\_\_

soil: \_\_\_\_\_

waves: \_\_\_\_\_



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### TEACHER GUIDE



### Activity MS.2.2: Environmental Cycles Vocabulary

What terminology do we need to know to discuss environmental cycles?

#### Overview

In this activity, students will learn key environmental cycle terminology in English and their local Alaska Native language by playing vocabulary games with peers.

#### Objectives

On successful completion of this lesson, students will be able to:

- read and speak indigenous terms related to climate and environmental cycles
- illustrate and define terms related to environmental cycles and changing climate's impacts on the environment

#### Alaska Standards:

##### Alaska Cultural Standards

[A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community. Students who meet this cultural standard are able to:

[A.1] assume responsibilities for their role in relation to the well-being of the cultural community and their lifelong obligations as a community member.

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.5] identify and utilize appropriate sources of cultural knowledge to find solutions to everyday problems.

#### Bering Strait School District Scope & Sequence

**7.7C** Knows that atmosphere is warmed through heat retention (greenhouse effect).  
(SD3.2)

**7.7D** Understand that the atmosphere protects life on earth by absorbing ultraviolet solar radiation.



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### TEACHER GUIDE



### Materials

- *REACH Up Middle School Student Guide: Environmental Cycles*
- Vocabulary card sets (1 per group of 4-6 students)
- *Student Information Sheet: Word Games Instructions* (1 per group)
- *Student Worksheet: Environmental Cycles Vocabulary*
- Dry Erase Markers (1 per group)
- Timers (optional)

### Activity Preparations

1. If your students completed Activity MS.2.1 Ask an Expert, refer to their completed worksheets for the terms you will have them use for the vocabulary word card games.
2. If your students did not conduct interviews with Native language speakers, consult with a local knowledge bearer or language expert to determine which language/dialect translation provided on page 6 of the Student Guide would be most appropriate for your students to practice. The following chart is provided for reference.

| Alaska Native Languages in the Bering Strait Region |                          |                                |                            |                  |
|---|--------------------------|--------------------------------|----------------------------|------------------|
| Language  | Dialect Group            | Dialect                        | Subdialect                 | Community        |
| Iñupiaq   | Seward Peninsula Inupiaq | Bering Strait                  |                            | Brevig Mission   |
|   |                          |                                | Diomedede                  | Little Diomedede |
|   |                          |                                |                            | Shishmaref       |
|   |                          |                                | Wales (Kinikmiu)           | Wales            |
|   |                          | Qawariaq                       | Teller                     | Teller           |
|   |                          |                                |                            | Unalakleet       |
|   |                          |                                |                            | Shaktolik        |
|   |                          |                                | Fish River                 | Golovin*         |
|   |                          |                                |                            | White Mountain   |
|   | Northern Alaskan Iñupiaq | Malimiut                       |                            | Koyuk            |
| Siberian Yupik                                      |                          | St. Lawrence Island Yupik      |                            | Gambell          |
|   |                          |                                |                            | Savoonga         |
| Yup'ik  |                          | Norton Sound (Unaliq-Pastuliq) | Unaliq                     | Elim             |
|   |                          |                                |                            | Golovin*         |
|   |                          |                                |                            | St. Michael      |
|   |                          | General Central Yup'ik         | Nelson Island and Stebbins | Stebbins         |



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### TEACHER GUIDE



\* It is very common for more than one language/dialect, or a combination of dialects, to be spoken in a community. It should also be noted that Inupiaq-Yup'ik bilingualism was common throughout the 1900s in the Norton Sound villages of White Mountain, Golovin, Elim, and Unalakleet. Golovin is listed twice on our chart because specific subdialects were cited in the research found on the Alaska Native Language Center website: <http://www.uaf.edu/anlc/languages/>.

3. Keep in mind that different individuals may translate certain terms differently. It's fine to have different student groups working with various translations, or you can choose a set list of words for your whole class to practice. Highlight the diversity and do not attempt to offer an authoritative translation; the goal is to practice an Alaska Native language while discussing climate change topics.
4. If using the Vocabulary Cards provided by REACH Up, label a sample set of cards with local indigenous words using a dry erase marker. If needed, create your own sets of the vocabulary cards from the template provided.
5. Make copies of the Word Games Instruction Sheet (one per group) and the Environmental Cycles Vocabulary worksheet (one per student).

#### Activity Procedure:

1. Distribute the REACH Up Middle School Student Guide: Environmental Cycles and review pages 1-6.
2. Show students the vocabulary cards. Hold up each card. Discuss what each card depicts. How do these terms relate to environmental cycles in their region?
3. Say the English and local Alaska Native Language word for the illustration depicted on the card. Ask students to repeat the words. Repeat this once or twice, then ask students to call out the correct words as you hold up each card.
4. Divide the class into four groups.
5. Provide each group with the Word Games Instruction sheet, a set of Vocabulary Cards, dry erase marker, and a timer (optional).
6. Instruct students to label their cards with the local indigenous words. Groups can select one student from the group for this task, or take turns.
7. Direct students' attention to the Word Games Instruction sheet. Students can commit to one game for a period of time or mix and match.
8. Encourage students to play the vocabulary games and practice the vocabulary words during free time throughout the duration of the Environmental Cycles unit. If possible, schedule 10-15 minutes twice per week to practice the vocabulary terms.
9. Write the following terms on the board: carbon cycle, carbon sink, carbon source, decomposition, first-year sea ice, photosynthesis, reservoir, respiration, and multi-year sea ice. Ask students to share definitions for these terms. Refer back to the REACH Up Middle School Student Guide: Environmental Cycles as necessary.
10. Distribute the Environmental Cycles Vocabulary Worksheet and ask students to complete it.





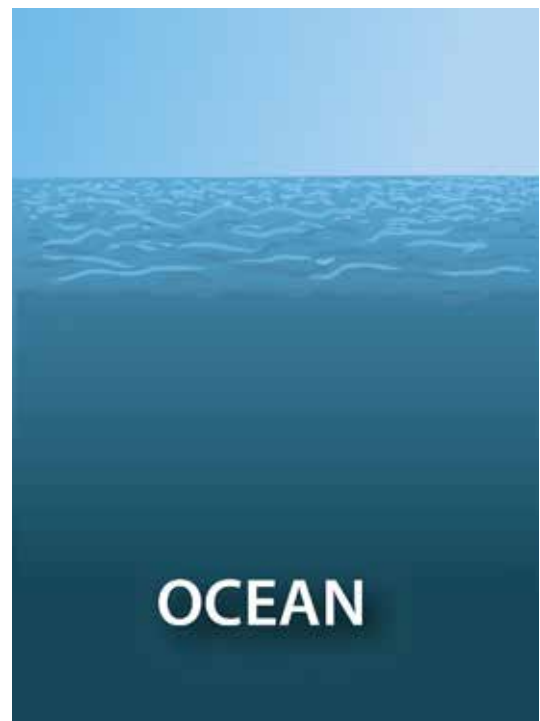
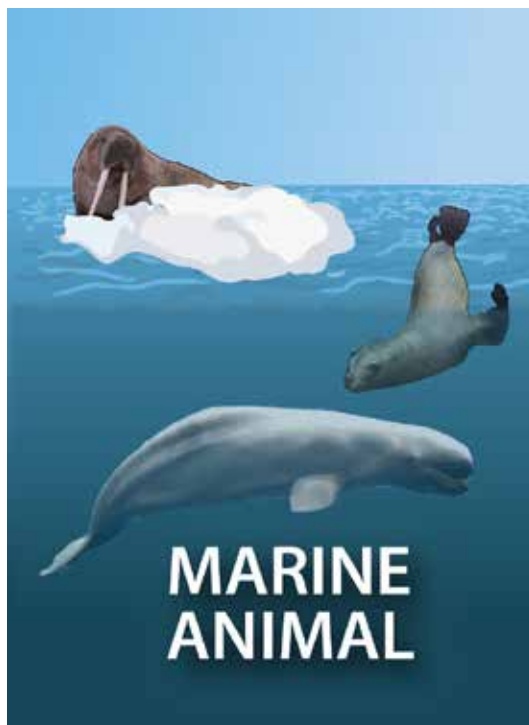
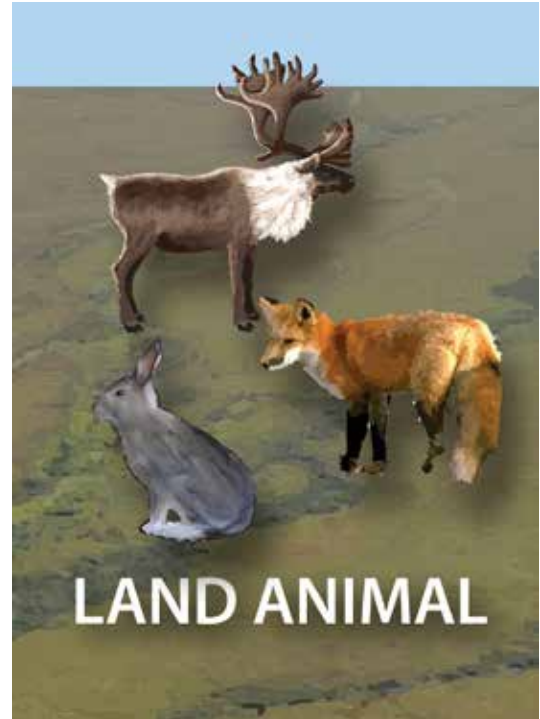
# CHANGING CLIMATE

## Environmental Cycles

Activity MS.2.2  
TEMPLATE



### Vocabulary Cards



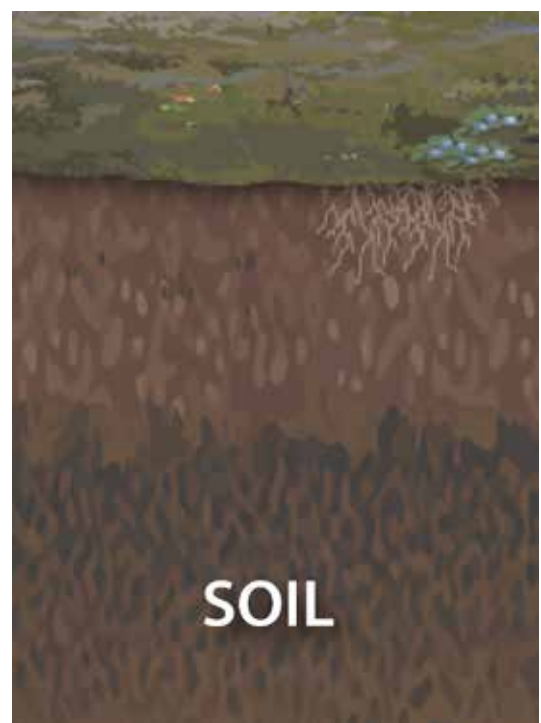
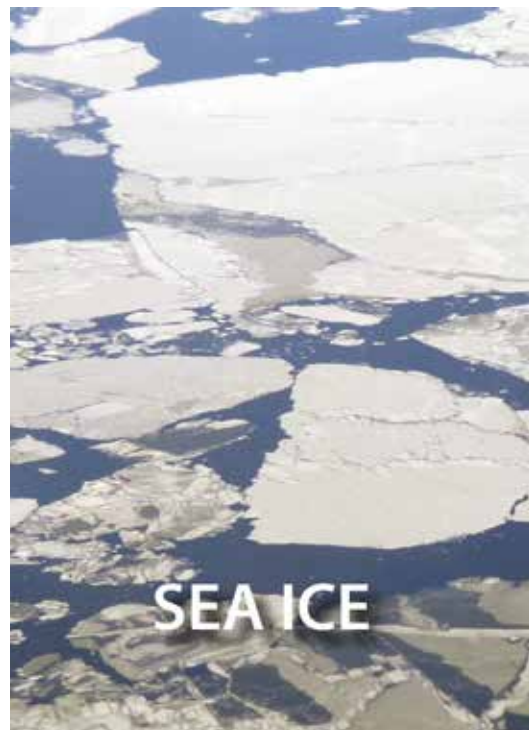
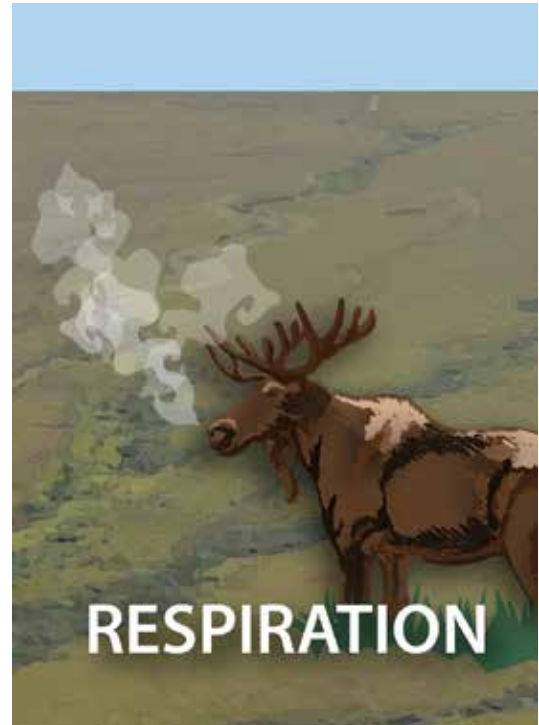
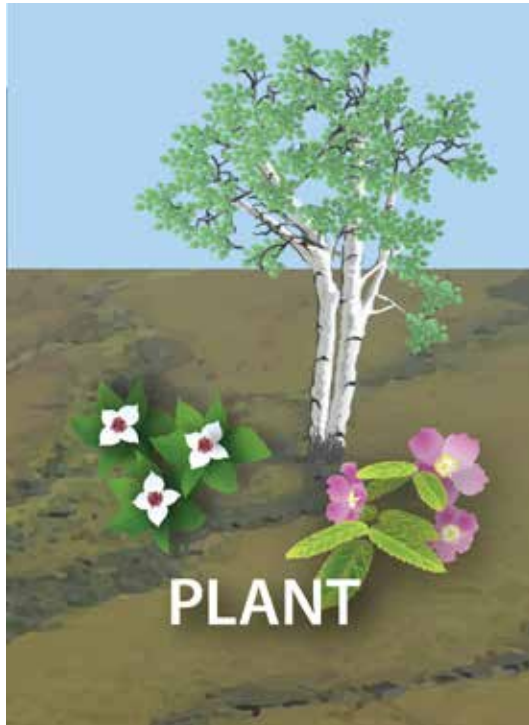
# CHANGING CLIMATE

## Environmental Cycles

Activity MS.2.2  
TEMPLATE



### Vocabulary Cards



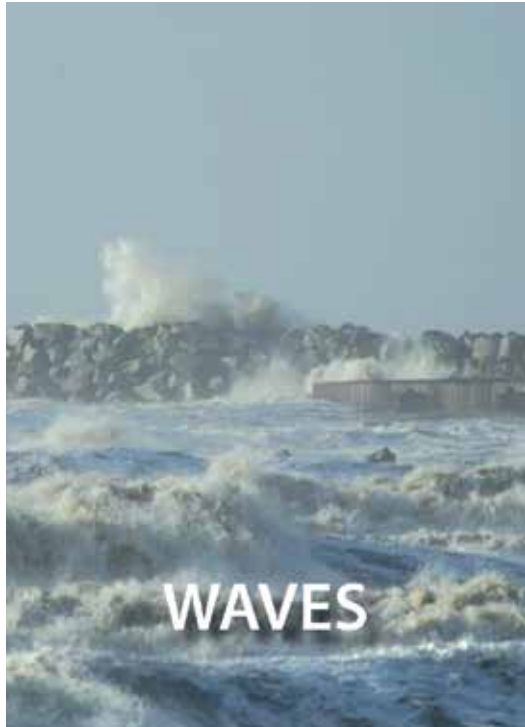
# CHANGING CLIMATE

## Environmental Cycles

Activity MS.2.2  
TEMPLATE



### Vocabulary Cards



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### TEMPLATE



### Vocabulary Cards

---

Local Indigenous Word

---

Local Indigenous Word

---

Local Indigenous Word

---

Local Indigenous Word



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### INFORMATION SHEET



#### **STUDENT INFORMATION SHEET:** *Word Games Instructions*

##### **VOCABULARY SWAP:**

1. Distribute one card to each person.
2. Practice the word on your card, then find a classmate. Teach them the word on your card and learn the word on their card. Trade cards.
3. Find another classmate and repeat.

##### **FIND THE CARD:**

1. Divide into small groups. Each group will need a set of vocabulary cards. Spread the cards in front of you so that everyone in your group can see the pictures.
2. Listen as your teacher says a word aloud from one of the cards.
3. Work with your group to find and hold up the correct card.

##### **VOCABULARY SLAP:**

1. Select one student to serve as the “caller” for this game. That student should make a list of the vocabulary words on a separate sheet of paper. The words can be found on the back of the cards.
2. Place the cards in a circle, picture-side-up, in the middle of the playing area.
3. The caller should call out a word from their list. Everyone else should quickly place their hand on the picture that they believe represents that word.
4. Turn over the card or cards that students selected to see who chose correctly. Each student who placed his or her hand on the correct card earns a point.
5. Put the card(s) back in the circle and play again.
6. Play for a designated period of time. At the end of the time, the person with the most points wins.

##### **TEAMWORK:**

1. Divide your group into two teams. Each team will need a pencil and paper.
2. Shuffle the vocabulary cards and stack them picture-side up in the middle of the table.
3. Work with your team to write down the local Alaska Native Language terms for the picture on the card.
4. After both teams have written answers for the top card, turn the card over to check. Teams get 1 point for the correct Alaska Native Language word.
5. Repeat until all cards are gone. The team with the most points wins.



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

### WORKSHEET



#### STUDENT WORKSHEET: *Environmental Cycles Vocabulary*

Name: \_\_\_\_\_

1) Match each definition to the vocabulary word. Write the corresponding letter on the appropriate line.

Carbon cycle \_\_\_\_\_

a) the action of breathing; a process in living organisms involving the production of energy, with the intake of oxygen and the release of carbon dioxide

Carbon sink \_\_\_\_\_

b) a place where matter, such as carbon atoms, are stored

Carbon source \_\_\_\_\_

c) the process of rotting; decay

Decomposition \_\_\_\_\_

d) a reservoir such as forests, soil, oceans, atmosphere, and fossil fuels, that absorbs more carbon than it gives off

First-year sea ice \_\_\_\_\_

e) floating ice of no more than one year's growth developing from young ice, thickness from 0.3 to 2 meters (1 to 6.6 feet)

Multiyear sea ice \_\_\_\_\_

f) a reservoir such as forests, soil, oceans, atmosphere, and fossil fuels, that emits more carbon than it absorbs

Photosynthesis \_\_\_\_\_

g) a series of chemical reactions that convert light energy, water, and carbon dioxide into the food-energy molecule glucose, and give off oxygen as a byproduct

Reservoir \_\_\_\_\_

h) ice that has survived at least one melt season; it is typically 2 to 4 meters (6.6 to 13.1 feet) thick and thickens as more ice grows on its underside

Respiration \_\_\_\_\_

i) the circulation or exchange of carbon between the environment and living things



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

### WORKSHEET



2) Complete the chart by writing the local Alaska Native Language terminology and illustrating the missing terms.

| <b>My Community:</b> _____ |  |                     |
|----------------------------|--|---------------------|
| <i>English Word</i>        | <i>Local Alaska Native Language Word</i> | <i>Illustration</i> |
| atmosphere                 |  |                     |
| land animal                |  |                     |
| marine animal              |  |                     |
| ocean                      |  |                     |
| plant                      |  |                     |
| respiration                |  |                     |
| sea ice                    |  |                     |
| soil                       |  |                     |
| waves                      |  |                     |



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.2

#### ANSWER KEY



### STUDENT WORKSHEET: *Environmental Cycles Vocabulary*

Name: \_\_\_\_\_

1) Match each definition to the vocabulary word. Write the corresponding letter on the appropriate line.

Carbon cycle   i  

a) the action of breathing; a process in living organisms involving the production of energy, with the intake of oxygen and the release of carbon dioxide

Carbon sink   d  

b) a place where matter, such as carbon atoms, are stored

Carbon source   f  

c) the process of rotting; decay

Decomposition   c  

d) a reservoir such as forests, soil, oceans, atmosphere, and fossil fuels, that absorbs more carbon than it gives off

First-year sea ice   e  

e) floating ice of no more than one year's growth developing from young ice, thickness from 0.3 to 2 meters (1 to 6.6 feet)

Multiyear sea ice   h  

f) a reservoir such as forests, soil, oceans, atmosphere, and fossil fuels, that emits more carbon than it absorbs

Photosynthesis   g  

g) a series of chemical reactions that convert light energy, water, and carbon dioxide into the food-energy molecule glucose, and give off oxygen as a byproduct

Reservoir   b  

h) ice that has survived at least one melt season; it is typically 2 to 4 meters (6.6 to 13.1 feet) thick and thickens as more ice grows on its underside

Respiration   a  

i) the circulation or exchange of carbon between the environment and living things





# CHANGING CLIMATE Environmental Cycles

## Activity MS.2.2 ANSWER KEY



2)

| <b>My Community:</b> _____ |   |  |
|----------------------------|---|--|
| <i>English Word</i>        | <i>Local Alaska Native Language Word</i>                                      | <i>Illustration</i>                    |
| <b>atmosphere</b>          | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>land animal</b>         | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>marine animal</b>       | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>ocean</b>               | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>plant</b>               | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>respiration</b>         | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>sea ice</b>             | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>soil</b>                | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |
| <b>waves</b>               | Answers will vary depending on language and dialect spoken in this community. | Sketch should illustrate word at left. |



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### TEACHER GUIDE



### Activity MS.2.3: You are a Carbon Atom!

#### Overview

In this lesson, students will learn about carbon sources and sinks by visiting different reservoirs, reading carbon facts of each reservoir, and answering questions.

#### Objectives

On successful completion of this lesson, students will be able to:

- identify three carbon sources and three carbon sinks
- describe processes that move carbon
- describe the process of photosynthesis, respiration, and decomposition

#### Next Generation Science Standards

##### Standards by Disciplinary Core Ideas:

Ecosystems: Interactions, Energy, and Dynamics

From Molecules to Organisms: Structures and Processes

**Standards by Topic:** Matter and Energy in Organisms and Ecosystems

#### Performance Expectations

The activity is just one step toward reaching the performance expectations listed below:

MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

#### Dimension:

##### *Science & Engineering Practices*

Developing and Using Models

Connections to Nature of Science

##### *Disciplinary Core Ideas*

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### TEACHER GUIDE



### *Crosscutting Concepts*

#### Energy and Matter

### **Alaska Standards:**

#### **Alaska Science Standards and Grade Level Expectations**

**SA1:** The student demonstrates an understanding of the processes of science by

[6-8] **SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

**SC3:** The student demonstrates an understanding that all organisms are linked to each other and their physical environments through transfer and transformation of matter and energy by

[6] **SC 3.1** recognizing that organisms can cause physical and chemical changes (e.g. digestion, growth, respiration, photosynthesis) to matter and recognizing the importance of energy transfer in these changes

[7] **SC 3.1** recognizing and explaining that organisms can cause physical and chemical changes (e.g. digestion, growth, respiration, photosynthesis) to matter and recognizing and explaining the importance of energy transfer in these changes

[8] **SC 3.1** stating that energy flows and that matter cycles but is conserved with an ecosystem

**SF:** The student develops an understanding of the dynamic relationships among scientific, cultural, social and personal perspectives.

### **Bering Strait School District Scope and Sequence**

**6.3B** Diagram the ways that matter and energy are transferred within and between living and nonliving things. (SC3.1)

**6.3E** Name and describe the processes involved in the water cycle, carbon and oxygen cycles.

**6.3H** Use scientific processes and inquiry to directly support concepts of cycling of matter and energy.

**7.7A** Understands composition and structure of the atmosphere (gases present and layers)

**7.7C** Knows that atmosphere is warmed through heat retention (greenhouse effect) (SD3.2)

**7.7D** Understand that the atmosphere protects life on earth by absorbing ultraviolet solar radiation.



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### TEACHER GUIDE



### Materials

- REACH Up Middle School Student Guide: *Environmental Cycles*
- Information Sheet: *Carbon Reservoir Station Cards*
- Student Worksheet: *You are a Carbon Atom!*

### Activity Preparations

1. Make copies (one per student) of the Student Worksheet: *You are a Carbon Atom!*
2. As preparation, set up each of the seven stations in a different location around the room. The seven stations include Atmosphere, Surface Ocean, Deep Ocean, Marine Life, Land Plants, Land Animals, and Soil. Mark each station clearly so students can easily see where they are when moving around the room. Place appropriate Carbon Reservoir Station Cards on the stations.

### Activity Procedure

1. Pre-Teaching: Read pages 2-4 of the REACH Up Middle School Student Guide: *Environmental Cycles* and introduce/review the carbon cycle as a class. Review the water cycle as a familiar concept, and introduce terms such as reservoir, source, and sink, using the water cycle as an example. Review with students why carbon is important to biology and climate. At the end of the session, ask students to list different carbon sources and sinks.  
**Note:** You may want to point out different day length depending on latitudes when you go over photosynthesis in the text.
2. Introduce the activity by telling students to imagine they are a carbon atom. They will travel the carbon cycle by visiting seven places where carbon is stored, which are set up around the room. (See Activity Preparations above).
3. Explain which sources and sinks will be included in this activity. Point out that there are many other sources and sinks that are not included in this activity, such as fossils fuels and vehicle emissions.
4. Each student will participate in the activity individually. Even though several students may be at the same station at any given time, they should each read the carbon facts sheet and answer questions on their worksheets individually. Distribute student worksheets and instruct students that they can visit the stations in any order as long as they go through all of them. At each station, they should read the carbon reservoir cards (Activity Preparations) and learn about themselves (carbon) in each area. Before moving on to the next station, they should answer the questions in that section of their worksheet.
5. At the end of the activity, discuss the questions as a class. (See the “Discuss” section on page 7 of the Student Guide). Help students understand that the path taken by a carbon atom through a biogeochemical cycle is complex and is not a circle by reviewing facts about carbon they have learned at each station.





# ATMOSPHERE



While you are here in the atmosphere, you will be bonded to two atoms of oxygen to form carbon dioxide ( $\text{CO}_2$ ).  $\text{CO}_2$  is only a very small part (0.04%) of the Earth's atmosphere, but it plays a large role in the energy balance of the Earth.

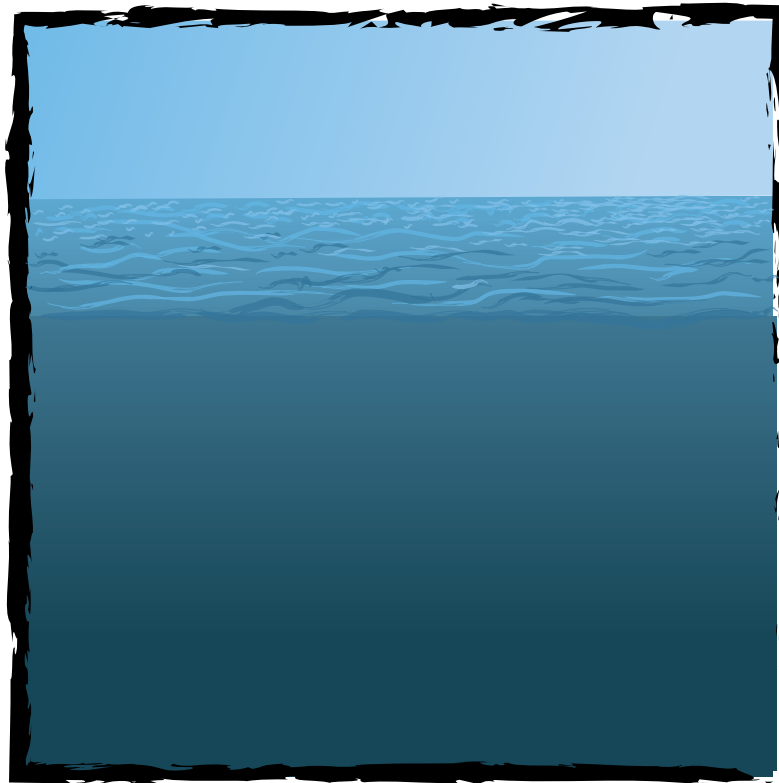
$\text{CO}_2$  in the atmosphere acts like a blanket over the Earth by trapping longwave radiation, which otherwise would radiate heat away from the Earth.  $\text{CO}_2$  is the largest contributor to this effect (currently 63%).

Because of burning fossil fuels, such as coal, oil and natural gas, the amount of  $\text{CO}_2$  has increased substantially since the Industrial Revolution. As the amount of  $\text{CO}_2$  increases, so will the warming effect.





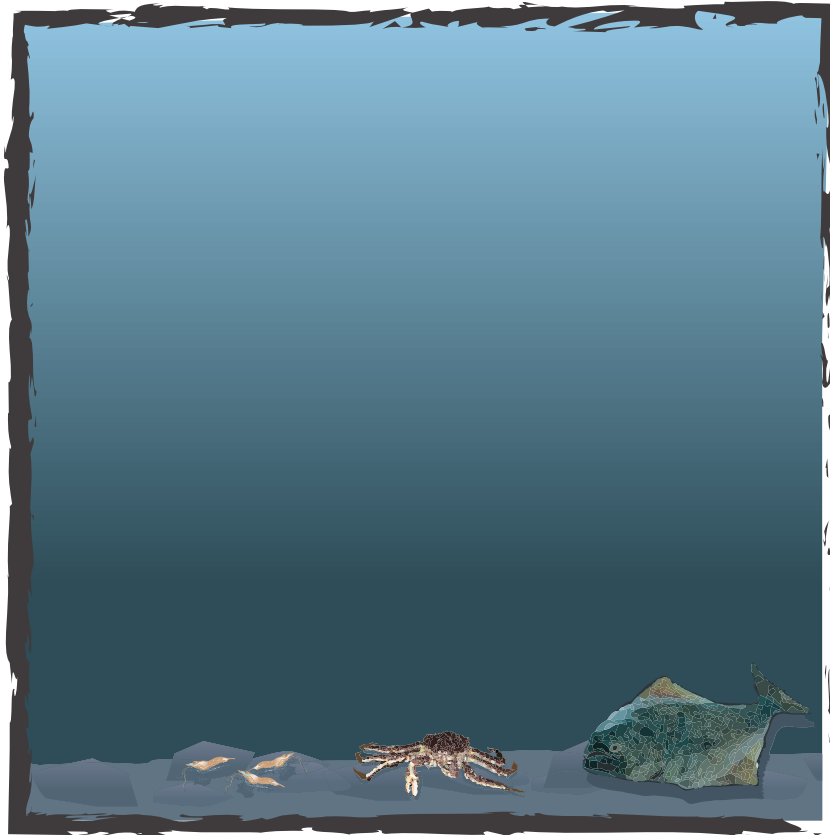
# SURFACE OCEAN



You got here either by diffusing from the atmosphere, by decomposing marine life, or from circulating water from the deep ocean. The ocean absorbs more carbon dioxide ( $\text{CO}_2$ ) from the atmosphere than the land does. (The ocean absorbs 85%, compared to the 15% absorbed by land.) Cold water absorbs more carbon than warm water.



# DEEP OCEAN

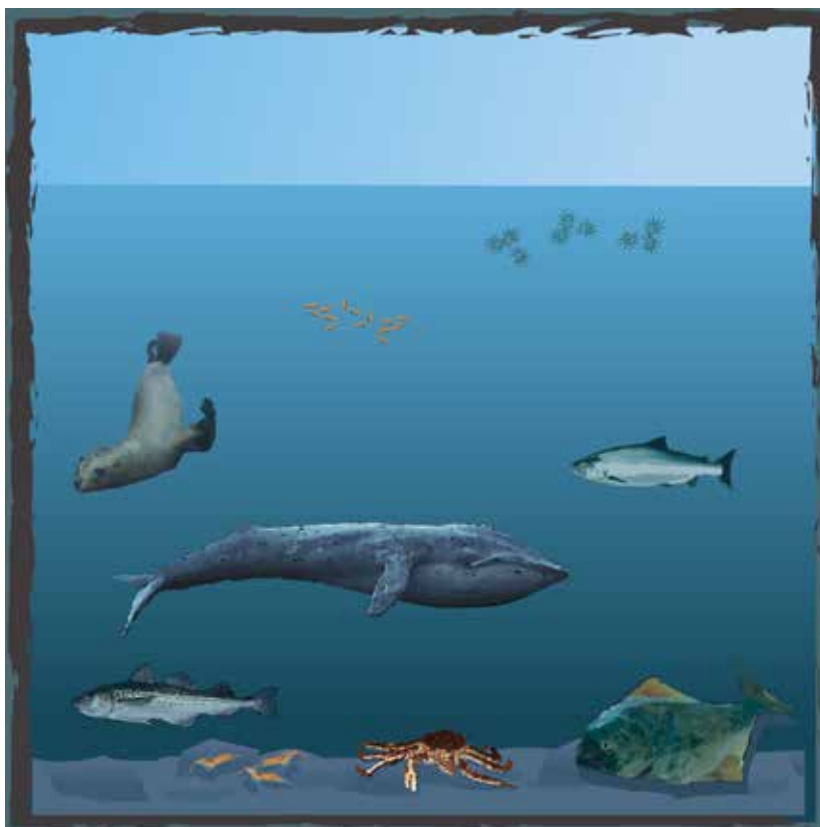


You got here from circulation with the surface ocean and dead and decaying marine life. When carbon gets to the deep ocean, it usually stays there for hundreds of years before moving on. The deep ocean holds more than 65% of the Earth's carbon.





# MARINE LIFE



You have been taken up by tiny organisms such as phytoplankton and microalgae to make the nutrition they need through a process called photosynthesis. In photosynthesis, organisms use sunlight to make the nutrients they need from carbon dioxide ( $\text{CO}_2$ ) and water. The phytoplankton are eaten by zooplankton and invertebrates, which are eaten by larger marine life, such as fish and whales. Carbon is essential for marine life survival, but an excess amount of carbon dissolved in ocean waters is harmful to marine organisms such as algae, pteropods ("sea butterflies"), shellfish and corals.







# LAND PLANTS



You have been taken out of the atmosphere by a plant for photosynthesis. Photosynthesis is the process by which a plant uses sunlight to make the food it needs from carbon dioxide ( $\text{CO}_2$ ) and water. You are now one of the building blocks (carbon compounds) that make up a plant.

As a byproduct of photosynthesis, plants produce oxygen, which is used by living organisms. Plants also release  $\text{CO}_2$  back to the atmosphere by respiration, but the amount of  $\text{CO}_2$  that plants give off in respiration is far less than the amount that plants take up during photosynthesis.





# LAND ANIMALS



You have been taken into the body of an animal from a plant it ate. Carbon is the basic building block to most cells in the body of animals, including humans. Carbon makes up 18% of the human body.

Animals inhale the oxygen made by plants and exhale carbon dioxide as a waste product (respiration) to the atmosphere.

Carbon is transferred from one animal to another animal (scavenger or predator) that ate it. Some carbon stored within the bodies of animals decompose in the soil when they die.



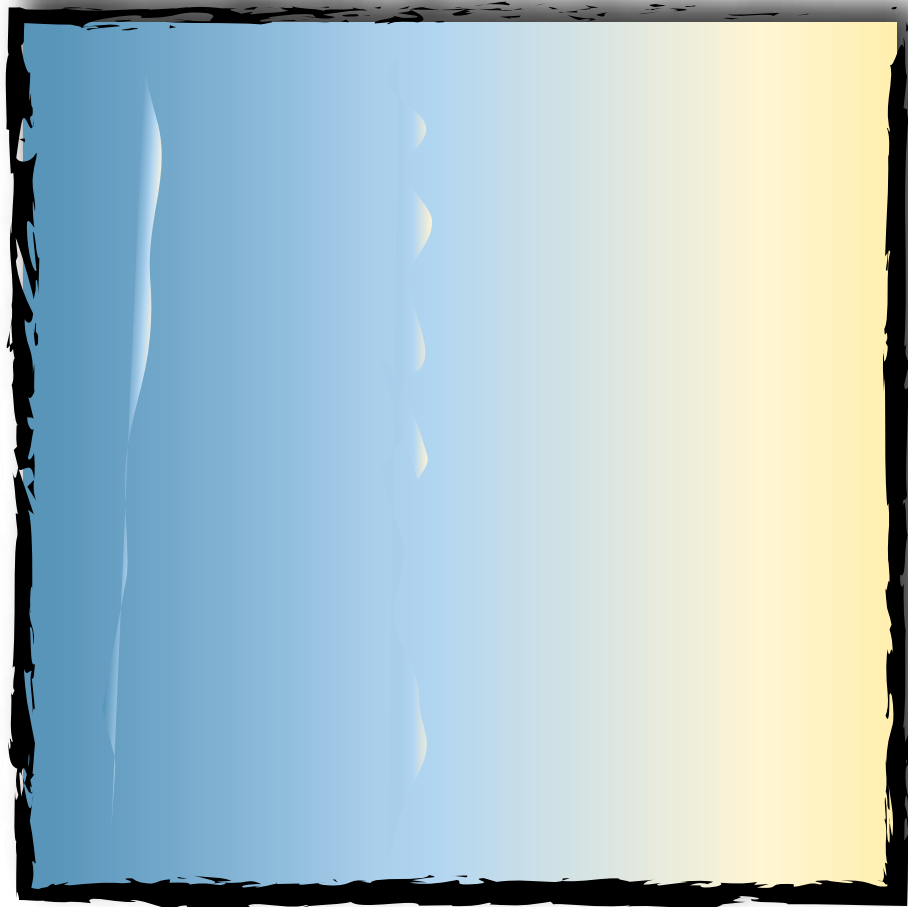
# SOIL



The plant/animal you were in has died and you are now a part of the decomposing layer of plants and animals, called detritus. Soil is also made of inorganic materials such as sand, silt and clay. Soils store about 3% of Earth's carbon. As bacteria and fungi breakdown the detritus, carbon is released back into the atmosphere.

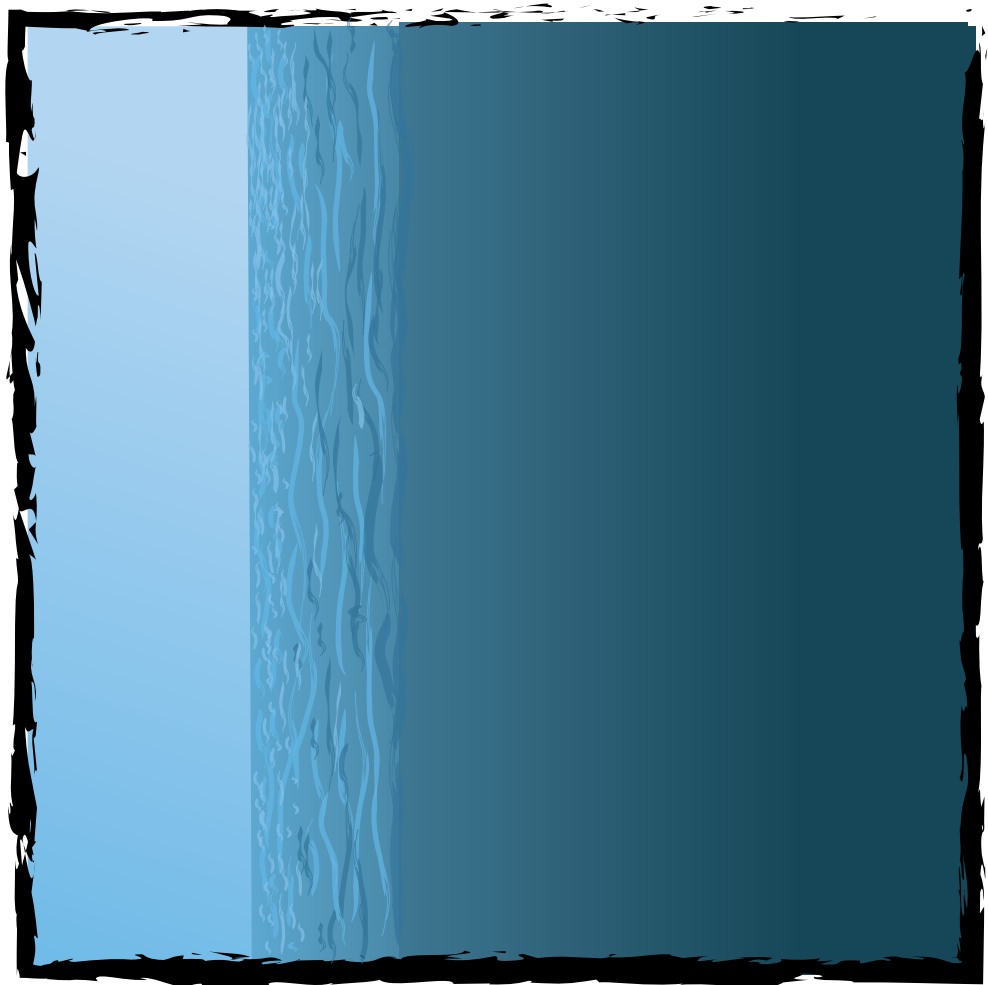


# ATMOSPHERE





# SURFACE OCEAN





# LAND PLANTS



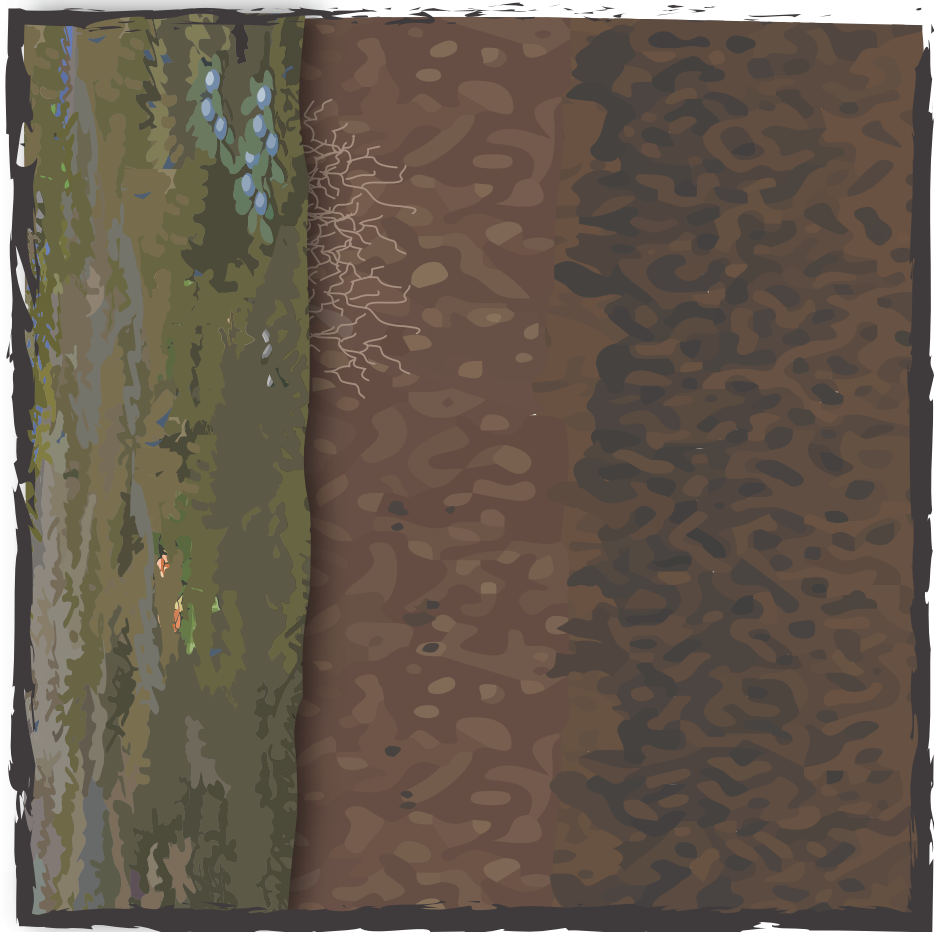


# LAND ANIMALS





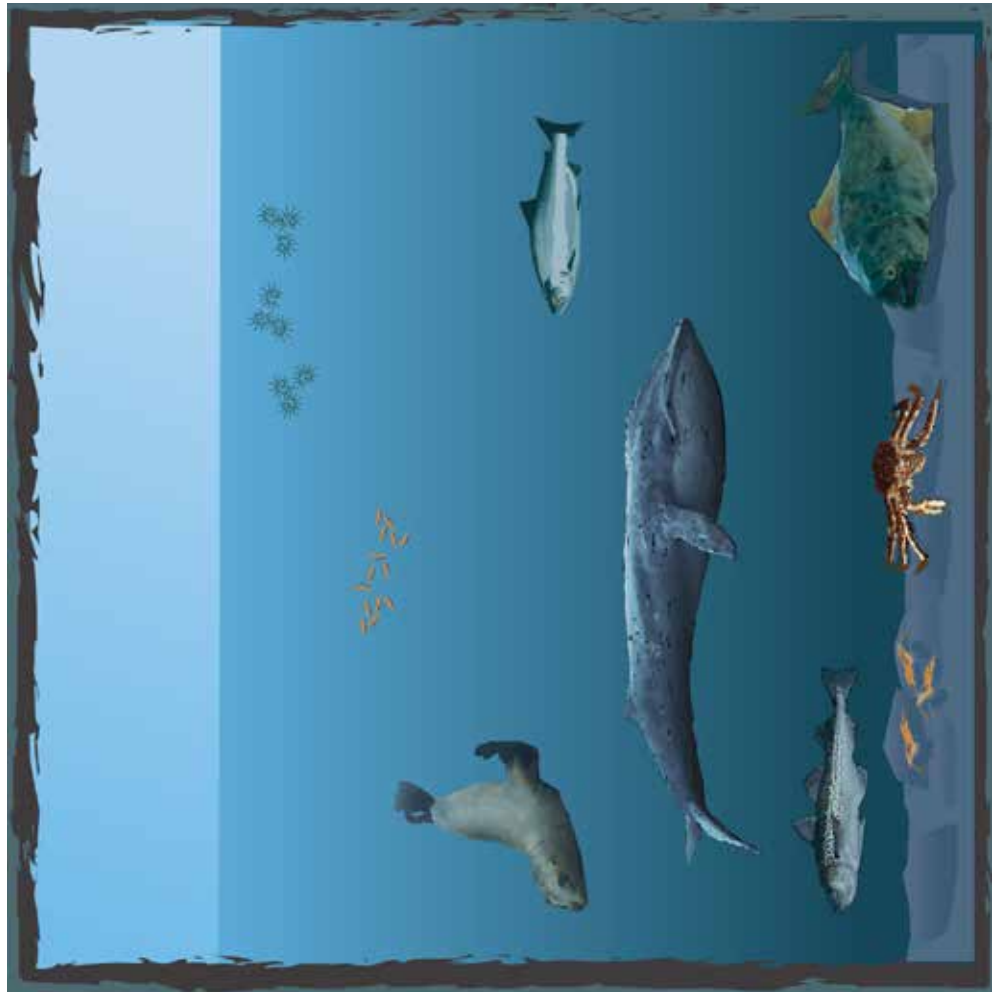
# SOIL





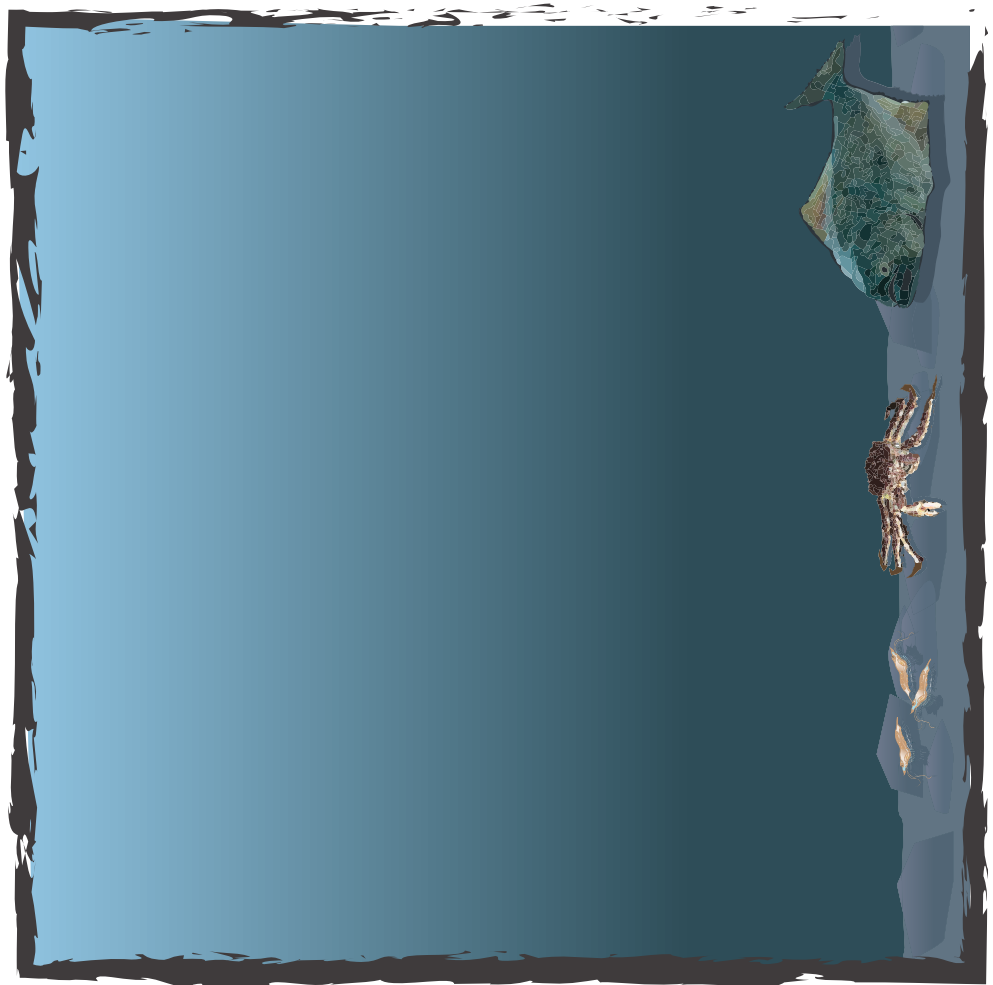


# MARINE LIFE





# DEEP OCEAN



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

### WORKSHEET



#### Student Worksheet: *You Are a Carbon Atom!*

Name: \_\_\_\_\_

1. You are a carbon atom. In this activity, you will travel the Carbon Cycle by visiting the places where carbon is stored.
2. The places include Atmosphere, Surface ocean, Deep ocean, Marine life, Land plants, Land animals, and Soil. You can start at any place. Go through all the places and learn facts about you (carbon) in each area.
3. Before moving to the next place, answer the questions on your worksheet.

#### Atmosphere

##### Questions:

1. More CO<sub>2</sub> in the atmosphere makes the Earth:
  - a. colder
  - b. warmer
2. Burning coal, oil, and natural gas by humans has \_\_\_\_\_ the amount of atmospheric carbon dioxide since the Industrial Revolution:
  - a. decreased
  - b. increased

#### Surface Ocean

##### Questions:

1. Cold water absorbs carbon \_\_\_\_\_ than warm water:
  - a. faster
  - b. slower
2. Carbon is added to the surface ocean from:
  - a. the deep ocean brought to the surface
  - b. the atmosphere
  - c. dead organisms in the ocean
  - d. all of the above



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### WORKSHEET



#### Marine life

##### Questions:

1. Phytoplankton \_\_\_\_ carbon dioxide during the process of photosynthesis:
  - a. needs
  - b. does not need
2. Too much CO<sub>2</sub> has \_\_\_\_ impacts on marine organisms:
  - a. positive
  - b. negative

#### Deep Ocean

##### Questions:

1. The ocean is the biggest sink of carbon:
  - a. True
  - b. False
2. Carbon stays in the deep ocean for a very \_\_\_\_ time:
  - a. long
  - b. short

#### Land plants

##### Questions:

1. Plants \_\_\_\_\_ carbon dioxide for photosynthesis to make the nutrients:
  - a. use
  - b. do not use
2. Through photosynthesis plants release:
  - a. carbon dioxide
  - b. oxygen



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

### WORKSHEET



#### Land animals

##### Questions:

1. Animals release carbon dioxide into the atmosphere through:
  - a. photosynthesis
  - b. respiration
  
2. Carbon is essential for living things, including humans. Carbon makes up \_\_\_\_% of the human body:
  - c. 8
  - d. 18
  - e. 80

#### Soil

##### Questions:

1. Carbon is transferred to soil from dead and decaying:
  - a. plants only
  - b. animals only
  - c. plants and animals
  
2. \_\_\_\_\_% of Earth's carbon is stored in the soil:
  - a. 3
  - b. 13
  - c. 30



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### ANSWER KEY



### Student Worksheet: *You Are a Carbon Atom!*

Name: \_\_\_\_\_

1. You are a carbon atom. In this activity, you will travel the Carbon Cycle by visiting the places where carbon is stored.
2. The places include Atmosphere, Surface ocean, Deep ocean, Marine life, Land plants, Land animals, and Soil. You can start at any place. Go through all the places and learn facts about you (carbon) in each area.
3. Before moving to the next place, answer the questions on your worksheet.

### Atmosphere

#### Questions:

1. More CO<sub>2</sub> in the atmosphere makes the Earth:
  - a. colder
  - b. warmer
2. Burning coal, oil, and natural gas by humans has \_\_\_\_\_ the amount of atmospheric carbon dioxide since the Industrial Revolution:
  - a. decreased
  - b. increased

### Surface Ocean

#### Questions:

1. Cold water absorbs carbon \_\_\_\_\_ than warm water:
  - a. faster
  - b. slower
2. Carbon is added to the surface ocean from:
  - a. the deep ocean brought to the surface
  - b. the atmosphere
  - c. dead organisms in the ocean
  - d. all of the above



# CHANGING CLIMATE

## Environmental Cycles

### Activity MS.2.3

#### ANSWER KEY



#### Marine life

##### Questions:

1. Phytoplankton \_\_\_\_ carbon dioxide during the process of photosynthesis:
  - a. needs
  - b. does not need
2. Too much CO<sub>2</sub> has \_\_\_\_ impacts on marine organisms:
  - a. positive
  - b. negative

#### Deep Ocean

##### Questions:

1. The ocean is the biggest sink of carbon:
  - a. True
  - b. False
2. Carbon stays in the deep ocean for a very \_\_\_\_ time:
  - a. long
  - b. short

#### Land plants

##### Questions:

1. Plants \_\_\_\_\_ carbon dioxide for photosynthesis to make the nutrients:
  - a. use
  - b. do not use
2. Through photosynthesis plants release:
  - a. carbon dioxide
  - b. oxygen

#### Land animals

##### Questions:

1. Animals release carbon dioxide into the atmosphere through:
  - a. photosynthesis
  - b. respiration



## CHANGING CLIMATE Environmental Cycles

### Activity MS.2.3 ANSWER KEY



2. Carbon is essential for living things, including humans. Carbon makes up \_\_\_\_% of the human body:
  - c. 8
  - d. 18
  - e. 80

### Soil

#### Questions:

1. Carbon is transferred to soil from dead and decaying:
  - a. plants only
  - b. animals only
  - c. plants and animals
  
2. \_\_\_\_\_% of Earth's carbon is stored in the soil:
  - a. 3
  - b. 13
  - c. 30

