Three Dimensional Instruction of Energy and Matter

Session 5

Session Goals

- **Climate science ideas:** Deepen understanding of the ocean-atmosphere connection and consider the water cycle through the lens of energy and matter.
- **Using Data:** Use models, compare and contrast using raw and simulated data, and work to relate what you have learned from the data to a bigger science concept. Authentic contexts for students to explore and deepen their understanding of science concepts.
- **Teaching and Learning:** Consider the affordances and limitations of different types of assessments and discuss the use of phenomena to support student engagement with science concepts.
- **Framework/ NGSS:** Use NGSS to determine what middle school students should be able to do to demonstrate their understanding regarding science concepts, practices and crosscutting concepts. Become familiar with NGSS Performance Expectations. Consider how use of phenomena can provide authentic contexts for students to engage with science concepts.

Turn and Talk

- What does it mean to teach science in a three-dimensional way?
- How might this be different from how science has been taught and assessed traditionally?
- How will assessment capture three-dimensional teaching and learning?

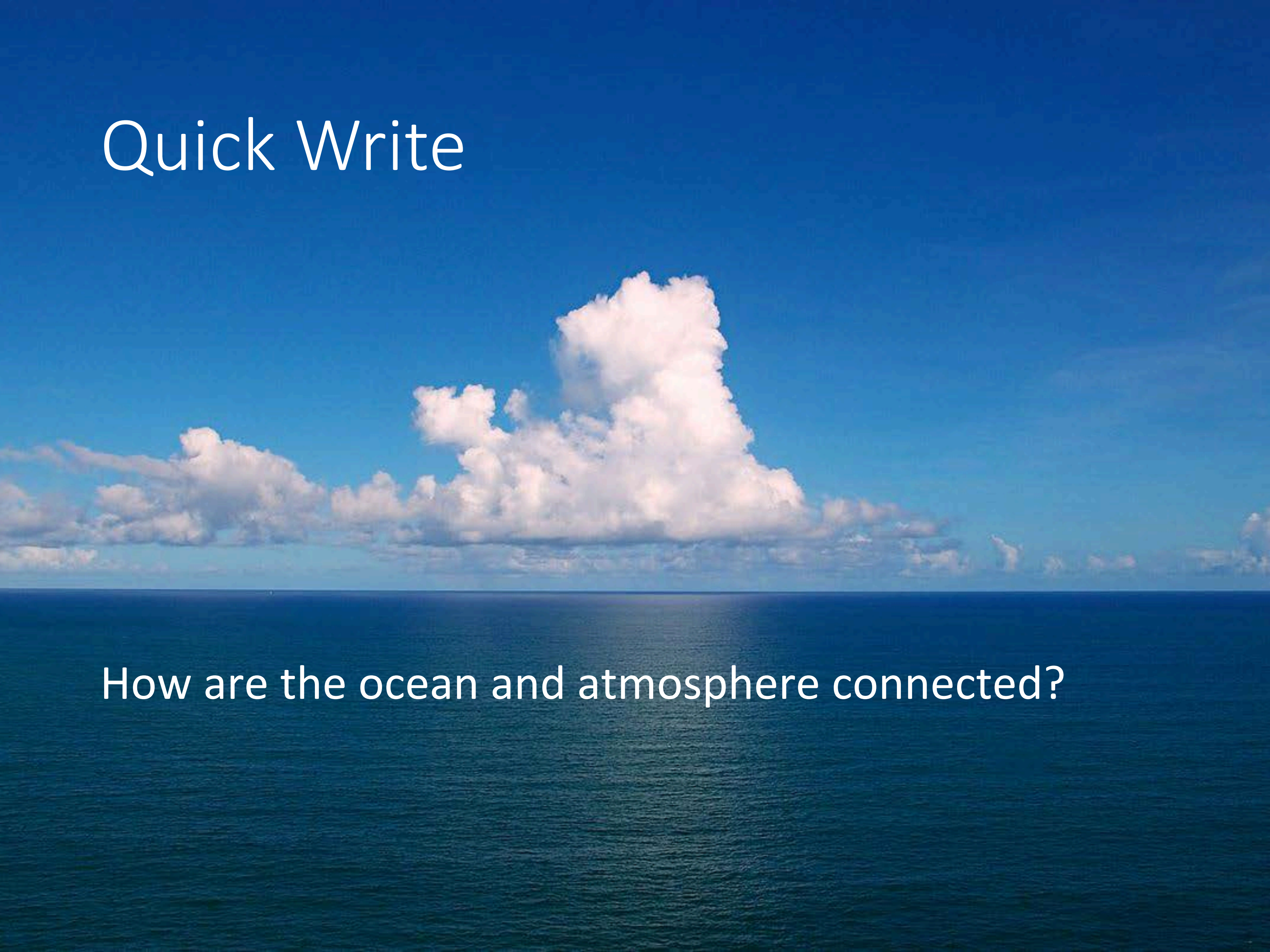
Summary

- Teachers have traditionally taught science using a more siloed approach. Content is one focus, and science practices are a separate focus (if taught at all).
- Crosscutting concepts have never been a traditional focus in science classrooms.
- Three-dimensional instruction calls on teachers to teach science in a way that mirrors how science is practiced. Students use science practices and crosscutting concepts to help them understand science content more deeply.
    - Example: During the Ocean as a heat reservoir activities, we used the crosscutting concept of energy and matter and the scientific practices of developing and using models (the simulation we observed) and Constructing Explanations to make sense of water's ability to act as a heat reservoir.
- To assess the three dimensions, students must demonstrate their understanding of disciplinary core ideas and crosscutting concepts by doing something.

Turn and Talk

- What similarities do you think there are in how water and air move around Earth? Why do you think this is so?
- How does adding heat energy affect air? water?
- What kind of data could you look at to give you more evidence?”

Quick Write

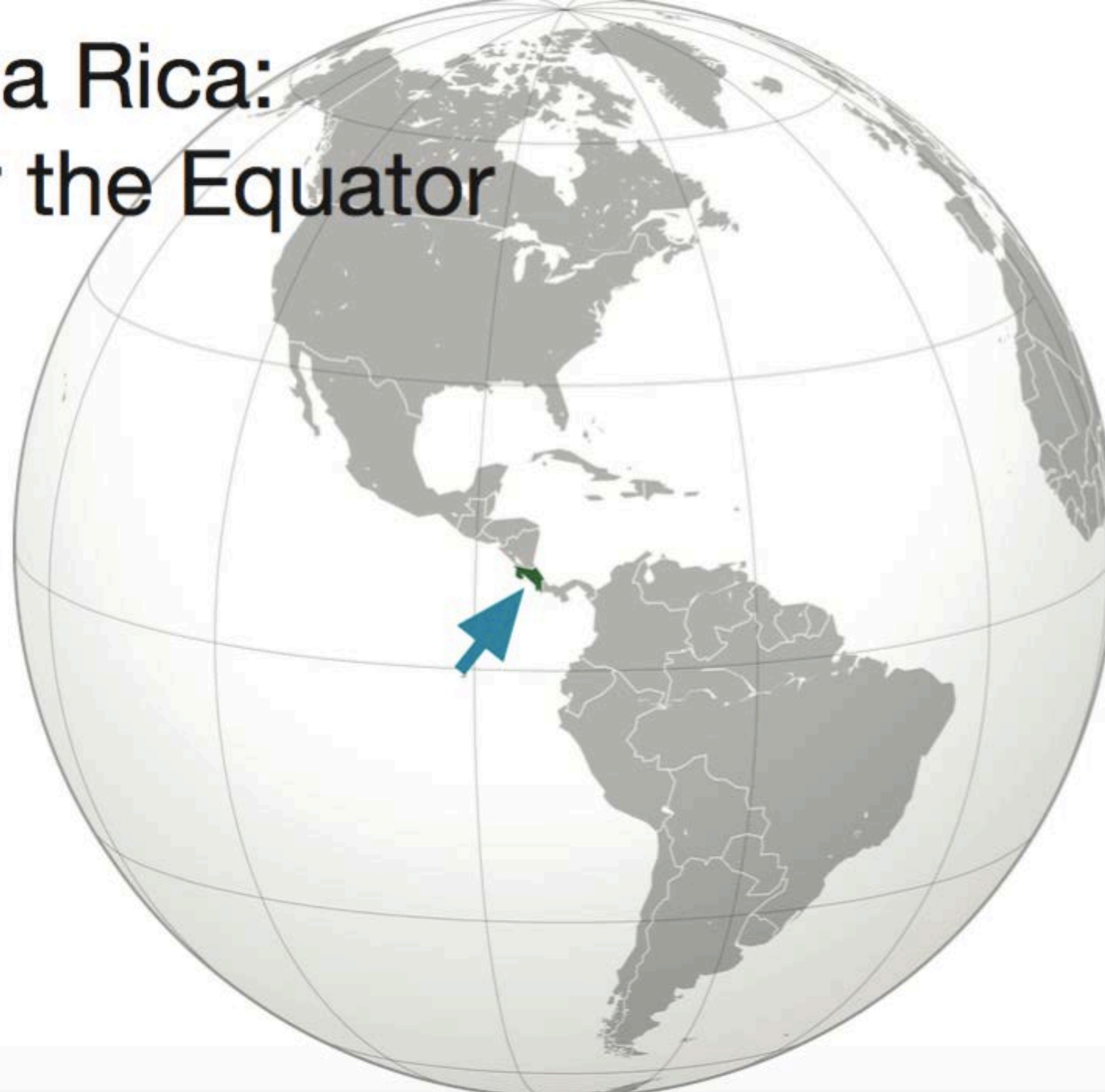


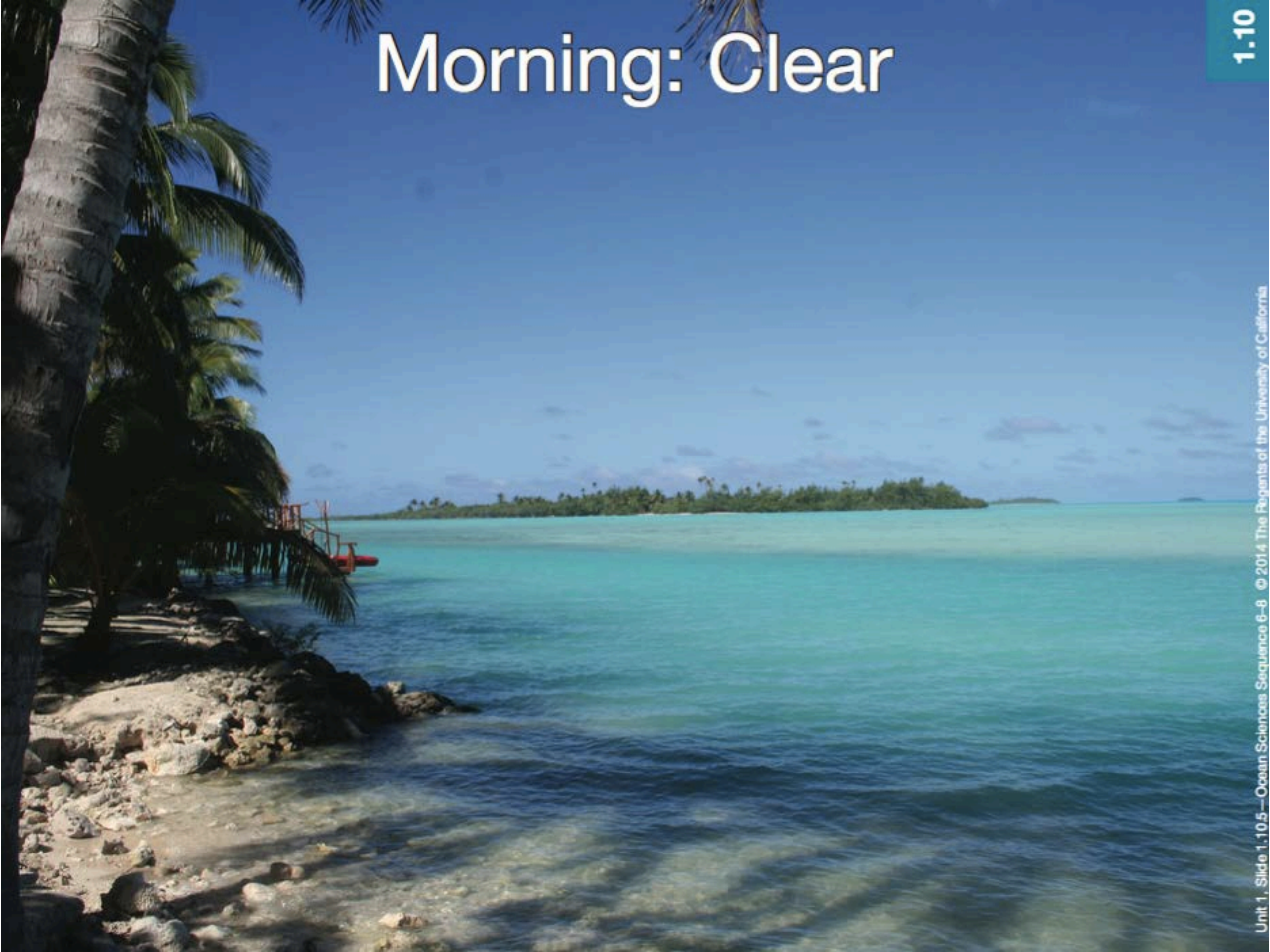
How are the ocean and atmosphere connected?

Session 1.10

The Puzzling Case of the Daily Rains

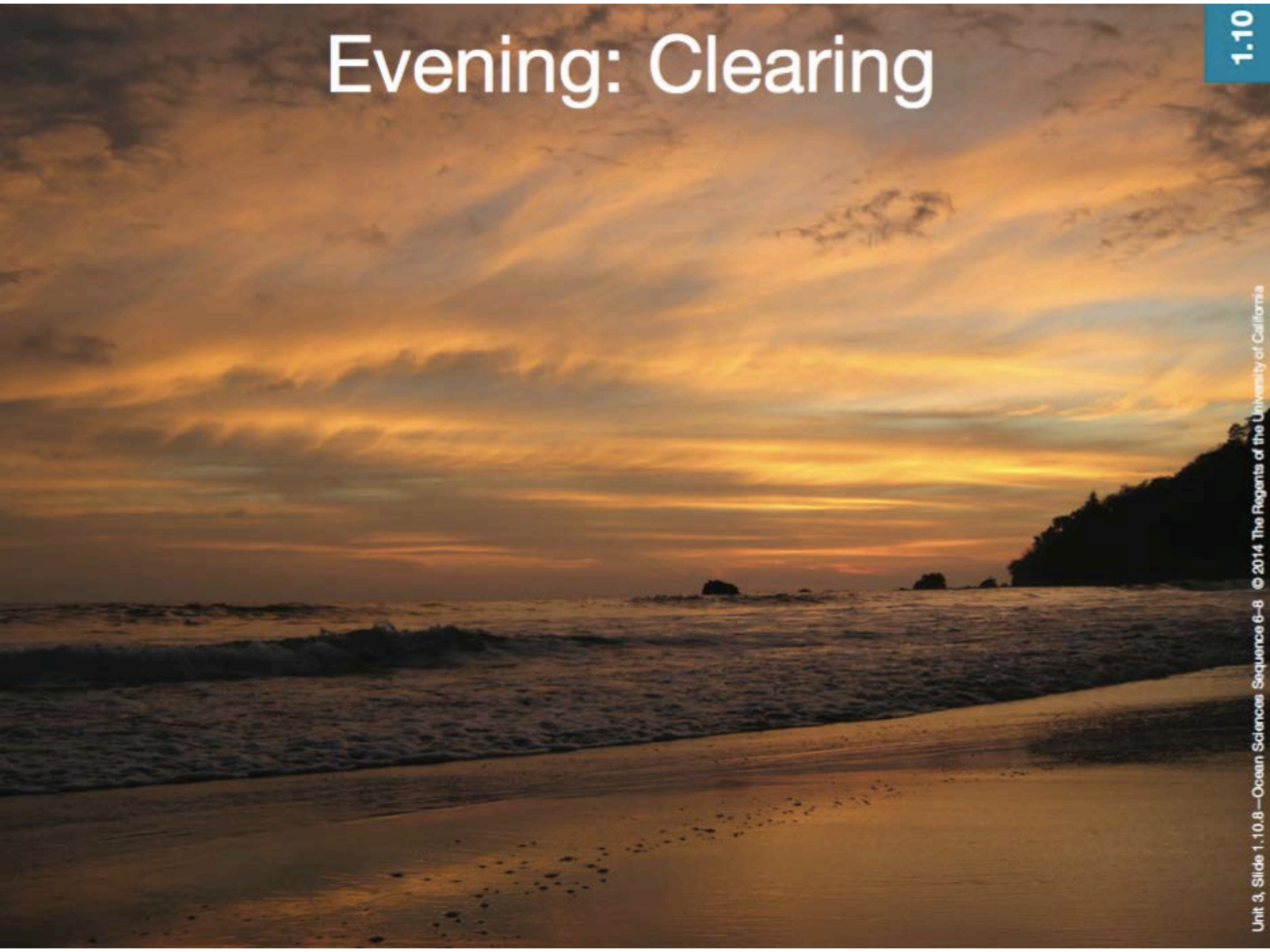
Costa Rica: Near the Equator



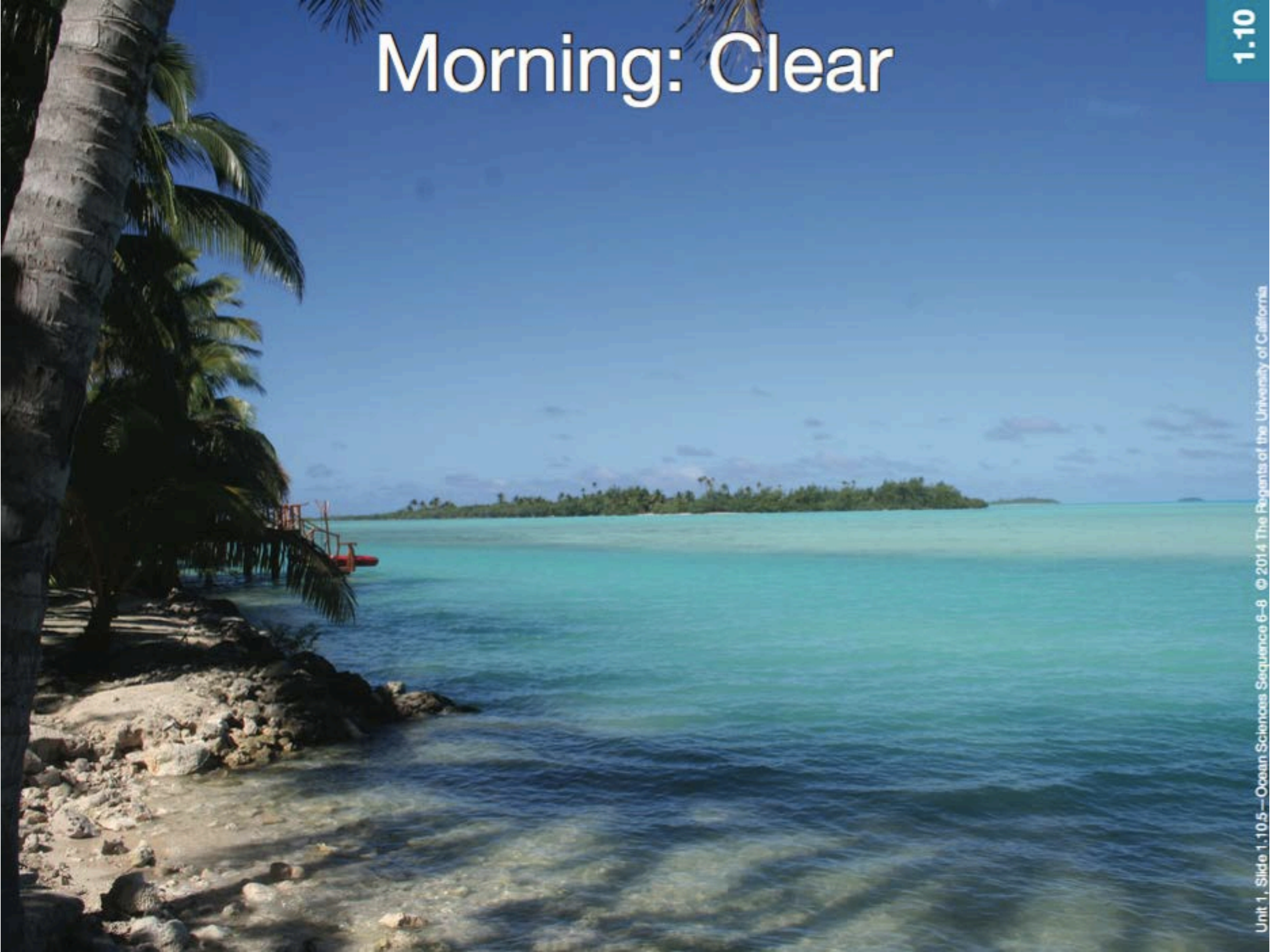

1.10
Morning: Clear


1.10
Afternoon: Clouds

Late Afternoon: Rain


1.10
Evening: Clearing
Unit 3, Slide 1.10.8—Ocean Sciences Sequence 6–8 © 2014 The Regents of the University of California

Night: Clear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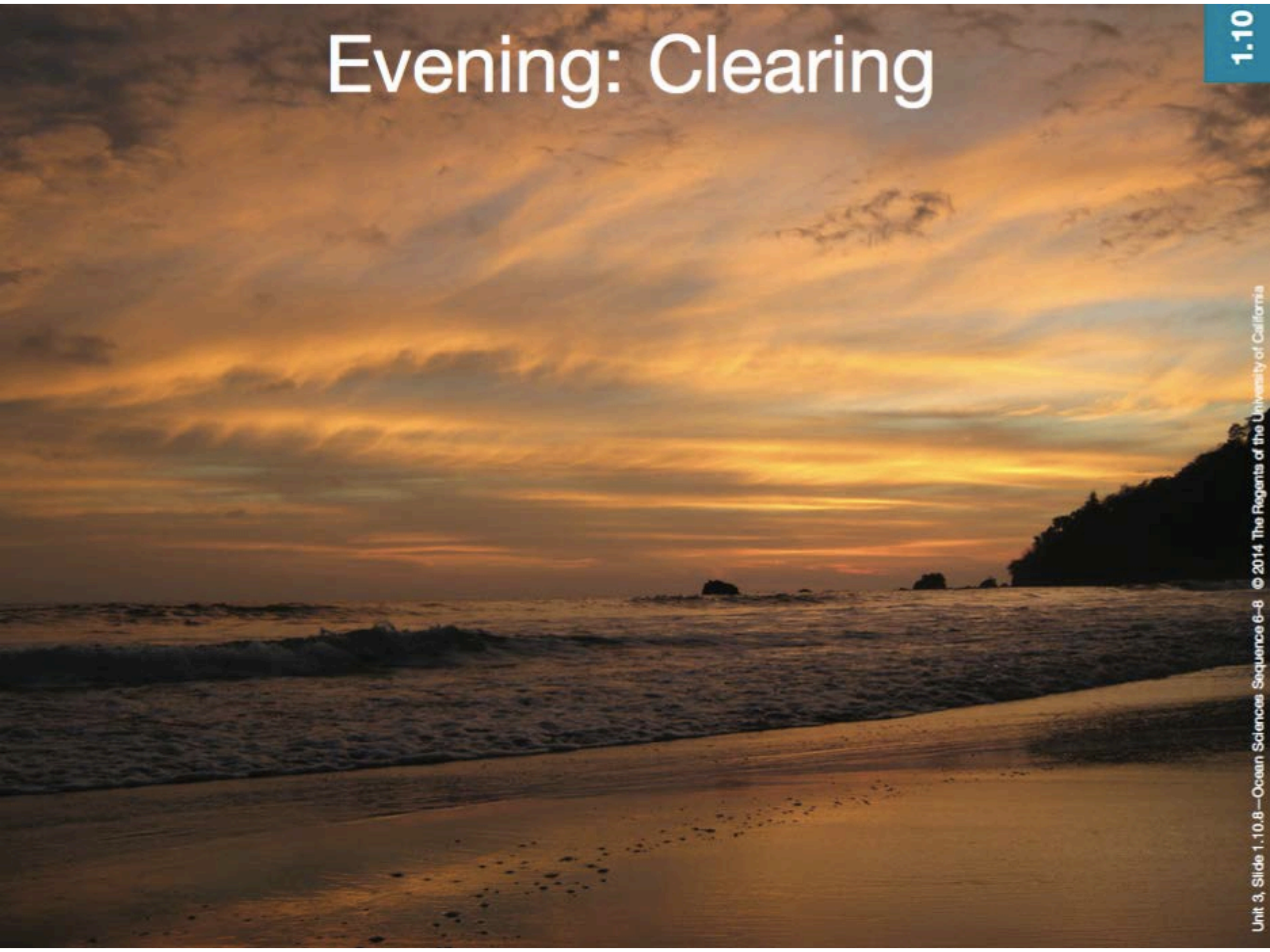
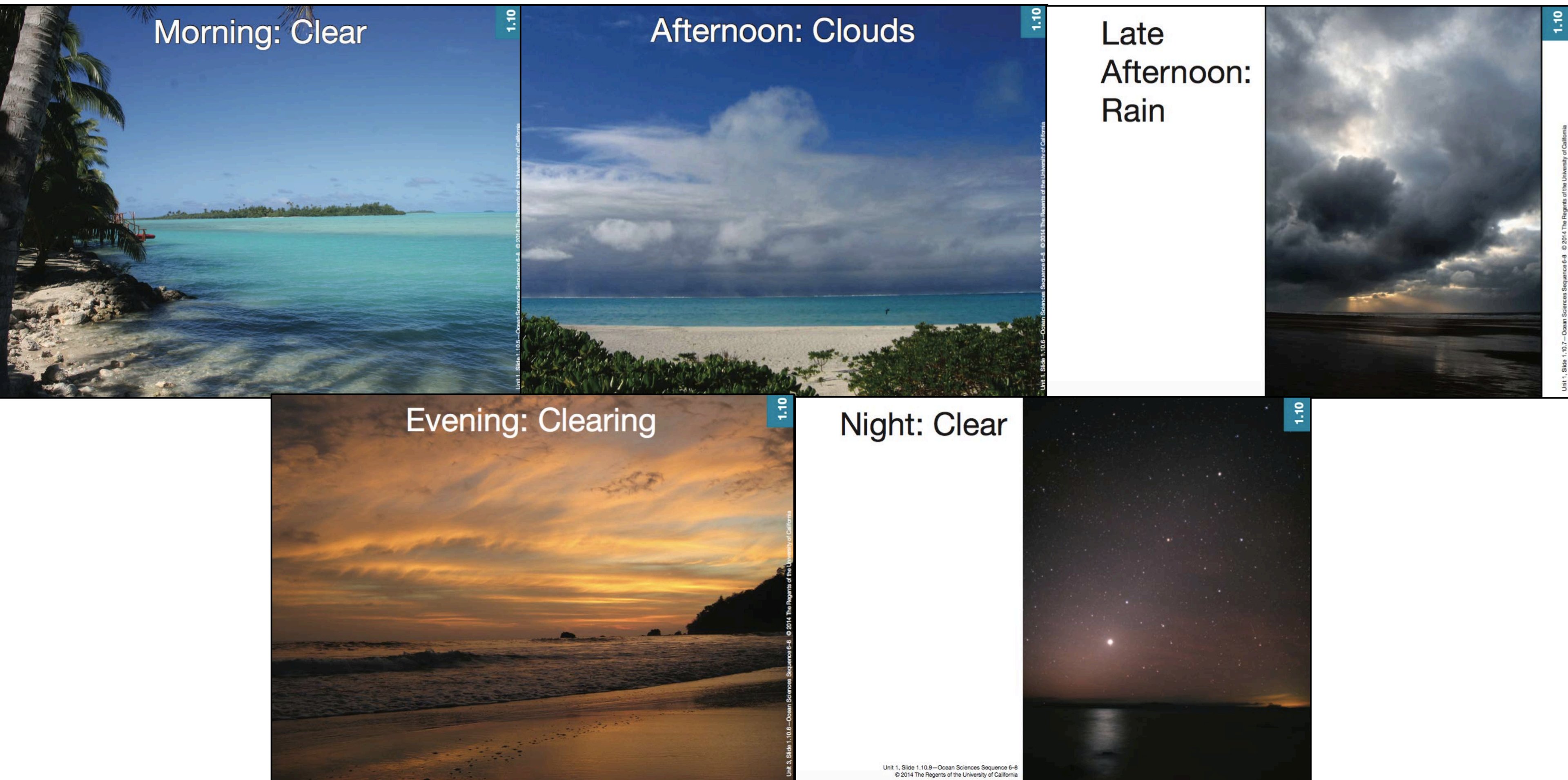

Evening: Clearing
1.10
Unit 3, Slide 1.10.8—Ocean Sciences Sequence 6–8 © 2014 The Regents of the University of California

Night: Clear

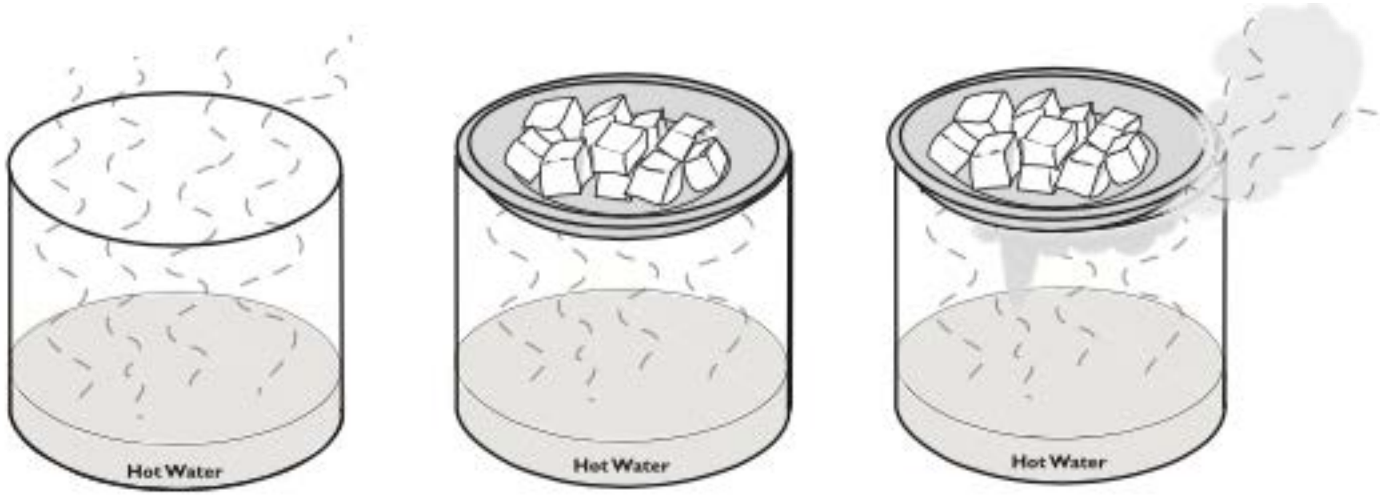
Turn & Talk

- In places near the ocean and equator, why might this weather pattern repeat itself over and over again?
  - Use your **molecule cards** and think about the crosscutting concept of **Energy and Matter** to discuss the question with a partner.



Cloud in a Jar Model

What variable should be included in this model of a tropical weather pattern?



Key Concept

If enough heat energy is –

- **added to liquid water, some of the water molecules at the surface evaporate into the air as water vapor.**
- **taken away from water vapor, some of the water molecules condense into liquid water.**

Evaporation and condensation move heat energy around Earth. Without this, Earth would be much hotter in some places and much colder in others.

Key Concept

1.11

The water cycle, winds, and ocean currents distribute heat energy around Earth, and that keeps temperatures more uniform.

Explaining the Daily Rains

Use the Puzzling Case of the Daily Rains page from the Investigation notebooks (p.37)

Use the following terms in your explanations:

- molecules
- density
- daily wind and temperature patterns near the ocean
- evaporation, and condensation

The Puzzling Case of the Daily Rains

Solve the mystery by explaining what's going on in each picture. Use what you know about molecules, density, evaporation, and condensation.

Morning: Clear

Afternoon: Clouds

Late Afternoon: Rain

Evening: Clearing

Night: Clear

Reviewing explanations

- **Morning**: Clear. The ocean water is still cool, so there isn't much evaporation, so there are no clouds.
- **Afternoon**: Clouds. The Sun's heat energy makes some water molecules evaporate into the air as water vapor. The water vapor rises, then cools as it meets colder air higher up in the atmosphere. The molecules slow down, move less far apart, and become denser; eventually the water vapor condenses into liquid water.
- **Late Afternoon**: Rain. The liquid water falls as rain.
- **Evening**: Clearing. Dust particles are washed away by the rain, and cooler air currents flow in. No new clouds form because it is cooler in the evening.
- **Night**: Clear. There are no clouds because it isn't warm enough for much evaporation to happen.

Quick Write

How are the ocean and atmosphere connected?

Turn and Talk: *Extend your thinking*

– Where in the world do you think the most clouds form? What is the cause? Why do you think that? What is your evidence?

– Knowing what you know about the water cycle, where would most of the evaporation on Earth take place? What is the cause? Why do you think that? What is your evidence?

– How do you think the key concepts from this session might connect to climate change?

Key Concepts:

- If enough heat energy is added to liquid water, some of the water molecules at the surface evaporate into the air as water vapor.
- If enough heat energy is taken away from water vapor, some of the water molecules condense into liquid water.
- Evaporation and condensation move heat energy around Earth. Without this, Earth would be much hotter in some places and much colder in others.

Big Chart of Science & Engineering practices

Share examples of how you and the instructor used some of the science and engineering practices in sessions 3 & 4.

- **Some possible examples:**
- **Developing and Using Models** - use molecule cards to support explanations; identifying model limitations with Conveyor Belt model, discuss variables and assumptions made to create the conveyor belt model
- **Construct Explanations and Develop Solutions** - used evidence from activities to build an explanation
- **Engaging in Argument from Evidence** - compared claims to find the best explanation, looking at evidence and reasoning

Revisit Big Chart of crosscutting concepts

Share examples of how you and the instructor used some of the crosscutting concepts in sessions 3 & 4.

- **Some possible examples:**
- Answered prompts that specifically called out and applied the big ideas of
  - Energy and Matter,
  - Patterns, and
  - Systems and System Models

Revisit Data Skills Chart

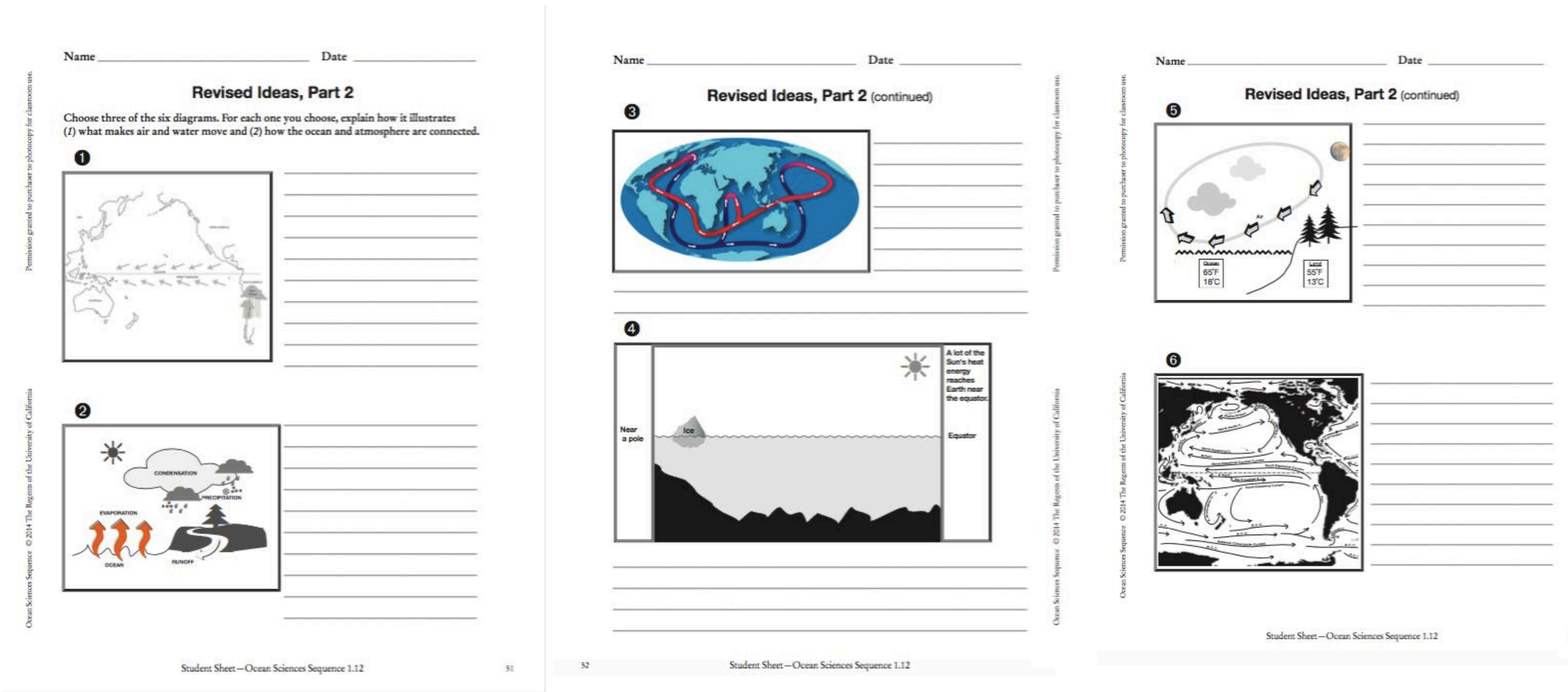
Share examples of how you and the instructor used some of the crosscutting concepts in sessions 3 & 4.

- **Some possible examples:**
  - **model ocean stations:** used physical models and simulations; used patterns/ trends in data to support explanations of what the data indicates; related and connected the observed data pattern/trend to physical phenomena/concepts; and compared predictions with the observed pattern/trend in data visualizations.
  - **nonsense data activity:** reflected on what helps us make sense of data, and levels of engagement with data; attended to the details and context of the data and recognized the basic components of data visualizations (e.g., title, labels, legends) needed to start reading different types of data visualizations.
  - **choosing data visualizations activity**: chose the right type of data visualizations for the data that you have
  - **looking at raw vs simulated data of ocean currents activity:** described the benefits and limitations of using simulated data, and evaluating the impact of a new data source on a previously formulated explanation
  - **reflection discussion:** what helped us make sense of ocean currents?

Assessments

Revised Ideas, Part 2

Choose three of the six diagrams on pages 51-53. For each one you choose, explain how it illustrates: (*1*) what makes air and water move, and (*2*) how the ocean and atmosphere are connected. To support your responses, use the *Revised Ideas Student Tool*.



Scoring Guides for Revised Ideas, Part 2

- Assess your own understanding of the science ideas as compared to the different levels of understanding described.
  - *for Item 1, see B1, B3, B4, and B6;*
  - *for Item 2, see C;*
  - *for Items 3 and 4, see B1–B5;*
  - *for Item 5, see A;*
  - *for Item 6, see B1, B3, and B4*

Think-Pair-Share about assessments and using data

1. What did you learn about your own understanding of the concepts addressed in the previous sessions about how the ocean and atmosphere interact? Did you find that there were some concepts that you felt less sure about? Which ones? Why do you think you had a less deep understanding of those concepts? What might a teacher do with the information gained from this assessment?

2. Did you find the scoring guide useful? In what ways? What might you be able to tell about student understanding of the concepts with this assessment? What are the challenges of using an assessment like this? How might you use information gleaned from this student assessment?

3. Did you find the tools for writing and the graphic organizer useful for your own writing? Why or why not? How might they be useful to your future students?

4. What are your personal feelings about this kind of assessment compared to a multiple choice test? What can you learn from each kind of assessment? How might you use both types of assessments in a formative way? (Formative assessments are given when the teacher still has time to do something about the results.)

5. Did you find that working with data (i.e. raw or simulated) helped you to gain a greater understanding of or become more engaged with the concepts presented in earlier sessions? If so, how? If not, why not? Which types of data did you find most helpful? Least helpful? Why?

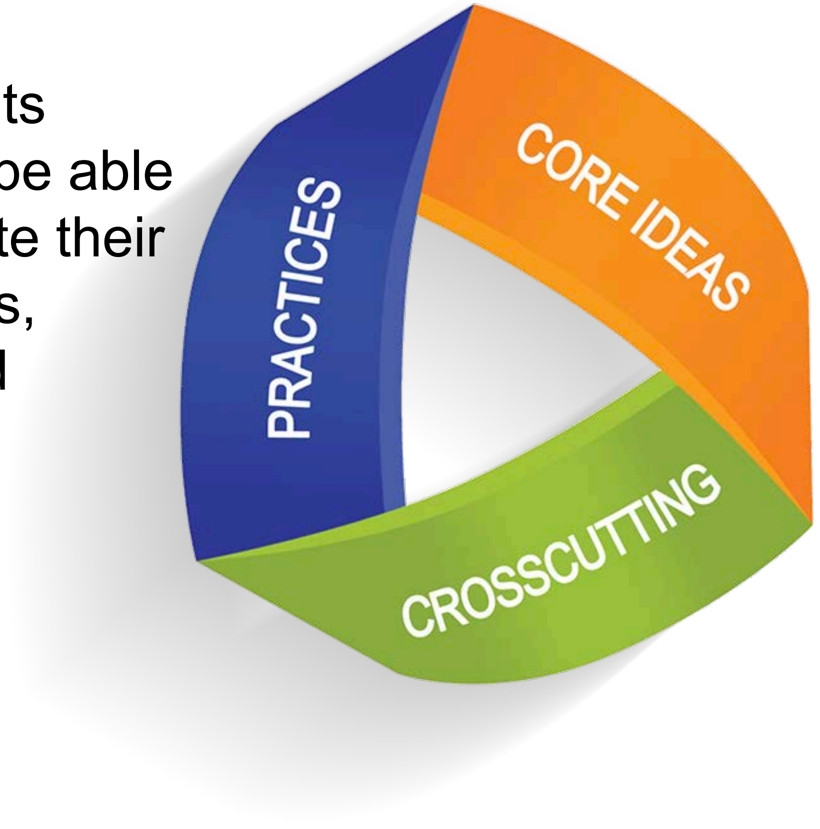
6. How might you assess your students understanding of a data visualization or what level of engagement (i.e. orientation, interpretation, or synthesis) they were at? What questions would you include in an assessment to find out?

Kinds of Assessments

- **Formative:** provides information about student learning **during** the course of instruction.
- **Summative:** measures students' progress **at the end** of the unit of instruction
- **Embedded:** curriculum embedded tasks assess what students understand about the **specific topic** being studied in class
- **Benchmark:** evaluates students' knowledge and skills relative to an explicit set of longer-term learning goals of the school and/or district curriculum. Administered periodically throughout the school year, at specified times, the results can be aggregated at the classroom, grade, school, & district levels to decision-makers, as well as to teachers
- **Large scale:** measures student progress at the local, state or national level to describe the educational status of students, make decisions about individual students, and develop or revise existing local, state, and national policies. Results are usually used to compare groups of students in districts, states, and nationally (e.g., GRE, SAT)

Performance expectations

Performance expectations: statements about what students should know and be able to do at each grade level to demonstrate their understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts.



Anatomy of the NGSS arranged by DCI

Performance Expectations

Foundation Boxes: Three dimensions of NGSS

CCSS-ELA/Literacy and Math Connections

2-PS1 Matter and its Interactions

2-PS1 Matter and its Interactions

Students who demonstrate understanding can:

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).
- Construct an argument with evidence to support a claim. (2-PS1-4)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Scientists search for cause and effect relationships to explain natural events. (2-PS1-4)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)
- Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3)
- A great variety of objects can be built up from a small set of pieces. (2-PS1-3)

PS1.B: Chemical Reactions
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)

Crosscutting Concepts

Patterns
- Patterns in the natural and human designed world can be observed. (2-PS1-1)

Cause and Effect
- Events have causes that generate observable patterns. (2-PS1-4)
- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)

Energy and Matter
- Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **4.ESS2.A** (2-PS1-3); **5.PS1.A** (2-PS1-1),(2-PS1-2),(2-PS1-3); **5.PS1.B** (2-PS1-4); **5.LS2.A** (2-PS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. *(2-PS1-4)*

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4)

RI.2.8 Describe how reasons support specific points the author makes in a text. *(2-PS1-2)*,(2-PS1-4)

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because, and, also*) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1-2),(2-PS1-3)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(2-PS1-3)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-PS1-2)*

MP.4 Model with mathematics. *(2-PS1-1),(2-PS1-2)*

MP.5 Use appropriate tools strategically. *(2-PS1-2)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(2-PS1-1),(2-PS1-2)*

MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-ESS2-6)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)**

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)

ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)

Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

Energy and Matter

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Standards Connection: PE's, DCI's and CCC

2-PS1 Matter and its Interactions

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2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and ...]

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. Construct an argument with ... heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

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Performance expectations are comprised of

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Plan and conduct an investigation collaboratively to produce data to ... answer a question. (2-PS1-1) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it ...	**PS1.A: Structure and Properties of Matter** ▪ Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1) ▪ ... purposes. (2-...) ▪ A great variety of objects can be built up from a small set of pieces. (2-PS1-3) **PS1.B: Chemical Reactions** ▪ He... changes that can be observed. Sometimes these changes are ...	**Patterns** ▪ Patterns in the natural and human designed world can be observed. (2-PS1-1) **Cause and Effect** ▪ Events have causes that generate observable patterns. (2-PS...) ▪ ... evidence to support or refute student ideas about causes. (2-PS1-2) **Energy and Matter** ▪ Obj... pieces and ... put together into larger pieces, or ...

Practices

Disciplinary Core Ideas

Crosscutting Concepts

Closer Look at a Performance Expectation

MS.PS-SPM.a. Structure and Properties of Matter

Students who demonstrate understanding can:

a. Construct and use models to explain that **atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.** [Clarification Statement: Examples of atoms combining can include Hydrogen (H_2) and Oxygen (O_2) combining to form hydrogen peroxide (H_2O_2) or water(H_2O). [*Assessment Boundary: Restricted to macroscopic interactions*.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Developing and Using Models	PS1.A: Structure and Properties of Matter	Patterns
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems. • Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs.	• All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data.

Blue box describes the practices involved in the performance expectation

Closer Look at a Performance Expectation

MS.PS-SPM.a. Structure and Properties of Matter		
Students who demonstrate understanding can: a. Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits. [Clarification Statement: Examples of atoms combining can include Hydrogen (H_2) and Oxygen (O_2) combining to form hydrogen peroxide (H_2O_2) or water(H_2O). [*Assessment Boundary: Restricted to macroscopic interactions*.]		
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Orange box explains the disciplinary core ideas needed

Closer Look at a Performance Expectation

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Green box makes connections to the crosscutting concepts

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Science and Engineering Practices

Developing and Using Models

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- Develop and use a model to describe phenomena. (MS-ESS2-6)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)**

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)

ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ES

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)

Systems and System Models

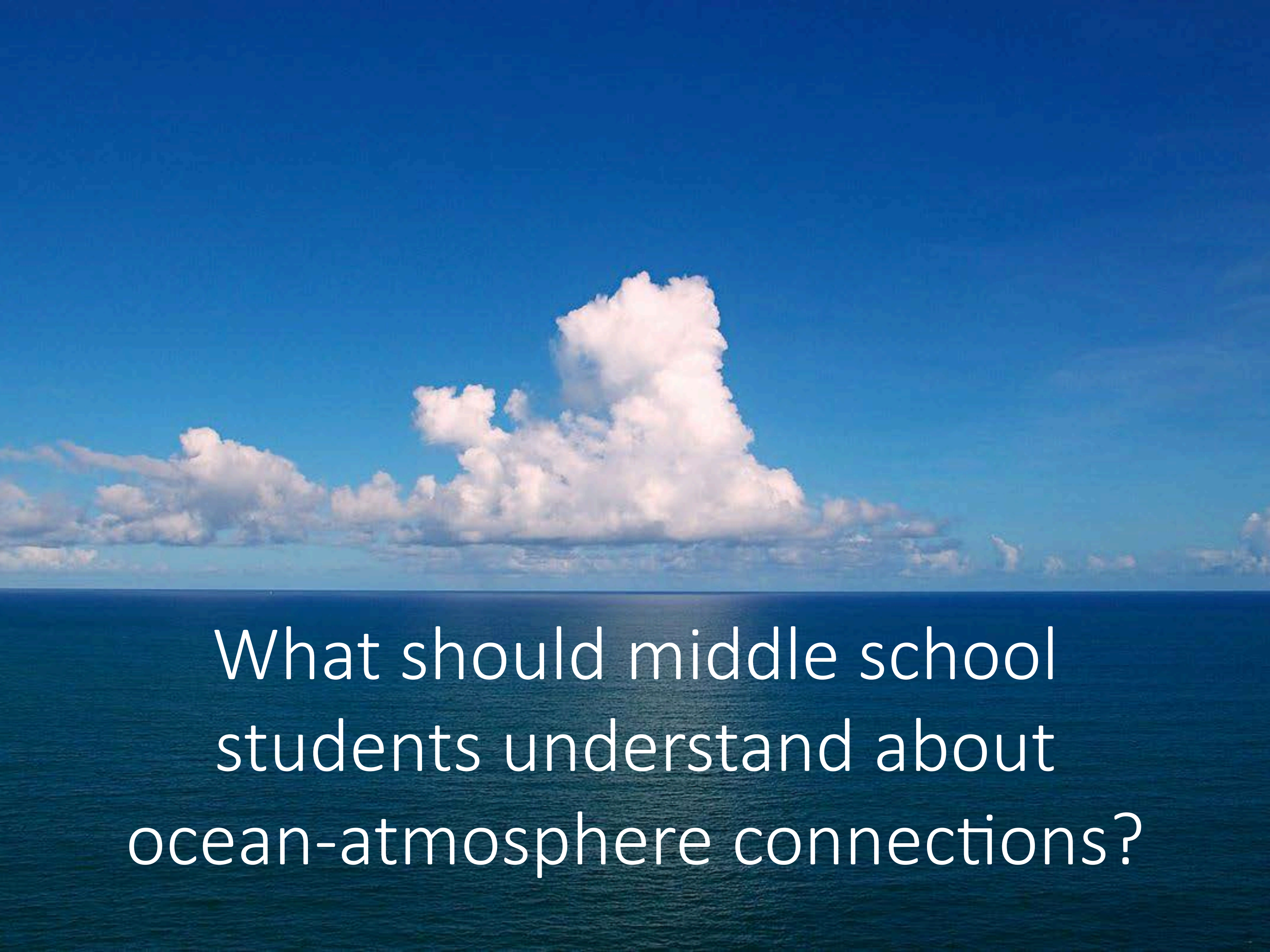
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

Energy and Matter

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

(cause and effect or systems and systems models)


What should middle school
students understand about
ocean-atmosphere connections?

Earth System

- MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
- MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Identify the 3-dimensions in the PE and discuss your experiences & understanding

- Work with a partner:
  - Identify the three dimensions in your selected PE and read about each of these in the foundation boxes below the PE
    - Check out the clarification statements and assessment boundaries in your PE
  - Identify what experiences <u>you</u> have had (in this or other classes) that would support <u>you</u> to be able to meet the PE
  - Identify the skills and understanding <u>you</u> still need in order to meet the PE

Share your discussions

- Share your partner discussion with your table group.
- Then be ready to share whole group:
  - One thing you found surprising or interesting from your examinations of the selected PE's and the ocean-atmosphere connections experiences you have engaged in.
  - Questions you have about the PE's.

Phenomena-driven learning

- Students explore, examine, and use science ideas to explain how and why phenomena occur.
- Based on how people learn, students learn best when they are able to cognitively engage with material in an authentic context.

Phenomena provide this context.

What's Phenomena-driven learning?

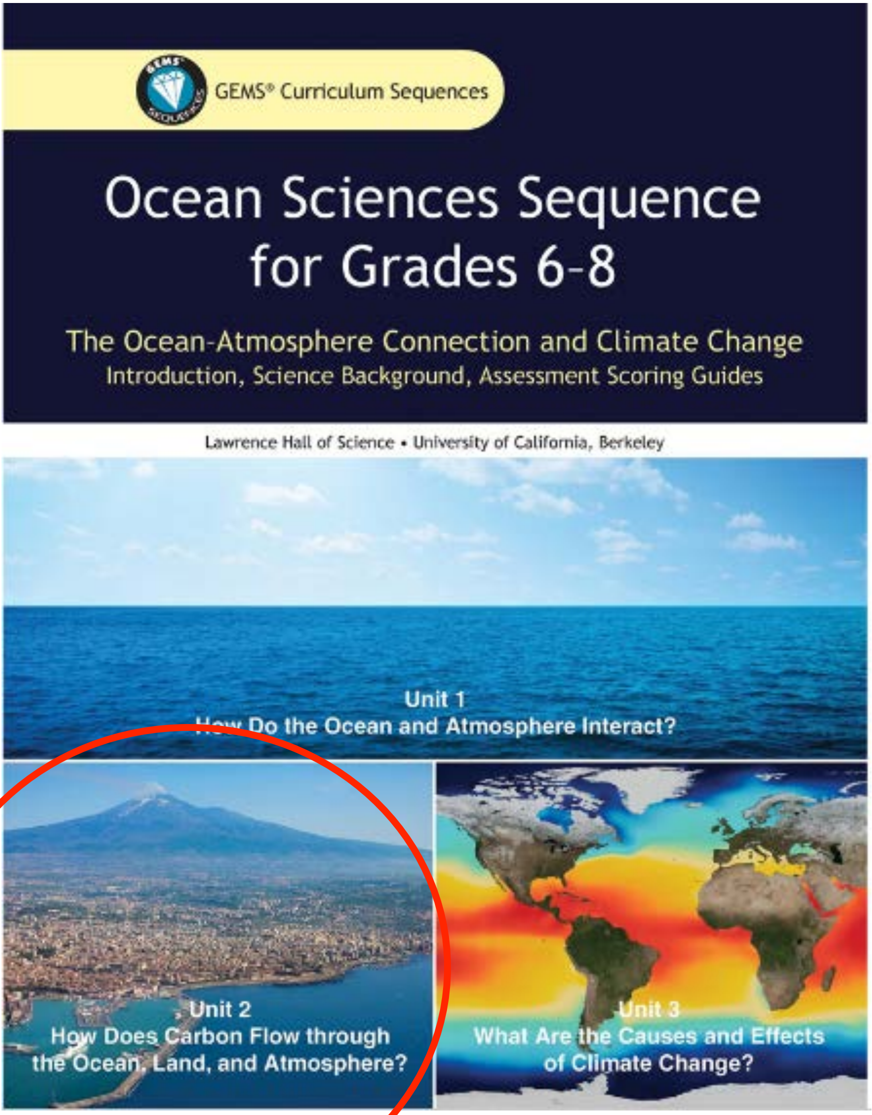
- any real world event that provides a student-driven question and explanation
- builds on everyday, familiar experience to build an understanding of science ideas while engaging in science practices and using crosscutting concepts, as thinking tools
- A phenomena can be an intriguing or unusual observation or case to investigate (a decaying body) or something that is puzzling (where does the rabbit body go?) or a wonderment (why isn't Earth covered in dead bodies?)

Turn and Talk – recalling phenomena

What are some examples of phenomena that have driven your learning about how the ocean and atmosphere are interconnected?

OSS Unit 2: How does carbon flow through the ocean, land and atmosphere?

Which processes do you think students might explore in this unit?



Middle School Life Science

- Individually (for about 5 minutes):
  - read DCI's LS1.C, LS2.B and PS3.D on handout
  - make notes in the margin about possible phenomena for students to engage with the content of the DCI's.
  - the phenomena should provide opportunities to engage in a way that will require students to gain a deeper understanding of the concept in order to explain it.
- After reading and taking some notes, join with a partner:
  - discuss one phenomenon you considered
  - think about the science ideas and experiences that would be needed for students to be able to explain the phenomenon.
  - be prepared to share out highlights from your discussion with the class.

Homework

Read:

- OSS Introduction, Science Background handout.
  - Select a concept that you don't fully understand. Find information that builds your understanding of this concept and be prepared to share where and how you found the information.

- *Framework for K–12 Science Education*, (LS1.C, pp. 147-148 and LS2.B 152-154) http://www.nap.edu/read/13165/chapter/10#147
  - Describe how the crosscutting concept of Matter and Energy might support students as they build their understanding of the Carbon Cycle.

Additional Resources/Optional Slides

- http://mare.lawrencehallofscience.org/curriculum/ocean-science-sequence/oss68-overview/oss68-resources/unit1

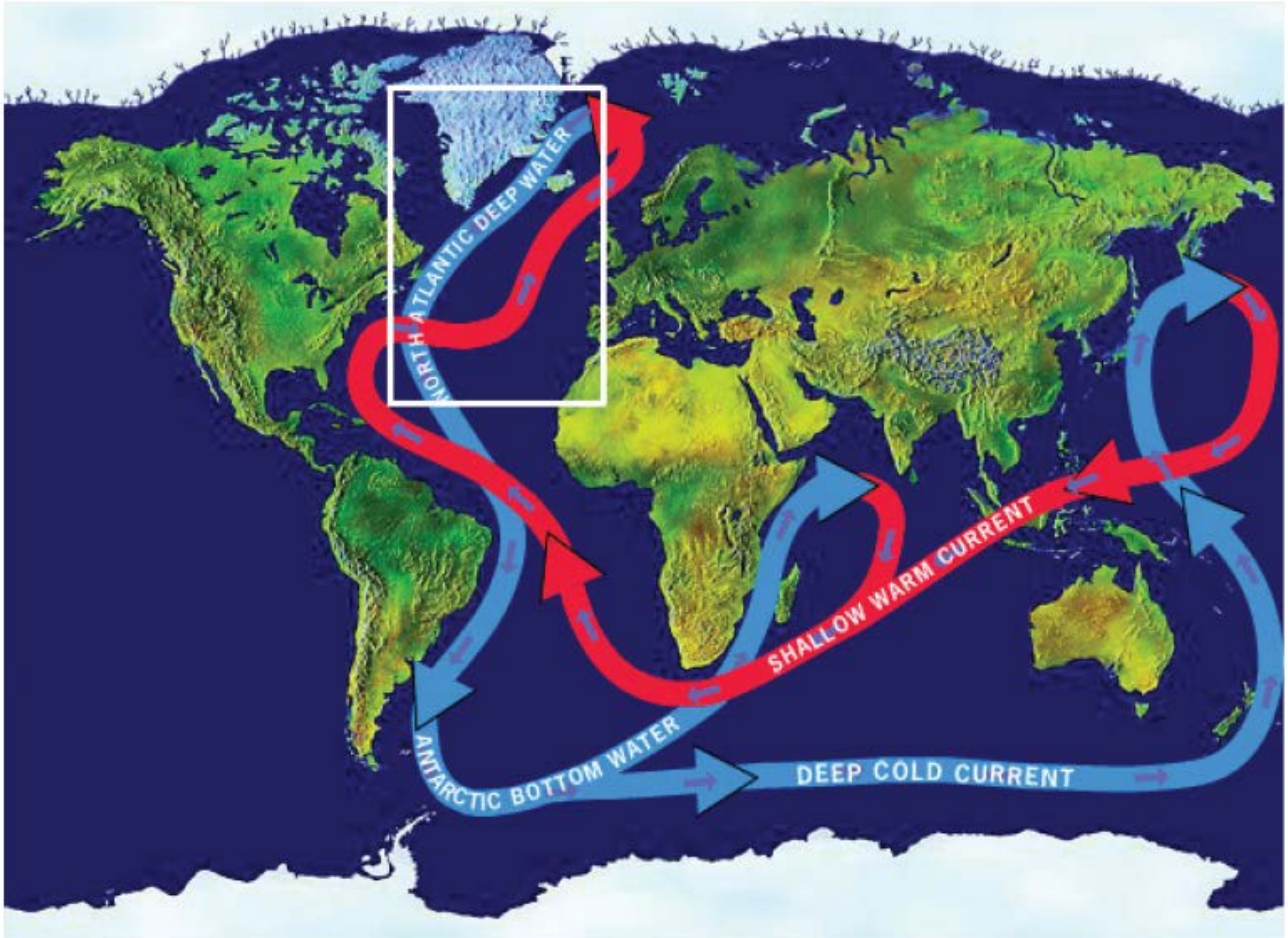
(click on animation for Session 1.10)

Or:
http://www.geography.hunter.cuny.edu/tbw/wc.notes/7.circ.atm/animations/GlobalWind.html

Crosscutting Concepts: *Patterns*

Noticing patterns is often a first step to organizing phenomena and asking scientific questions about why and how the patterns occur.
—Framework, pp.85

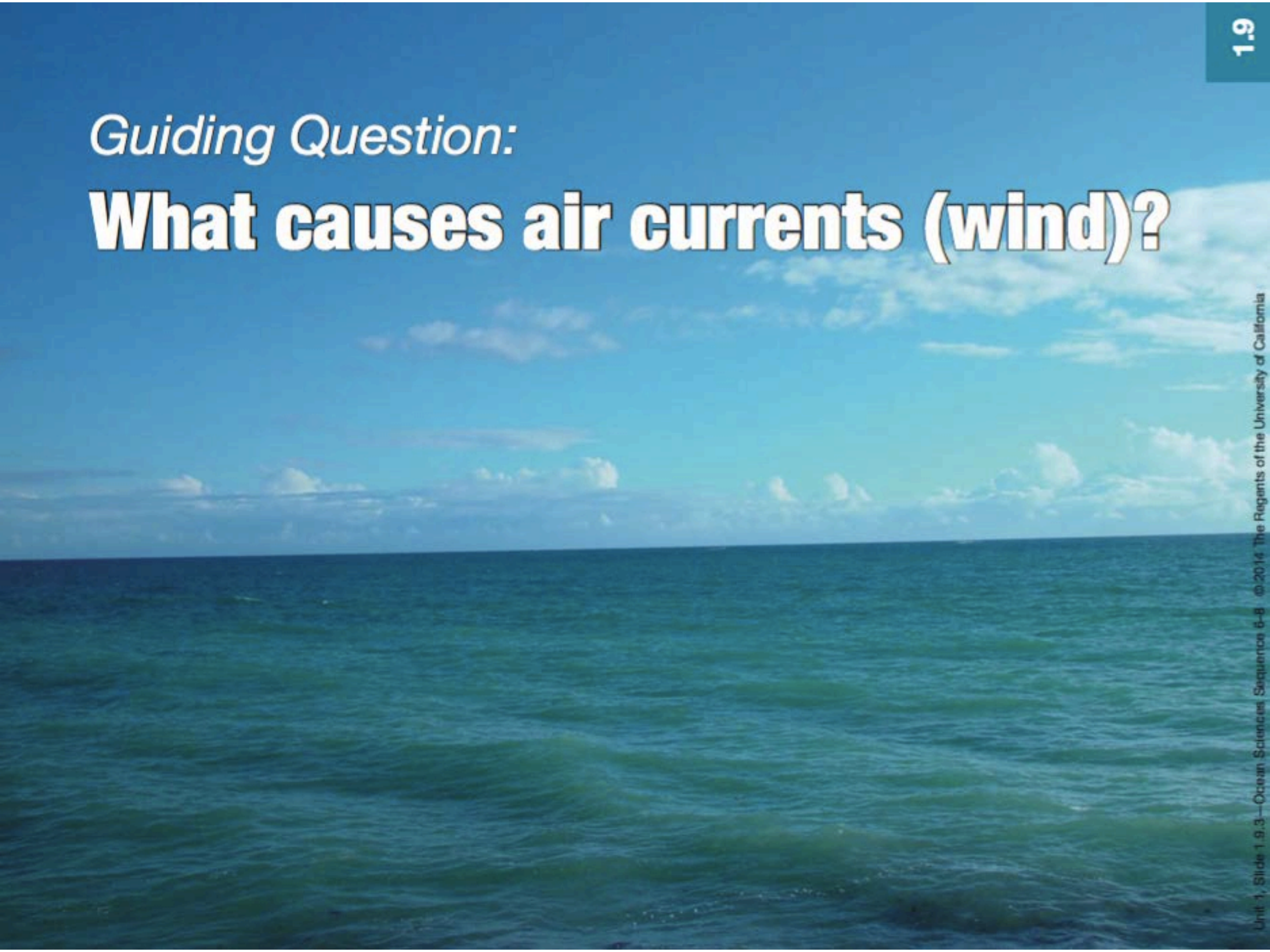
The Great Ocean Conveyor Belt



Summarizing the Great Ocean Conveyor Belt

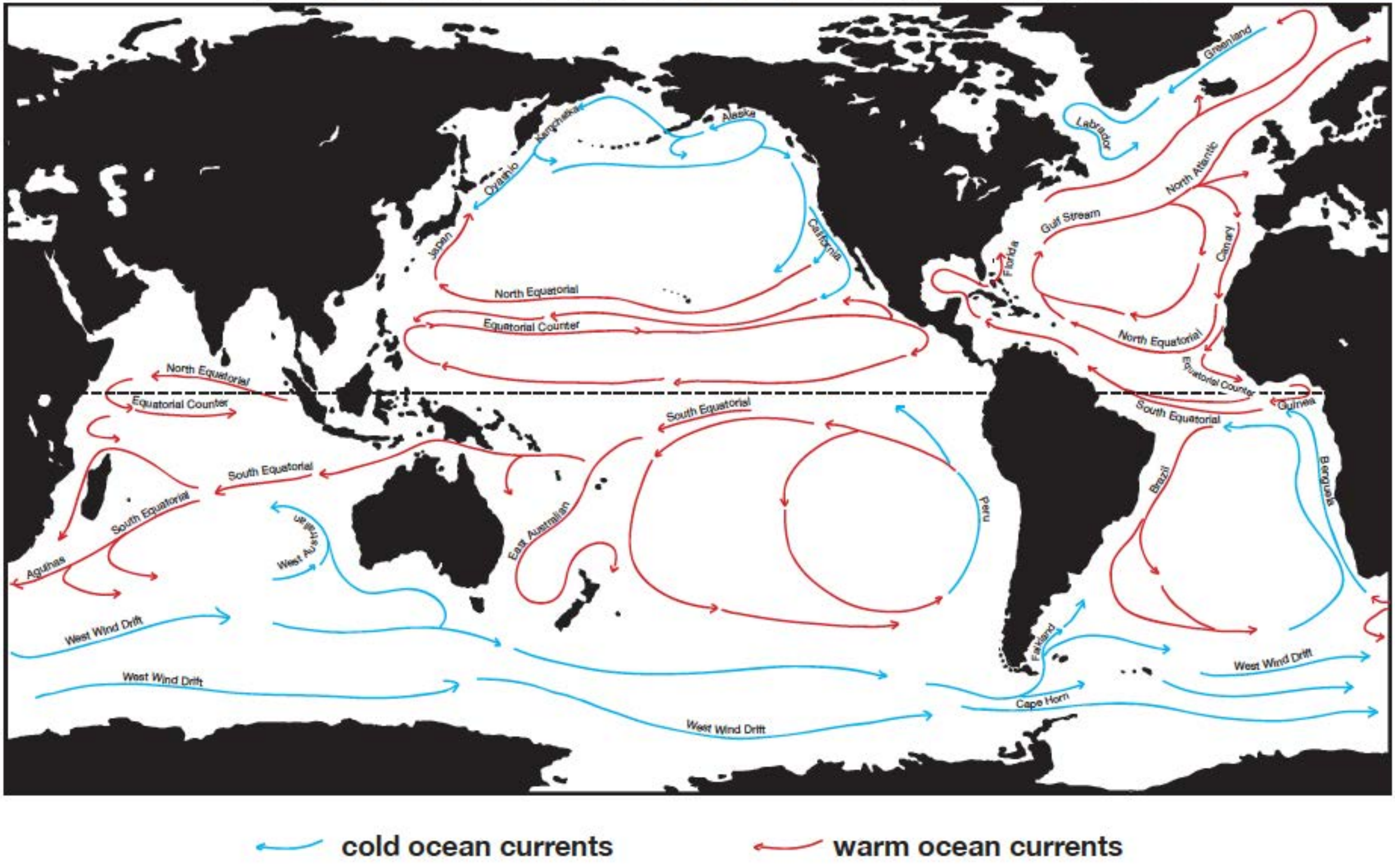
- The Great Ocean Conveyor Belt currents are driven by differences in the density of ocean water; the density differences are created because of changes in temperature and salinity; cold, dense water travels along the bottom of the ocean.

- The Great Ocean Conveyor Belt is a global current that connects the atmosphere and deep ocean circulation systems, transporting oxygen and nutrients, as well as heat energy, around the planet.

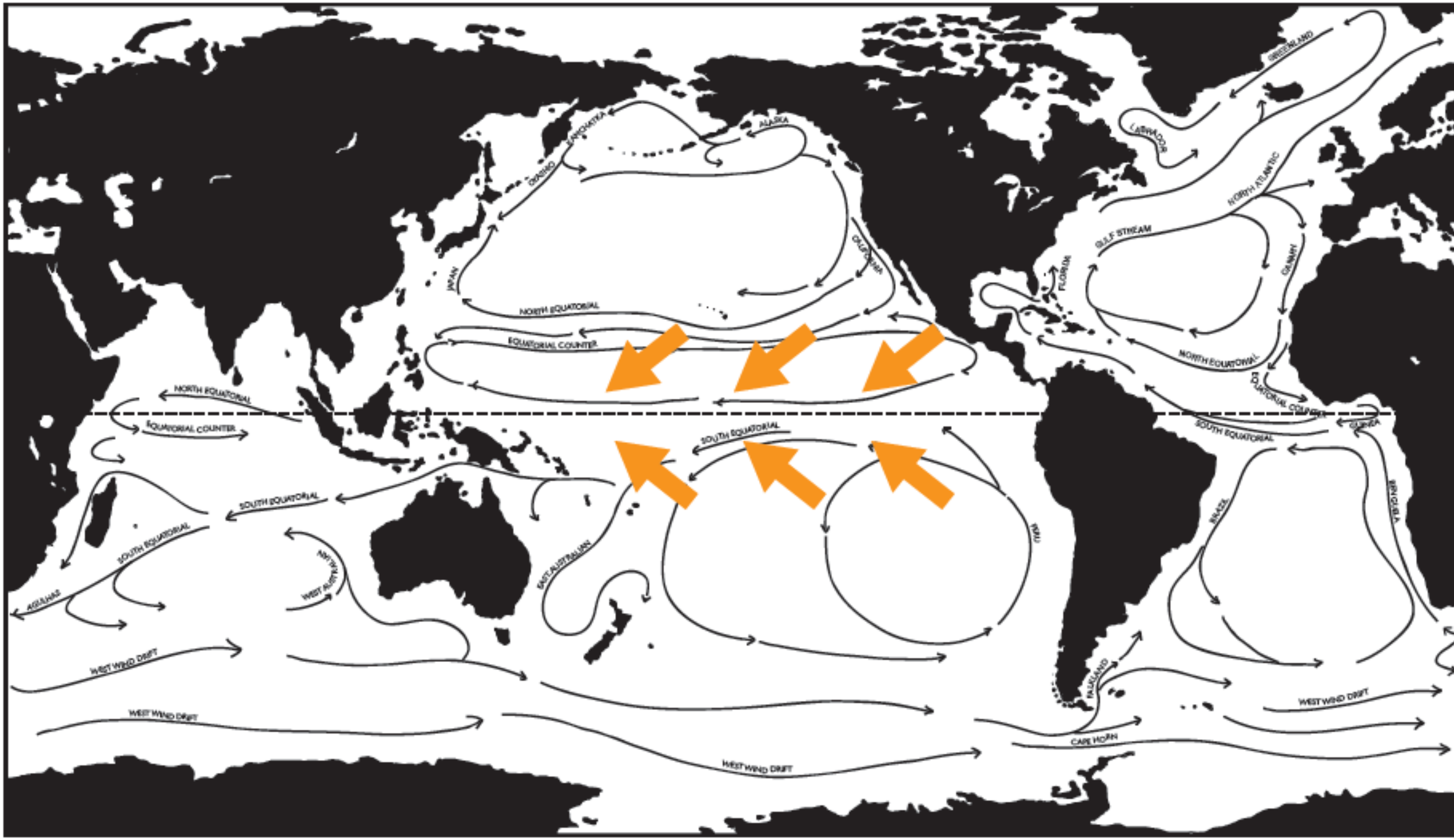

1.9
Guiding Question:
What causes air currents (wind)?
Unit 1, Slide 1.9.3—Ocean Sciences Sequence 6–8 © 2014 The Regents of the University of California

- **Dense air sinks, and less dense air rises. When air rises, denser air flows in to replace it, and this causes air currents (wind).**
- **Wind is caused by the unequal heating of Earth.**

Ocean Surface Currents



Trade Winds and Ocean Currents



Winds are the main cause of ocean surface currents. Winds set these currents in motion, but land masses, Earth's rotation, and friction direct the movement of currents from the equator toward the poles.