# How Learning Happens & the Ocean-Atmosphere Connection

Session 3

### Climate Science Ideas

 What do the ideas you've learned about ocean currents have to do with climate change?

### **Session Goals**

#### **Climate science ideas** - Understand that:

- the ocean covers 70% of Earth's surface, and all this water has a huge impact on temperatures on Earth. (OSS 1.3)
- average temperatures near the coast are moderated by the ocean.
   (OSS 1.3)

**Using Data** - Build on skills covered in previous sessions and explore ways to:

- Compare and contrast data sets and use patterns as evidence to support conclusions.
- Engage with and collect environmental data using a web-based portal of national estuarine observing data

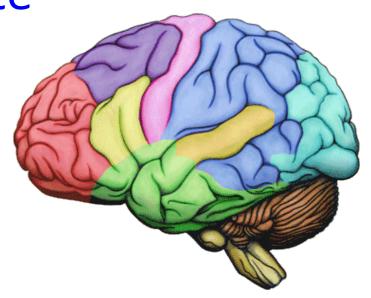
**Teaching & Learning** - Read & discuss how prior knowledge, the use of models, conversations with peers, and facilitation by the instructor, influence learning. Learn about and apply the Learning Cycle instructional model.

**Framework/NGSS** - Experience shifts in teaching and learning as described in the Framework and NGSS.

**Quick Write** 

### How does learning happen?

 What are your ideas about what facilitates and supports learning?



### Read and Discuss

#### Discuss with a partner:

- What do you think each idea means?
- How do these ideas apply to your experiences as a learner?

## How might these ideas apply to you as an educator?

- Learning is an active process to construct understanding.
- Learning builds on prior knowledge.
- Learning occurs in a complex social environment and is a social activity.
- Learning should be situated in an authentic context.
- Learning is affected by motivation and cognitive engagement.

### Synthesis of Discussion

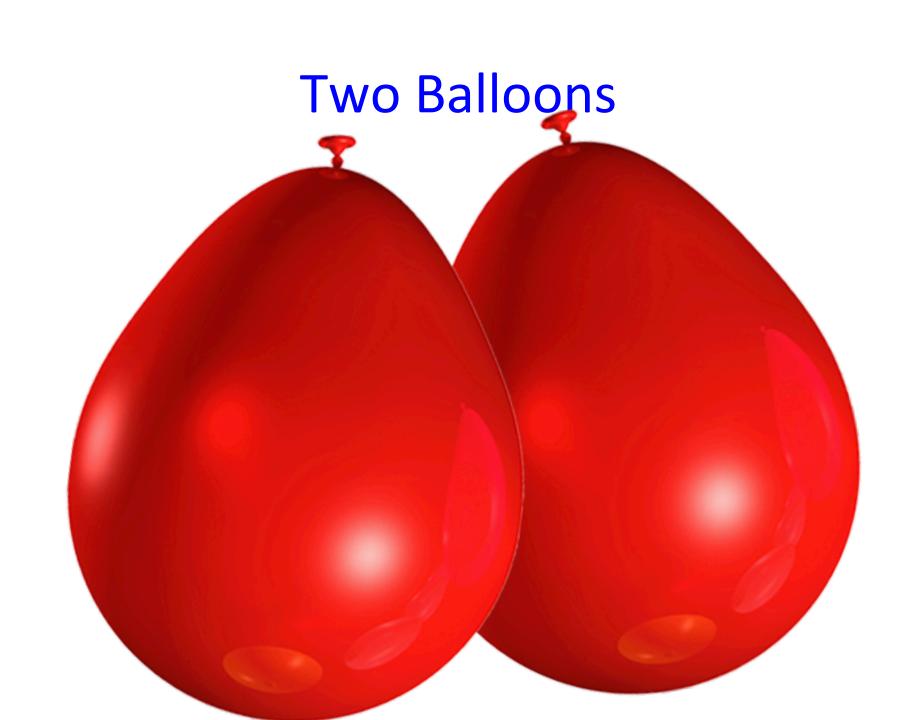
- People construct understanding of complex ideas over a long period of time.
- Learners don't acquire concepts simply by having someone tell them the content, or even by doing hands-on activities.
- Learners must encounter multiple learning experiences that encourage them to
  - question their assumptions;
  - engage in discussion about their ideas;
  - make connections to and build on their prior knowledge; and
  - apply their new understandings in different contexts.

### **Designing Learning Experiences**

Given what you know about how people learn, how would you design learning experiences to take all of these ideas into account and promote learning for all learners?

# As you participate in the learning experiences, consider

- How are you engaging with the materials in each activity to learn the content?
- What seems to be the purpose of each activity?
- Which of the Five Foundational Ideas of Learning are being addressed?



Why did one balloon pop and the other one not?



 What are you thinking now about why one balloon popped and the other did not?

 What questions do you have now about the phenomenon?

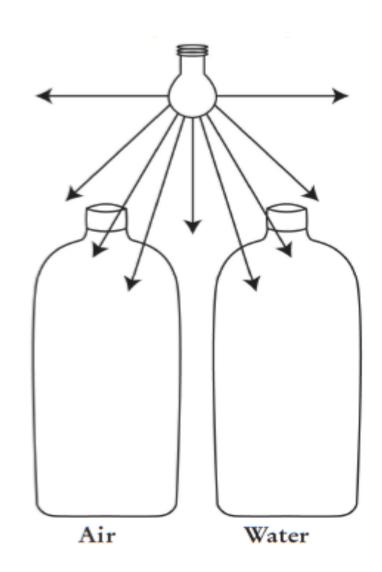


What additional information would be helpful to make an explanation for the balloon phenomenon?



### Water Vs. Air Investigation

What will happen to the temperature of the two bottles receiving heat energy?



Which bottle do you predict will heat up faster?

### Questions to Consider

- What is heat?
- What is temperature?
- Which bottle contains more mass?



### **Small Group Discussion**

 Does this simulation add to or support your explanation? If so, how?

Which of your questions haven't been

answered?

• What new questions arise?

 Why did one balloon pop and the other one not?

 How might this balloon activity be similar to what happens in the Earth system?



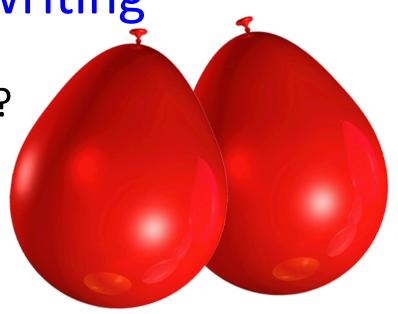
- Circle ideas you find confusing or have questions about.
- Write your questions in the margins.
- ➤ When you finish reading, share your ideas and questions with a partner.

Revise your writing

Why did the air balloon pop?

 Why didn't the water balloon pop?

 What role does the concept of heat reservoir play in the larger Earth system?



Whole Group Share

 Why did one balloon pop and the other one not?

 How might this balloon activity be similar to what happens in the Earth system?



The ocean covers 70% of Earth's surface, and all this water has a huge impact on temperatures on Earth.

Water acts as a heat reservoir. Water absorbs a lot of heat energy before it warms up, and it holds onto the heat for a relatively long time before the heat energy is released and the water cools down.

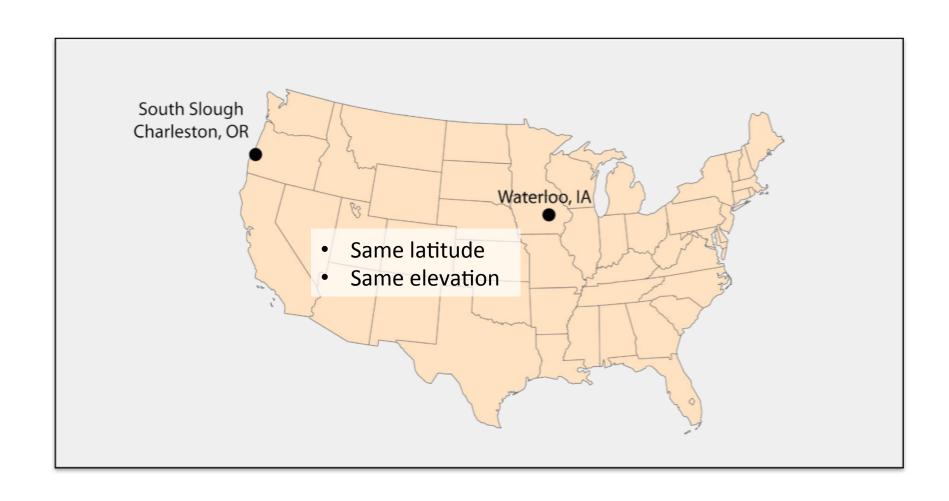
### **Key Concept**

In absorbing and releasing heat energy, the ocean warms cold air and cools warm air. The heat reservoir of the ocean keeps air temperatures moderate all over the planet, not just in coastal places.

### Revisiting two balloons

- Which of our questions have been answered?
- What questions remain?
- What additional questions should be added about the role of heat reservoir in climate change?
- Why is it important for me to understand this content?

### Charleston, Oregon and Waterloo, Iowa



# Why doesn't Charleston get as hot or as cold as Waterloo?



The table below reports the average, maximum and minimum temperature recorded at the two locations on the map above.

Location	Average	Minimum	Maximum
Charleston, OR	11.4°C	2.5°C	19.5°C
Waterloo, IA	7.2°C	25°C below zero	27.5°C

# Key Concepts: What might these ideas have to do with climate change?

- The ocean covers 70% of Earth's surface, and all this water has a huge impact on temperatures on Earth
- Water acts as a heat reservoir. Water can absorb a lot of heat energy before it changes temperature, and it holds onto the heat for a relatively long time before releasing that heat energy to the atmosphere as the water cools down.
- In absorbing and releasing heat energy, the ocean warms cold air and cools warm air. The heat reservoir of the ocean keeps air temperatures moderate all over the planet, not just in coastal places.

### **Activity Debrief**

- How was prior knowledge accessed and connected to in the two balloons activity?
- What did you do to make sense of the two balloons activity?

# Which of these teaching strategies helped you make sense of the science?

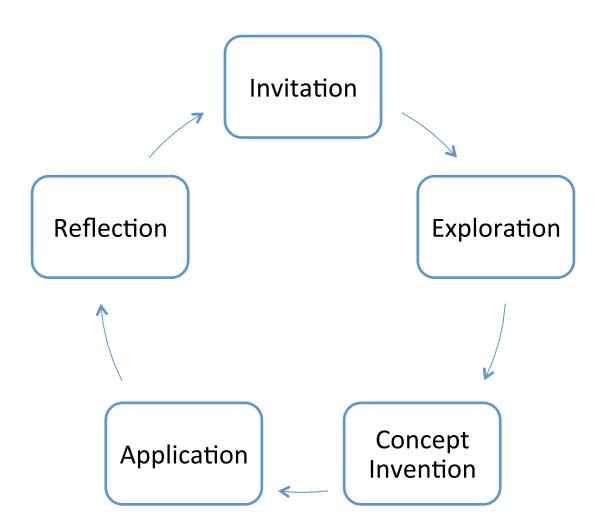
- Observing models and activity set ups
- Listening to and talking with peers
- Thinking on your own
- Listening and talking with the instructor in the whole group
- Overhearing other peers
- Discussing and testing out ideas that agree or disagree with your own understanding
- Asking new questions
- Explaining your ideas to peers or instructor
- Accessing and making connections to prior knowledge and experiences

### Where in today's session have you engaged in one or more of these ideas?

- Learning is an active process to construct understanding.
- Learning builds on prior knowledge.
- Learning occurs in a complex social environment and is a social activity.
- Learning should be situated in an authentic context.
- Learning is affected by motivation and cognitive engagement.

### Synthesis of Discussion

- People construct understanding of complex ideas over a long period of time.
- Learners don't acquire concepts simply by having someone tell them the content, or even by doing hands-on activities.
- Learners must encounter multiple learning experiences that encourage them to
  - question their assumptions;
  - engage in discussion about their ideas;
  - Recall, make connections to and build on their prior knowledge;
  - apply their new understandings in different contexts;
  - want to learn.





#### **Invitation:**

- A question, problem, observation, or demonstration that initiates the learning task
- Connects past and present learning experiences
- Anticipates activities
- Organizes learners' thinking toward the learning outcomes of current activities
- If learners are not engaged, they may not retain what they learn, and are probably only involved in rote learning.

Invitation

#### **Exploration:**

- Learner is engaged in open-ended investigation of real phenomena
- Can also involve some discussion about discoveries, results, ideas, and questions that arise (can be through hands-on activity or through discourse and thought processes)
- Can be more or less structured, but the idea is that exploration should be driven mainly by the learner's interest and questions

**Exploration** 

ncept ention

#### **Concept Invention:**

- Active processing of the experience by the learner
- Learners review evidence and data gathered through exploration and try to make sense of it
- With interest and attention focused, new ideas can be discovered and the learner can solve problems and begin to construct new meanings
- When possible, learners should be free to invent and discuss their own understandings directly from their hands-on experiences, through discussion with their peers and with those with more knowledge.

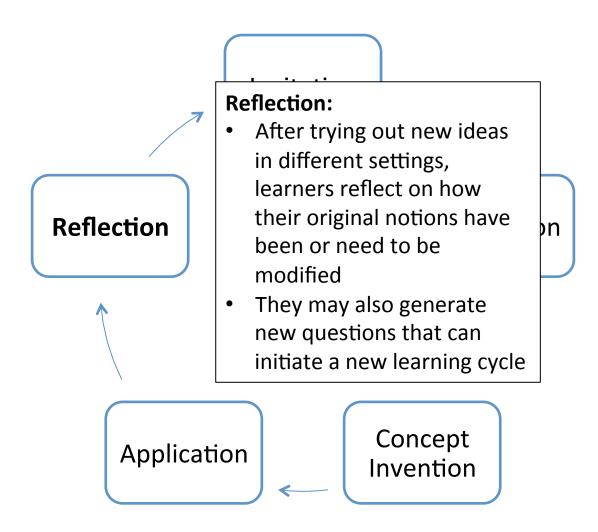
Application Concept Invention

#### **Application:**

- Armed with new ideas and concepts, the learner applies knowledge and abilities to different situations than those they have already encountered
- Researchers agree that in-depth learning requires being able to transfer knowledge from familiar circumstances to novel ones

**Application** 

Concept Invention



	Ocean Currents lesson	Today's session
Invitation	The description of the demonstration and initial question about what will happen to the two balloons. A phenomenon was introduced, and you were challenged to gather evidence to construct an explanation.	
Exploration	You discussed your ideas in pairs and small groups. The whole group discussion was facilitated to explore thinking and identify what additional information was needed to solve the mystery.	

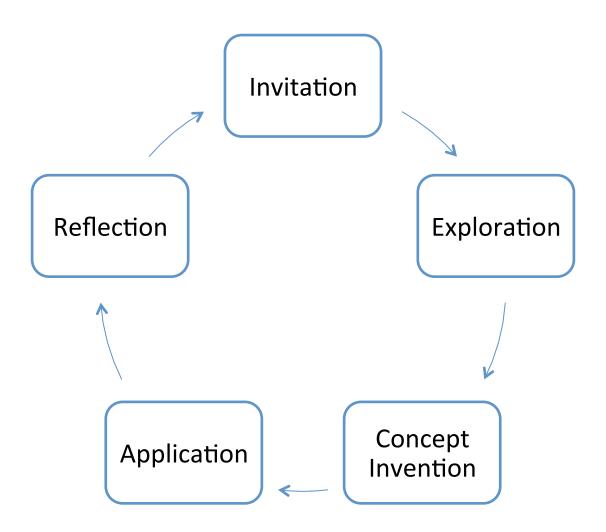
	Ocean Currents lesson	Today's session		
Concept Invention	Instructor used an animation to provide information about how water and air molecules behave as they absorb heat energy; checked your understanding with questions about heat and temperature definitions and asked you to connect animation to the two balloons; provided a reading to support your explanations and answer some of your remaining questions.			
Application	Applied your understanding of the ocean as a heat reservoir to explain a real-world scenario of temperature differences in two cities, one inland and one coastal.			
Reflection	Revised your thinking regarding why one balloon popped and the other one didn't and how you think this is the same or different from what happens in the Earth system; generating and addressing your own questions throughout.			

	Ocean Currents lesson	Today's session
Invitation	The description of the demonstration and initial question about what will happen to the two balloons. A phenomenon was introduced, and you were challenged to gather evidence to construct an explanation.	The initial questions posed at the beginning of the session - How does learning happen? Given what you know about how people learn, how would you design learning experiences to take all of these ideas into account and promote learning for all learners?
Exploration	You discussed your ideas in pairs and small groups. The whole group discussion was facilitated to explore thinking and identify what additional information was needed to solve the mystery.	Active Learning activities (Ocean as a Heat Reservoir and Debrief Discussion) to explore ideas and assumptions.

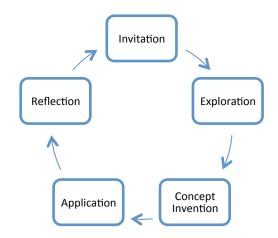
throughout.

	Ocean Currents lesson	Today's session
Concept Invention	Instructor used an animation to provide information about how water and air molecules behave as they absorb heat energy; checked your understanding with questions about heat and temperature definitions and asked you to connect animation to the two balloons; provided a reading to support your explanations and answer some of your remaining questions.	Research Presentation on the Learning Cycle model and discussion of how it supports learning.
Application	Applied your understanding of the ocean as a heat reservoir to explain a real-world scenario of temperature differences in two cities, one inland and one coastal.	The current and following activities.  Applying the Five Foundational Ideas about Learning to the Ocean as a Heat Reservoir activity. Further applications will occur in subsequent sessions in this course.
Reflection	Revised your thinking regarding why one balloon popped and the other one didn't and how you think this is the same or different from what happens in the Earth system; generating and addressing your own questions	Opportunity coming up.

# The Learning Cycle

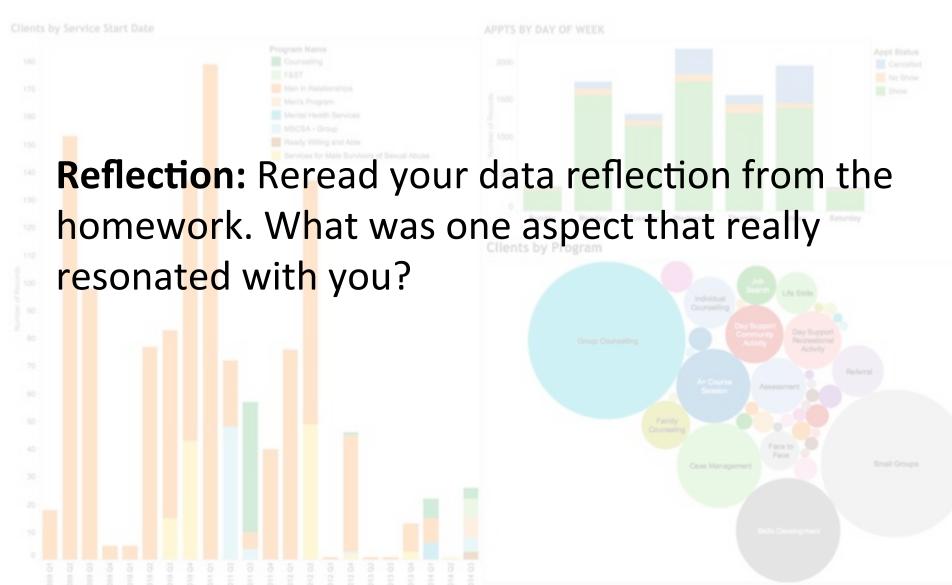


# Reflection: *The Learning Cycle instructional model*

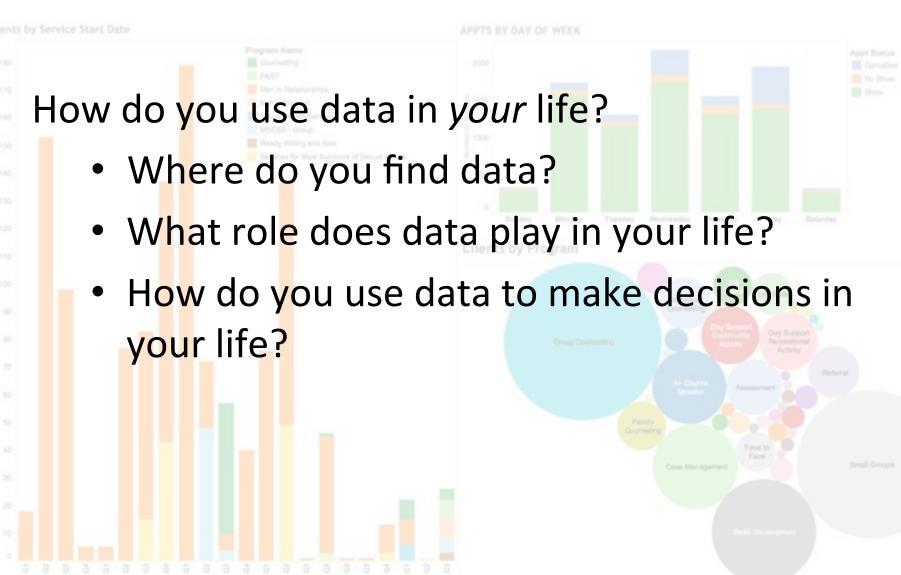


- What do you feel are the pros and cons about the way the science content in the Ocean as a Heat Reservoir was presented?
- Which stage(s) of the learning cycle do you find has the greatest impact on your learning? Why do you think that?
- What questions do you have about the learning cycle?
- Describe a traditional science activity example that could be reformatted to follow a learning cycle approach.

# Teaching with Data & Types of Data



# **Quick Write**



# To be a more effective science teacher, you need to understand:

- What is involved in using data
- How data are used in science
- Good pedagogy for teaching with data

## Data-enhanced learning experiences can:

- Prepare studnets to address real-world complex problems
- Develop students' ability to use scientific methods, including consideration of the values and ethics of working with data
- Teach students how to evaluate critically the integrity and robustness of data or evidence and of their consequent interpretations or conclusions
- Provide training in scientific, technical, quantitative, and communication skills

# **Data Literacy**

The ability to ask and answer meaningful questions by collecting, analyzing and making sense of data encountered in our everyday lives.

### **Increasing Data Literacy**

- 1) in a data-driven society, data literacy is an important civic skill
- 2) learners can engage in more meaningful learning experiences by using data to connect school subjects with real-world events.

# **Types of Data Literacy**

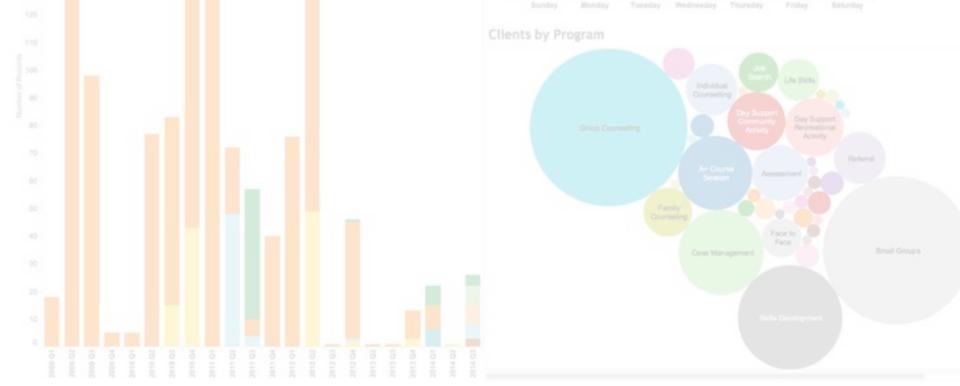
- Raw Data: Actual data collected using instruments/ equipment/models that are not cleaned up or averaged, in order to demonstrate an overall concept. Example:
  - Data charts and graphs
- Simulated Data: Representations of data manipulated to clearly emphasize and demonstrate a particular scientific concept with minimal confusion.
  - Example: Textbook graphs and diagrams

# Ways Data are Collected/Created

- Learner-generated
- Real-/near-real-time data (RTD)
- Archived data (>30 days old)
- Local Ecological Knowledge (LEK)
- Traditional Ecological Knowledge (TEK)

### Turn and Talk

What types of data have you used so far in this course? (e.g., the type of data and the way in which the data was collected)



# Learner-generated Data



### Simulated Data

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### Making a line graph

Independent and A line graph shows how a change in one variable influences dependent another variable. The independent variable is the variable you variables believe might influence another variable. It is often controlled by the experimenter. The dependent variable is the variable that may be influenced by the independent variable. The following example illustrates how to graph variables.

An example As a scuba diver goes deeper under water, she has to think about pressure. How does an increase in depth affect the pressure? Pressure is measured in units of atmospheres. You live at Earth's surface under a pressure of 1 atmosphere. Figure 1.10 shows depth and pressure data. A graph can help you visualize the relationship between the depth of water and pressure.

### Step 1: choose x-

Depth is the independent variable and y-axis because we are interested in how it affects pressure. The independent variable always goes on the x-axis of a graph. The dependent variable always goes on the y-axis. In this example, pressure is the dependent variable.

Step 2: make a To create a scale for a depth versus scale pressure graph, you first make a scale. The word scale refers to size of something. When talking about a graph, scale refers to how each axis is

divided up to fit the range of data values. Use the formula below to make a scale for any graph.

ndependent Variable

Depth (m)

Data range + number of boxes on the axis = value per box

### VOCABULARY

### independent variable - a

variable that you believe might influence another variable. The independent variable is sometimes called the manipulated variable.

### dependent variable - the

variable that you believe is influenced by the independent variable. The dependent variable is sometimes called the responding variable.

Depth (m)	Pressure (atm.)
0	1.0
5	1.5
10	2.0
15	2.5
20	3.0
25	3.5
30	4.0
35	4.5
40	5.0

Figure 1.10: Depth of the ocean and pressure data.

### Simulated data

### In a small group:

 Brainstorm a list of benefits and limitations of using simulated data in your classroom instruction.

## Scope of Data in this Course

- Focused on increasing
  - Overall comfort with working with different kinds of data and data visualizations
  - Ability to teach the concepts of science through patterns and relationships
  - Confidence in teaching with real/near real-time data
  - Success in helping your future students engage with data (orientation, interpretation, and synthesis)

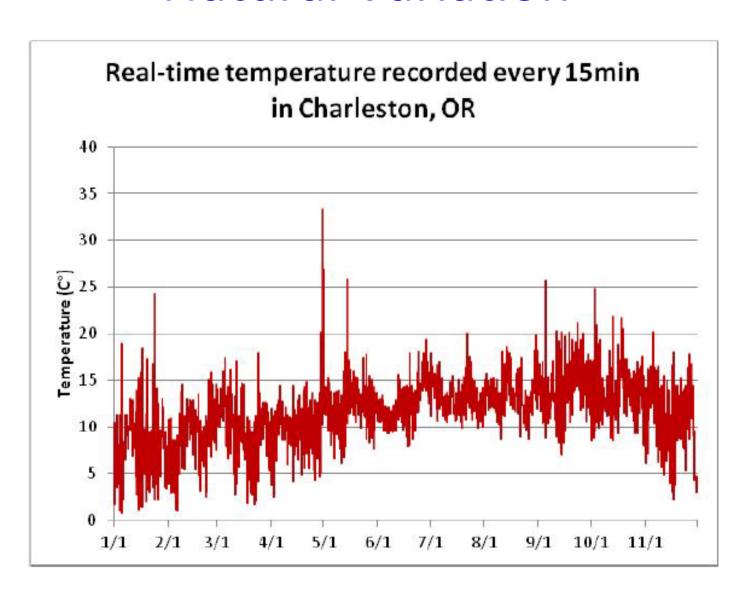
# **Big Chart of Data Skills**

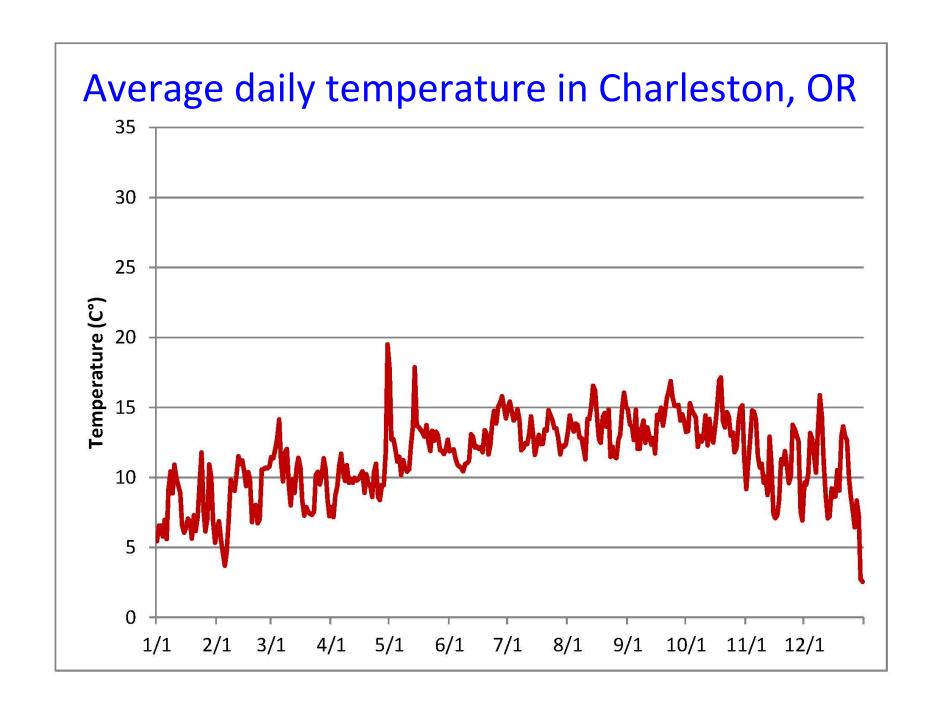
	Teacher	Learner	NGSS Science & Engineering Practices
Prior to Having a Data Visualization			
Data Orientation			
Data Interpretation			
Data Synthesis			

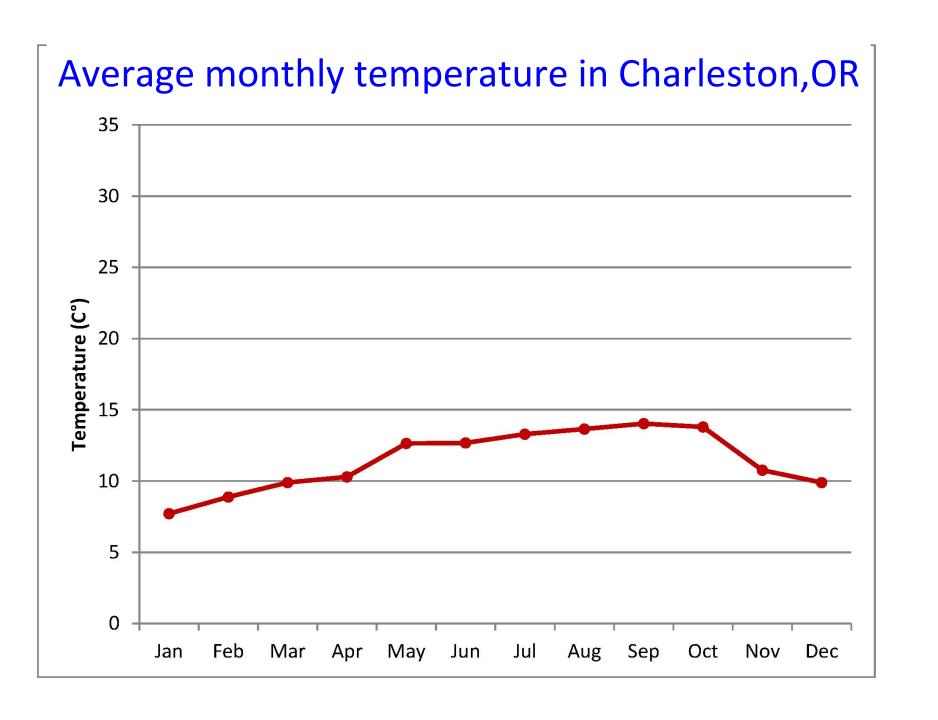
### Homework

- Online Data Scavenger hunt and Data Collection.
  - Use Homework handouts #1 and 2 and create
     Reserve water temperature graphs. (If possible work with a partner).
- Online Discussion on How People Learn Research.
  - Describe what you think are the most important ideas from each section.
  - How can the ideas about learning described in the reading be useful and relevant to you as a learner?
  - When you teach, how might you use what you know about how people learn to help your learners to make sense of the science?

### **Natural Variation**

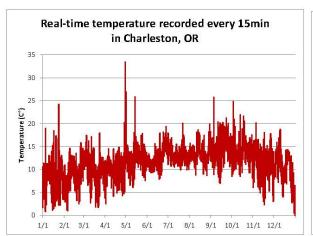


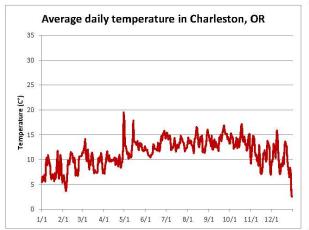


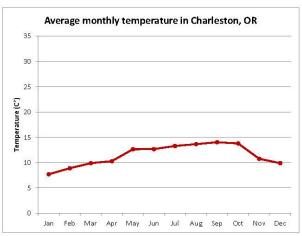


# Turn & Talk: Average Vs. Raw Data

The figures below show air temperature data collected at the South Slough Reserve in Charleston OR during 2014.







- Do your descriptions change when looking at the averaged data only?
- Do your conclusions change about the relationship/pattern of how temperature varies over time when looking at the averaged data only?
- Does the range of temperature values change when looking at the averaged data only?

# Average vs. Raw Data

- In science it is important to look at averaged data as well as the raw data that is full of natural variability in order to get a broader sense of the patterns and how confident you can feel in the patterns.
- If there is a large amount of variation around the average, then you can lose a lot of information about the situation if you only look at the averaged data.