CHICAGO BOTANIC GARDEN

Activity 2.2: Recognizing Change (Observation vs. Inference)

Grades 5 – 6

Materials
- Student handouts
- PowerPoint presentation (or overheads of the images)
- Projector and screen
- Pens or pencils

Description: Students are introduced to the difference between observation, inference, and prediction. They first make a prediction about what evidence they might use to determine whether climate change is happening. Then, students view a PowerPoint of both images and graphs that document evidence for climate change. They will make observations and inferences based on the pictures, and then summarize what they have learned by revising their initial predictions.

Total Time: One to two 45-minute class periods

National Science Education Standards:
A1.d Develop descriptions, explanations, predictions, and models using evidence.
A1.e Think critically and logically to make the relationships between evidence and explanations.
G2.a Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.

AAAS Benchmarks:
1A/E2 Science is a process of trying to figure out how the world works by making careful observations and trying to make sense of those observations.
B/H6b In the long run, theories are judged by the range of observations they explain, how well they explain observations, and how useful they are in making accurate predictions.
9D/E1 Some predictions can be based on what is known about the past, assuming that conditions are pretty much the same now.
11C/M10/M7 Trends and cyclical patterns based on what has happened in the past can be used to make predictions about what things will be like in the future. However, these predictions may not always match what actually happens.

Guiding Questions
- What are the differences between observation, inference, and prediction?
- What kinds of evidence to scientists use to prove that climate change is happening?

Procedure:
1. Before starting the PowerPoint presentation, establish the difference between an observation and an inference. Ask students if they have heard either of these words, and what they might mean.

2. An observation uses your five senses, while an inference is a conclusion we draw based on our observations. It might be helpful to have some examples.

- **Observations** can be made only with the five senses.
  Example: I see that the red and green flowers are growing.

- **Inferences** involve a decision being made about something you observe.
  Example: I think the flowers are growing because they were planted and tended with care.

- A **prediction** is a statement about the way things will happen in the future, based on experience, knowledge, or evidence.

3. One way to introduce the difference between observations and inferences is the "potato candle" activity. Peel a potato and carve into a cylinder and stick an almond sliver in the top so that it looks like a candle. Hold the "potato candle" in front of the class and light the almond. Ask students what they think is happening. Most likely they will say the candle is burning. Take a bite of the potato to demonstrate that they were making inferences, or an explanation for their observations. In this case their inference, or conclusion was incorrect. An example of this lesson can be seen here (note this is in PC format, Macs may have problems displaying this activity):
   http://www.agpa.uakron.edu/p16/lessons/pdf/obs_and_inf_print.pdf

4. Tell students that they will be making observations and inferences regarding evidence for climate change. These observations and inferences will help them make **predictions** about what might happen to climate in the future. Review the definition of a predication with students. Students should understand that a prediction is a forecast of the outcome of a specific future event, based on a pattern of evidence. It is not a wild guess. Or to paraphrase: A prediction is the result you expect to see from an investigation. It is neither right nor wrong, but it may be proved or disproved, or the results of the investigation may be inconclusive.

5. Distribute the handout titled "Evidence for Climate Change."

6. Have students answer the first question, brainstorming all the possible evidence for climate change that they can think of. They should write down their answers on their handout. You may also write their ideas on the board, so you can refer back to their suggestions during the PowerPoint presentation.

7. Begin the PowerPoint. Students will carefully observe the scenes on the slides and be asked to make observations and inferences after each set (see teacher notes and student handout). Discuss the observations and inferences students draw as you go through the PowerPoint. Make sure students are consistently and correctly differentiating between the two.

8. After students view the PowerPoint they will review their original thoughts on the evidence for climate change and will revise their responses to include the evidence they have seen in the PowerPoint. Students should reference specific examples from the class.

CHICAGO BOTANIC GARDEN

Name:_____ **Date:**_____ **Room:**_____

Evidence for Climate Change

Part 1: Is there evidence for climate change?

What types of evidence might you use to determine whether climate change is happening? Write all the types of evidence you can think of in the space below.

Part 2: Observations and Inferences

A. Image 1

Observe the image on the first slide. List your **observations** in the space below.

List any **inferences** you can make below.

Observe the graph on the second slide. Using the graph and the image, explain what you think is happening in these slides. Use your observations and inferences to make a **prediction.** What do you think will happen to temperatures over the next century?

B. Images 2 and 3

Observe Images 1 and 2 on the third slide. List your **observations** for each in the space below.

Image 2 observations	Image 3 observations

List any **inferences** you can make below.

Image 2 inferences	Image 3 inferences

Read the information that appears on the slide. Using images and the information provided, explain what you think is happening. Use your observations and inferences to make a **prediction.** What do you think will happen to precipitation over the next century?

C. Image 4

Look at the image on the fifth slide. List your **observations** in the space below.

List any **inferences** you can make below.

Name:_____ **Date:**_____ **Room:**_____

C. Image 4 (cont.)

Read the information on Slide 6. Using the image and the information provided, explain what you think is happening in these slides. Make a **prediction.** What do you think will happen to the ice sheets over the next century?

D. Image 5

Observe the image graph on the first slide. List your **observations** in the space below.

List any **inferences** you can make below.

Observe the graph on the second slide. Using the graph and the image, explain what you think is happening in these slides. Use your observations and inferences to make a **prediction.** What do you think will happen to sea levels over the next century?

E. Images 6 and 7

Observe Images 1 and 2 on the third slide. List your **observations** for each in the space below.

Image 6 observations	Image 7 observations

List any **inferences** you can make below.

Image 6 inferences	Image 7 inferences

Read the information that appears on the slide. Using images and the information provided, explain what you think is happening. Use your observations and inferences to make a **prediction.** What do you think will happen to extreme weather events over the next century?

F. Images 8 and 9

Observe the graph on the first slide. List your **observations** in the space below.

F. Images 8 and 9 (cont.)
List any **inferences** you can make below.

Observe the graph on the second slide. Using the two graphs, explain what you think is happening in these slides. Use your observations and inferences to make a **prediction.** What do you think will happen to carbon dioxide levels over the next century?

Part 3: Evidence for Climate Change

After viewing the PowerPoint presentation, is there evidence for change? How do scientists know the climate is changing? Give specific examples. Use the space below for your answer.

TEACHER ANSWER KEY

Evidence for Climate Change

Part 1: Is there evidence for climate change?

What types of evidence might you use to determine whether climate change is happening? Write all the types of evidence you can think of in the space below.

Student answers will vary but may include:

- *Increased temperature*
- *Increased CO_2*
- *Melting ice caps*
- *Sea level rise*
- *Drought becomes more widespread*
- *Parent/adult told me*
- *Polar bear populations are decreasing*

Part 2: Observations and Inferences

A. Image 1 (sun rising in Arizona)

Observe the image on the first slide. List your **observations** in the space below.

Student answers will vary but may include:

- *The sun is on the horizon*
- *There are no clouds*
- *The sky is orange/yellow/red*
- *There is a road*

List any **inferences** you can make below.

Student answers will vary but may include:

- *It is hot*
- *The sun is rising/setting*
- *It is dry*
- *This is a desert*

Observe the graph on the second slide. Using the graph and the image, explain what you think is happening in these slides. Use your observations and inferences to make a **prediction.** What do you think will happen to temperatures over the next century?

Student answers will vary but may include:

- *Temperatures will increase*
- *Temperatures will stay the same*
- *Temperatures will decrease*

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TEACHER ANSWER KEY

Evidence for Climate Change

B. Images 2 (desert) and 3 (torrential rainstorm)

Observe Images 1 and 2 on the third slide. List your **observations** for each in the space below.

Student answers will vary but may include:

Image 2 observations

- *The ground is cracked*
- *It is brown/red*

Image 3 observations

- *It is raining hard*
- *People are under umbrellas*
- *There are many people there*

List any **inferences** you can make below.

Image 2 inferences

- *It is dry*
- *It hasn't rained in a long time*
- *It is hot*
- *It is summer*
- *The heat and drought are caused by climate change*

Image 3 inferences

- *People are wet*
- *People are shopping*
- *It might flood*
- *It started raining unexpectedly*

Read the information that appears on the slide. Using images and the information provided, explain what you think is happening. Use your observations and inferences to make a **prediction.** What do you think will happen to precipitation over the next century?

Student answers will vary but may include:

- *Some places will get dryer and some will get wetter*
- *Places will be hotter and dryer*
- *It will become more uneven*

C. Image 4 (Greenland ice sheets)

Observe the image on the fifth slide. List your **observations** in the space below.

Student answers will vary but may include:

- *There is an ice sheet (or glacier)*
- *There is a river/water on the ice sheet*
- *There are people standing on the ice*

TEACHER ANSWER KEY

Evidence for Climate Change

C. Image 4 (cont.)

List any **inferences** you can make below.

Student answers will vary but may include:

- *The ice is thick*
- *The ice is melting*
- *It is below 32 degrees Fahrenheit*

Read the information on Slide 6. Using the image and the information provided, explain what you think is happening in these slides. Make a **prediction.** What do you think will happen to the ice sheets over the next century?

Student answers will vary but may include:

- *The ice sheets will shrink*
- *The ice sheets will disappear*
- *Everything will stay the same*
- *The ice will get thinner*
- *There will be less ice*

D. Image 5 (Island Republic of Maldives)

Observe the image on the first slide. List your **observations** in the space below.

Student answers will vary but may include:

- *It is an island*
- *It is surrounded by water*
- *There are buildings on the island*
- *Buildings are close to the water*
- *There is no beach*

List any **inferences** you can make below.

Student answers will vary but may include:

- *It is warm on the island*
- *It is in the tropics*
- *People live on the island*

Using the graph and the image, explain what you think is happening. Use observations and inferences to make a **prediction.** What do you think will happen to sea levels over the next century?

Student answers will vary but may include:

- *Sea level will continue to rise*
- *The warmer ocean will speed the melting ice sheets*
- *Islands will flood or be covered by water*

TEACHER ANSWER KEY

Evidence for Climate Change

E. Images 6 (snowstorm) and 7 (flood)

Observe Images 1 and 2 on the third slide. List your **observations** for each in the space below.

Student answers will vary but may include:

Image 6 observations

- *There is snow on the ground*
- *There is a snowplow on the road*

Image 7 observations

- *The house has collapsed*
- *There is someone in the house*
- *There is water under the house*

List any **inferences** you can make below.

Image 6 inferences

- *It is winter*
- *It is freezing*
- *This is a northern state/location*

Image 7 inferences

- *It rained hard*
- *There was a flood*

Read the information that appears on the slide. Using images and the information provided, explain what you think is happening. Use your observations and inferences to make a **prediction.** What do you think will happen to extreme weather events over the next century?

Student answers will vary but may include:

- *Sea level will continue to rise*
- *The warmer ocean will speed the melting ice sheets*
- *Islands will flood or be covered by water*

F. Images 8 (Keeling Curve) and 9 (historical CO_2 cycles)

Observe the graph on the first slide. List your **observations** in the space below.

Student answers will vary but may include:

- *Atmospheric CO_2 in increasing*
- *There is a seasonal difference in CO_2 concentrations*
- *There is more CO_2 in the atmosphere in the summer than in the winter*

List any **inferences** you can make below.

Student answers will vary but may include:

- *CO_2 was lower before 1958*
- *Humans are causing CO_2 rise*
- *CO_2 rise is natural*

TEACHER ANSWER KEY

Evidence for Climate Change

F. Images 8 and 9 (cont.)

Observe the graph on the second slide (CO_2 from 650,000 B.C.E. to present). Using the two graphs, explain what you think is happening in these slides. Use your observations and inferences to make a **prediction.** What do you think will happen to carbon dioxide levels over the next century?

Student answers will vary but may include:

- *CO_2 will keep rising*

G: Do you think there is evidence for climate change?

Use this slide to transition to Part 3. You can use this to start a class discussion, or to conclude the activity and have students complete Part 3 as homework.

Part 3: Evidence for Climate Change

After viewing the PowerPoint presentation, is there evidence for climate change? How do scientists know the climate is changing? Give specific examples.

Student answers will vary but may include:

- *CO_2 concentration and temperature move together and are both increasing*
- *There have been changes in precipitation distribution (dry places are getting dryer and wet places are getting more hard rains and floods)*
- *Ice sheets are shrinking*
- *Oceans are warming*
- *Sea level is rising*
- *There are increasing numbers of extreme weather events*

