SCIENTIST IN RESIDENCE PROGRAM™

Science Unit: *Fossils*

Lesson # 1: *Process of Science - Data vs. Inference*

School Year:	2015/2016
Developed for:	George T. Cunningham, Vancouver School District
Developed by:	Kate Gregory (scientist); Jodi Carson and Craig McNeil (teachers)
Grade level:	Presented to grade 5-7; appropriate for grades 3-7 with age appropriate modifications
Duration of lesson:	1 hour

Objectives

- Understand that science is process for answering questions about our world, not just a collection of facts
- Learn the difference between data (facts) and inferences (opinion)
- Practice collecting data and making inferences by examining a collection of shoes

Background Information

"Without data, you're just another person with an opinion" - W. Edwards Deming

What is science, exactly? Many students have misconceptions; they may think science is a collection of facts in book, or something done by lone geniuses in white lab coats. It is important for students to understand that **science is a process for answering questions about our world**. It is often a very social activity, and one that *anyone* can do. To do science, we make observations and then develop inferences to explain them.

In this activity, students learn about the process of science by examining a collection of shoes. They make observations (collect data) and then try to make inferences - based on their observations - about who owned the shoes or how they were used. By the end of the lesson, students should have a better idea how scientists answer questions.

Vocabulary

Data:	Information that we gather with one of our five senses; a fact, measurement, or description
Inference:	An explanation for an observation; made with our brain and based on prior experience
Science:	A process for answering questions about our world

Materials

- 5+ pairs of shoes from family, friends or a thrift store
- Pictures of or information about the shoe's owners, if available
- Slide presentation
  (https://drive.google.com/open?id=1zTQsUx9SHoQGhIsAHW1k2HmNIRitwhSZBi0D7qtjDgI)
- "Whose Shoes" worksheets (below) - Note it will be easier for the students if you print out this worksheet on 2 separate pages
- Average shoe size chart (can be found online, or see Bibliography)

In the Classroom

Introductory Discussion

Use the slide presentation to introduce the ideas of science, data, and inference. For older students, you might want to show a clip of a "deduction battle" from the show Sherlock, though students will need to listen carefully as the dialog is very quick.

Safety Considerations

Students should wash their hands after handling the shoes

Science Activity/Experiment

1. Break students into groups of 2-3. Have them read over the worksheet (Appendix)
2. Each group picks one shoe. Make sure that both shoes of a pair are used - that will make the discussion period more fun.
3. Have each group make observations on their shoe, using the "Whose Shoes" worksheet. To help direct the students' observations, tell them the goal is to figure out information about the owner, or how the shoe was used.
4. When students have finished making observations, have them make some inferences (page 2 of the worksheet)
5. When students are done, have them find the other group with the same shoe. Have them compare observations of the shoes on page 1. Did they only write down facts? Are there any opinions? Then have them compare inferences. Did they agree with each other?

Closure Discussion

- Now the reveal. Show a picture each pair of shoes, and have the groups that worked on them give their inferences. Then, if available, show a picture of the owner. How did the students do?

- Do the students think that a person who works in a shoe store might have been able to make more inferences? In general, the more one knows about something, the more inferences one can make (Sherlock Holmes and his insight into a hat wearer, based on his "blog post on the varying tensile strength of different natural fibres" is a good example of this)

- Do the students understand the concept of averages? If a shoe is size child 13, can you say positively: "the owner is 5 years old". Or do you need to say "based on averages, the owner is probably around 5 years old." Sherlock Holmes tends to state things definitively, based on the "balance of probability," but should scientists do this?

What can we tell about the owner? Child or adult? Girl or Boy? What sport do they play?

Extension of Lesson Plan

- Other possible activities that can be used to explore scientific inquiry (see Bibliography for links):

    Inferring the characteristics of people from their hands

    Diagnosing why a lamp does not work

    Testing horoscopes lab

- Borrow an animal skull or skeleton from a science museum or university. Can students figure out what kind of creature it is from?

- English: As a cross-curricular extension, students could read a Sherlock Holmes story, such as the *Red-Headed League* or the *Musgrave Extension*.

References

1. Hansen, Thor, and Slesnick, Irwin. 2006. Inferring the Characteristics of People from their Hands. in Adventures in Paleontology. NSTA Press. pp 17-19.

   2. Hansen, Thor, and Slesnick, Irwin. 2006. Scientific Inquiry. in Adventures in Paleontology. NSTA Press. pp 13-14.

3. Oakes-Bockenstedt, Catherine and Oates, Michael. 2015. Testing Your Horoscope Lab. in Earth Science Success. pp 3-6.

4. <https://museumoftherockies.org/uploads/Resources/Trunks__Kits/MORLessons_InferFromHands.pdf> Inferring the Characteristics of People from their Hands. Museum of the Rockies. [adaption of data vs. inference activity in Hansen and Slesnick]. Accessed November, 2015.

5. <https://museumoftherockies.org/uploads/Resources/Trunks__Kits/MORLessons_SheddingLight.pdf> Shedding Light on Scientific Inquiry. Museum of the Rockies [students diagnose what a lamp does not work, adapted from Hansen and Slesnick] Accessed November, 2015

6. <http://undsci.berkeley.edu/teaching/misconceptions.php> Misconceptions about science. University of California at Berkeley Understanding Science website [list of student misconceptions about science]. Accessed November, 2015.

7. <http://www.healthyfeetstore.com/kids-shoe-sizing-guide-with-sizing-chart.html> Kids' Shoe Sizing Guide from HealthyFeetStore.com. [chart of children's average shoe sizes vs. age] Accessed November, 2015.

8. <https://www.youtube.com/watch?v=5qrnf6Yc6GM>. Sherlock Deduction Battle part 1. Accessed November, 2015.

9. <https://www.youtube.com/watch?v=_bw5ybXMyRQ> Sherlock Deduction Battle part 2. Accessed November, 2015.

10. <https://www.youtube.com/watch?v=73Mr0fK5wMg> Sherlock Deduction Battle part 3. Accessed November, 2015

Name: _____

Whose Shoes? Observations

Observation = a description (made using our senses) or measurement; a fact

Type of Shoe:
Size:
Colour/Decoration:
Condition of soles (i.e. clean, dirty, worn etc…):
Condition of top of shoe and inside:
Any other observations:

Name: _____

Whose Shoes? Inferences

Inference = an explanation for an observation(s) that is based on our knowledge or experience; an interpretation of fact(s)

Try and answer the following questions about your shoes. Be sure to give observations to support your inferences: Example: Based on the chart of age versus average shoe size, I think the shoes belong to a child around age 5 (inference) because they are a kids' size 11 (observation). The shoes were more likely worn by a girl than a boy (inference), because they have pink stripes (observation), and shoe companies are more likely to put pink on a girl's shoe than a boy's shoe (inference based on experience).

1. Do you think the shoes belong to a child or an adult? Why?

2. Do you think the shoes belong to a girl or boy? Why?

3. What activities do you think the shoes were used for? Why?

4. Do you have any other inferences on how the shoes were used, or about the shoes' owner(s)?   Remember to support your inferences with observations!