Solving the Puzzle
Student Material

Procedure

1. Each team should remove 20 pieces of the puzzle from the envelope. After examining the pieces, develop a hypothesis about the complete scene or picture shown represented by the puzzle. Identify the key evidence used to support the hypothesis.

2. Remove an additional 20 pieces of the puzzle from the envelope and either retain or revise your 1st hypothesis or develop a 2nd hypothesis. Again key evidence should be identified.

3. Now remove an additional 5 puzzle pieces (only 5!!) from the envelope and proceed as in step 2. This step may be repeated.

4. When directed to do so by the teacher, one member of your team should visit another team to observe the team’s puzzle pieces, hypotheses, and evidence. One member of your team should remain with the home team’s materials and interact with the visiting team members. Unused puzzle pieces should remain in the envelope.

5. Each team should convene to consider the collective evidence seen and develop a final hypothesis. State your hypothesis and the evidence you’ve accumulated to support it.
6. Teams should share their hypotheses. Is there a consensus regarding the hypothesis that best fits the evidence?

7. What evidence was most useful in developing and evaluating your hypotheses?

9. Was any information misleading and result in the development of a hypothesis that had to be rejected as new evidence was found?

10. Did any personal biases within your group influence the development and evaluation of one or more of your hypotheses?

11. How did your final hypothesis compare with your 1st hypothesis?

12. How did collaboration with other teams affect your final hypothesis?

13. Did similar evidence used by more than one team result in different hypotheses?

14. Did different evidence used by more than one team result in identical or very similar hypotheses?

15. What degree of certainty did you have about your final hypothesis? Why?
16. Did the absence of the “edges” of the puzzle influence the level of difficulty in developing your hypotheses?

17. If you only had “edges” to use would you have any advantages or limitations?

18. Are there edges that limit or “pin in” scientists as they explore and investigate various questions and problems?

19. How are the “edges” like a theory early in its development?

20. What scientific or medical advances have occurred during your lifetime through the steady accumulation of evidence?

21. How did this activity model the process of science used as individuals seek answers to questions and problems?
Solving the Puzzle
Teacher Material


**Overview**
Darwin formulated his theory of evolution by observing nature and analyzing evidence—or using the scientific process. In this activity, student teams use evidence (jigsaw puzzle pieces) revealed over time to gain knowledge of the nature of science and its limitations.

**Objective**
Use evidence from a jigsaw puzzle to make inferences.
Use a jigsaw puzzle as a model of a scientific investigation.

**Texas Essential Knowledge and Skills**
C3E evaluate models according to their adequacy in representing biological objects or events
C2C organize, analyze, evaluate, make inferences, & predict trends from data

**Materials**
- One 300-500 piece jigsaw puzzle
- 1 large envelope or baggie for each team
- 1 piece of cardboard (large enough to support the teams’ puzzle pieces) for each team.

**Preparation**
Remove all or most edge pieces from the puzzle and place in a separate bag for use by one team. Divide the remaining pieces of the puzzle evenly (approximately) into the envelopes or Baggies. Hide the puzzle box cover.

**Engagement**
Use the following or similar questions to open the lesson:
- How do you attempt to determine what’s in a wrapped gift as you wait impatiently to open it?
- How is it possible to know that someone has been in the space where you keep your clothes, CDs, or some other possessions? Is it possible to conclude who “messed” with your possession?
Procedure
Exploration
Note: hypothesis, evidence, and answers to the questions will vary with the teams.

1. Each team should remove 20 pieces of the puzzle from the envelope. After examining the pieces, develop a hypothesis about the complete scene or picture shown represented by the puzzle. Identify the key evidence used to support the hypothesis.

2. Remove an additional 20 pieces of the puzzle from the envelope and either retain or revise your 1st hypothesis or develop a 2nd hypothesis. Again key evidence should be identified.

3. Now remove an additional 5 puzzle pieces (only 5!!) from the envelope and proceed as in step 2. This step may be repeated.

4. When directed to do so by the teacher, one member of your team should visit another team to observe the team’s puzzle pieces, hypotheses, and evidence. One member of your team should remain with the home team’s materials and interact with the visiting team members. Unused puzzle pieces should remain in the envelope.

5. Each team should convene to consider the collective evidence seen and develop a final hypothesis. State your hypothesis and the evidence you’ve accumulated to support it.

Concept Formation
Note: Be flexible at this stage of the activity. Rather than each group answering each question individually, the entire class could be engaged in a discussion.

6. Teams should share their hypotheses. (There may be some difficulty in restraining students from sharing before this step) Is there a consensus regarding the hypothesis that best fits the evidence?

7. What evidence was most useful in developing and evaluating your hypotheses?

8. Was any information misleading and result in the development of a hypothesis that had to be rejected as new evidence was found?

9. Did any personal biases within your group influence the development and evaluation of one or more of your hypotheses?

10. How did your final hypothesis compare with your 1st hypothesis?
11. How did collaboration with other teams affect your final hypothesis?

12. Did similar evidence used by more than one team result in different hypotheses?

13. Did different evidence used by more than one team result in identical or very similar hypotheses?

14. What degree of certainty did you have about your final hypothesis? Why?

15. Did the absence of the “edges” of the puzzle influence the level of difficulty in developing your hypotheses?

16. If you only had “edges” to use would you have any advantages or limitations?
   *Edges sometimes provide critical evidence whereas at other times there is a lack of context and “fit” with the overall puzzle.*

17. Are there edges that limit or “pin in” scientists as they explore and investigate various questions and problems?
   *Boundaries can confine research. The history of science is full of examples where “edges” confined the research and work of individuals such as Galileo, Copernicus, and Darwin. Researchers interested in stem cell technology and therapy are confined by certain edges.*

18. How are the “edges” like a theory early in its development?
   *Theories in their early stage of development could be compared to that of a fish net with webbing, or a network, with large openings that will only catch and hold large fish. Smaller ones can swim through the large opening of the network. As a theory becomes more developed and refined, it can be compared to a net that has a tighter network, which traps both large and small fish. Edges in a puzzle tend to give evidence that is broad and on the periphery.*

Application
19. What scientific or medical advances have occurred during your lifetime through the steady accumulation of evidence?

20. How did this activity model the process of science used as individuals seek answers to questions and problems?

Extension
Later in the study of evolution, discuss how Darwin and others have studied evidence from various sources that led them to conclude that life has changed, or evolved, over time and that organisms living today are descendents of those that have lived in the past. For example, as Charles Darwin completed his voyage on the *Beagle*, the plants and animals he saw in various locations that did not exist in England puzzled him. He also noted the variation in domestic animals. He was puzzled by this variation. After studying much evidence, he wrote the following:

When I visited during the voyage of the H.M.S. *Beagle*, the Galapagos Archipelago, I fancied myself brought near to the very act of creation. I often asked how these many peculiar animals and plants had been produced: the simplest answer seemed to be that the inhabitants of the several islands has descended from each other, undergoing modification in the course of their descent; and that all the inhabitants of the archipelago were descended from those of the nearest land, namely America.” (From *Variation of Animals* published in 1868) (Quoted in Larson, Edward J. 2001. *Evolution’s Workshop*. New York: Basic Books, p. 85)

Darwin’s challenge, or puzzle, was to explain the variation he saw in life. He studied evidence from many sources, read widely, and thought through various hypotheses before he arrived at his conclusion published in 1868. When he left England on the voyage of the *Beagle*, the boundaries or “edge” of his puzzle was extended as he left the confines of England. However, the boundaries or “edge” of the scientific process were such that he was required to support his hypotheses with evidence. Other scientists who have attempted to explain the diversity of life on Earth have had to deal with self-made and imposed boundaries, or “edges”, which restrained their work and sometimes led them to hypotheses that could not be supported with evidence.

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