



The Great Fossil Cake – Teacher Instructions

Each person will be given a slice of cake representing a section of the earth's crust. Each layer of cake *or* frosting represents a rock layer. Items within the layers are “fossils”.

I. Draw a sketch of your slice of fossil cake. Label each layer, with the bottom-most layer as “Layer 1”.

II. Record the types of “fossils” found in each layer.

Types of Fossils Found – suggested pattern

Layer 8: (top) Raisins, Chocolate-covered raisins, Yoghurt-covered raisins

Layer 7: Raisins, Chocolate-covered raisins

Layer 6: Raisins

Layer 5: Empty

Layer 4: Raisins, Peanuts, Chocolate-covered peanuts, Peanut M&Ms, Plain M&Ms

Layer 3: Raisins, Peanuts, Chocolate-covered peanuts, Peanut M&Ms

Layer 2: Raisins, Peanuts, Chocolate-covered peanuts

Layer 1: (bottom) Raisins, Peanuts

III. Construct an evolutionary tree of “fossils” from the cake.

1.) Select a group of organisms that you want to analyze.

Include the following group of fossil organisms in your tree:

- Peanuts
- Chocolate covered peanuts
- Peanut M&M's
- Plain M&M's

2.) For each member of the group, determine some observable traits (characters). Ideally, the characters should have only two possible states. List the characters and their possible states below.

Example: character – *candy shell* states – *present or absent*

character – *chocolate* states – *present or absent*

character – *surface texture* states – *wrinkled or smooth*

character – *whole plant part(fruit or nut)* states – *present or absent*

3.) For each character, determine which state is evolutionarily older (ancestral) and which is evolutionarily newer (derived). This is usually done by comparison with a more distantly related organism termed the outgroup. Use **raisins** as your outgroup.

Example: character – *candy shell* states – *present=derived or absent=ancestral*

character – *chocolate* states – *present=derived or absent=ancestral*

character – *surface texture* states – *wrinkled=ancestral or smooth=derived*

character – *whole plant part(fruit or nut)* states – *present=ancestral or absent=derived*

4.) Construct a table showing the states of the characters exhibited by each fossil organism in your analysis.

| Character | Outgroup Raisin | Peanut | Chocolate-covered peanut | Peanut M&M | Plain M&M |
|--------------------------------|-----------------|---------|--------------------------|------------|-----------|
| Surface texture | wrinkled | smooth | smooth | smooth | smooth |
| Chocolate | absent | absent | present | present | present |
| Candy shell | absent | absent | absent | present | present |
| Whole plant part(fruit or nut) | present | present | present | present | absent |

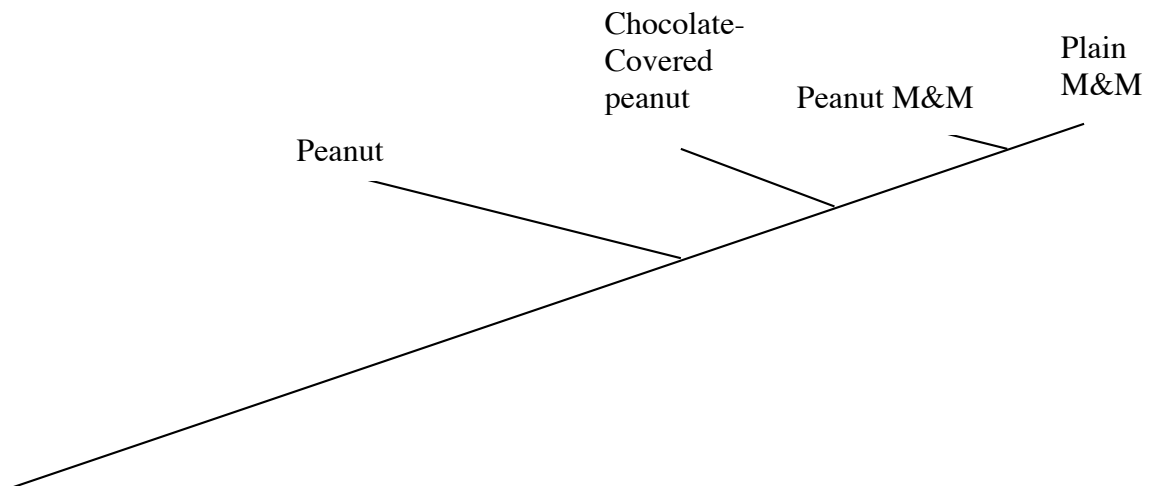
5.) Construct a matrix showing the number of identical characters exhibited by each pair of organisms in your analysis.

Matrix

| | Outgroup Raisin | Peanut | Chocolate-covered peanut | Peanut M&M |
|--------------------------|-----------------|--------|--------------------------|------------|
| Peanut | 3 | 4 | 3 | 2 |
| Chocolate-covered peanut | 2 | 3 | 4 | 3 |
| Peanut M&M | 1 | 2 | 3 | 4 |
| Plain M&M | 0 | 1 | 2 | 3 |

6.) Draw your tree diagram. Use the matrix to identify the organism closest to the outgroup (will share the most characters with the outgroup). This organism will be placed closest to the outgroup on the evolutionary tree.

Evolutionary Tree for Cake Fossils:



7.) Evaluate your tree. Does the fossil record revealed in the cake support your tree diagram? Why or why not?

The fossil record supports the tree because the fossils appear in the record in a chronological order that corresponds well with the proposed tree. Plain M&Ms are the last group to appear in the fossil record, and they are also the most derived group, for example.

IV. Thought Questions

1.) Which fossil(s) in the cake are the oldest?

Raisins, Peanuts

2.) Which fossil(s) in the cake are the youngest?

Raisins, Chocolate-covered raisins, Yoghurt-covered raisins

3.) What are some hypotheses you can propose to explain why the empty layer has no fossils in it?

Answers will vary. Possibilities include:

H1: An extinction event occurred. So few organisms were alive when this layer formed, that none were fossilized in this slice.

H2: This layer did not form in such a way as to preserve fossils.

H3: Metamorphic events occurred that erased fossils in this layer.

4.) What are some hypotheses you can propose to explain why the raisin line of descent began to diversify after a long period of stasis?

Answers will vary. Possibilities include:

H1: An extinction event wiped out the peanut line of descent. Without the peanut competitors around, the raisins were able to diversify.

H2: Environmental change occurred which favored raisin diversification.

5.) Describe any characters that you had to revise or delete when constructing your tree. Explain why these characters had to be changed or deleted. What characters replaced them?

Answers will vary.

6.) a.) Describe the difference observed between chocolate covered peanuts preserved in a “cake” layer versus a “frosting” layer.

The chocolate part may be melted in the cake layer.

b.) Given that fossils are preserved differently in different types of rock layers, what problems could this cause for scientists studying the fossil record?

If fossils form differently in different layers, they may look different. It may be difficult to tell whether one is seeing two different types of fossils or the same type of fossil but formed under different circumstances.

7.) a.) Were there any layers in which you didn’t find the same fossils that another group found in that same layer?

b.) Given that fossils are not distributed evenly throughout rock layers, what problems could this cause for scientists studying the fossil record?

Scientists can only examine a small slice of the fossil record, most of which is buried beneath the ground. If a fossil type is distributed unevenly, it is possible that the slice of the fossil record examined by the scientist may not contain any fossils of that type, even though they are present in clumps elsewhere.