Evidence of Evolution

Use this scavenger hunt through the Earthquake and African Hall to help answer the following:

What can geology, fossils, DNA, and anatomy tell us about the relationship of species?

Marsupials

Find at least three anatomical traits that all marsupials share.

- **Unique teeth**: Marsupials have 16 molars. Placental mammals have 12 molars.
- **Pouches**: In most species, a very short gestation period is followed by a long developmental period in a pouch.
- **Newborns**: Newborns have well developed forelimbs help them crawl into the pouch.

Where do scientists think the earliest marsupials originated? On what evidence is this based?

- China or “far to the North” because the oldest marsupial fossil was found in China.

What type(s) of evidence show(s) that Australian marsupials have evolutionary origins in South America?

- DNA shows that Australian marsupials are related to those in the Americas. And fossil teeth found in Antarctica are much like those of a living South American marsupial.

How do we know that there were once marsupials living in Antarctica?

- Fossil teeth found in Antarctica are much like those of a living South American marsupial.

Consider this: Would it have been possible for marsupial populations to spread from South America to Australia 30 million years ago? What about 60 million years ago? (Hint: look at the maps of how the continents moved)

Think about marsupial fossils you would expect to find on different continents. Circle the continent on which you would expect to find the oldest fossil. Try to rank the rest by the oldest to most recent marsupial fossils you might find.

Antarctica - Oldest fossils
Australia - Most recent fossils
South America - 2nd Oldest fossils

Asia - Oldest fossils

Plants of Gondwana

Compare the characteristics of these plants.

<table>
<thead>
<tr>
<th></th>
<th>King Protea (Sugarbush)</th>
<th>Red Silky Oak</th>
<th>Fire Bush</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Present Day Continent</strong></td>
<td><strong>Protea cynaroides</strong></td>
<td><strong>Grevillea banksii</strong></td>
<td><strong>Oreocallis grandiflora</strong></td>
</tr>
<tr>
<td><strong>Anatomical Characteristics</strong></td>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
<td>Answers will vary.</td>
</tr>
</tbody>
</table>

What does DNA and fossil evidence tell us about the relationship of these three species?

Fossil pollen and DNA from living plants provide clues to evolutionary relationships. DNA evidence links the genus Protea to Gondwana. Flowers of South American plants in the family Proteaceae are much like those of Australian species. DNA shows they shared a common ancestor before South America, Antarctica and Australia separated.

Put a star next to the species that has a more distant common ancestor compared to the other two species.
Flightless Birds

What are the physical characteristics of flightless birds? Start with the Ratites in the Earthquake exhibit before moving on to African Hall to find the African Penguins.

<table>
<thead>
<tr>
<th>Ratites</th>
<th>African Penguins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth breastbone: Ratites lack the keel that anchors the wing muscles.</td>
<td>Smaller breastbone where wing muscles attach.</td>
</tr>
<tr>
<td>No wishbone: Ratites lack the fused collarbones (wishbone) that strengthen the ribcage during flight.</td>
<td>Wings that have adapted to be more like flippers.</td>
</tr>
<tr>
<td>Heavy bones: Flying birds have lightweight bones.</td>
<td>Feathers that insulate rather than aid flight.</td>
</tr>
<tr>
<td>Larger size: Ratites tend to have large, heavy-boned bodies.</td>
<td></td>
</tr>
<tr>
<td>Less-developed wing bones: Ratites have fewer and smaller wing bones.</td>
<td></td>
</tr>
<tr>
<td>Soft, plume-like feathers: Ratites do not have the stiff feathers with supporting vanes and hooks that aid flight</td>
<td></td>
</tr>
</tbody>
</table>

Based solely on physical evidence, what would you conclude about how many times flightlessness evolved in the Ratites?

Answers will vary. Once or twice because they all share the same flightlessness characteristics.

How does DNA evidence change your conclusions about the number of times flightlessness evolved? Explain.

Answers will vary. The exhibit explains that DNA data show that the common ancestor of the Ratites was a bird that could fly. This evidence suggests that each bird evolved a flightless lifestyle independently as the continents broke apart.

What kind of additional evidence might you want to find to confirm when flightlessness evolved in the Ratites?

Answers will vary.

If you took DNA from an ostrich, an emu, and an African penguin, which two DNA sequences would you expect to be most similar? Explain your answer.

The DNA sequences of an ostrich and an emu would be more similar to each other than to the penguin. Explanations will vary, but might include because they shared a more recent common ancestor.

Variation

Visit the display about variation outside the entrance to African Hall.

Evaluate the following statement:

“Variation is the path to speciation.”

Using the ladybird beetles as an example, what does this statement mean to you?

Answers will vary.

Look carefully at the beetles. Try to find two that are identical, then try to find two that are as different as possible. Why do you think these differences exist?

Answers will vary.