SN EDUCATOR GUIDE

February 4, 2017
Dino Doomsday

Teacher's Guide for Geology of Dino Doomsday Activity

Class time: 30-60 minutes

Purpose: Students can examine real meteorites, meteorite impact samples, fossils and rocks relevant to "Devastation detectives."

Notes to the teacher: You can adapt this activity based on what materials you are able to buy, borrow or find. Museums are sometimes willing to loan specimens for educational purposes. It may be worth checking with a local museum. Ammonites, belemnites and small dinosaur fossils are inexpensive to buy.

Materials:

- Rocks, minerals, fossils, meteorites and/or meteorite impact materials (depending on what you have or can obtain—see suggestions below)
- Gloves (if the samples are sharp or messy)
- 10–30x stereo dissection microscopes with top illumination*
  *If you do not have these microscopes but do have regular higher-power microscopes, then students can use those with the lowest power setting (40x), the sample resting on a glass slide covering the hole in the stage, the below-stage light off, a flashlight or task lamp for top illumination and strict instructions not to bump the objectives into the samples.
- Hand magnifiers
- Directions for student groups (using the directions below, decide what questions to ask your students based on the samples you obtain)
- Books or websites to help students identify the samples (see suggested resources below)

Sample Identification Resources:

- For very concise identification guides for rocks, minerals and fossils, as well as other related activities, see Pages 12–14 and 20–22 of the MIT Lincoln Laboratory Mini Science Kit guide
- For a more extensive identification guide to rocks and minerals, see: Shaffer & Zim, *Rocks, Gems and Minerals* (St. Martin's Press Golden Guide, 2001); Chris Pellant, *Smithsonian Handbooks: Rocks and Minerals* (DK, 2002); or Prinz, Harlow, & Peters, *Simon & Schuster's Guide to Rocks and Minerals* (1978)
- For a more extensive identification guide to fossils, see: Rhodes, Zim, & Shaffer, *Fossils* (St. Martin's Press Golden Guide, 2001) or Cyril Walker & David Ward, *Fossils* (DK, 2002)
- For a good guide to meteorites, see: Norton and Chitwood, *Field Guide to Meteors and Meteorites* (Springer, 2008)

Sample Resources:

- For a very good quantity, quality and variety of fossils at a relatively low price (50 fossils for $67, including K-T boundary layer material or a 1 lb bag of K-T boundary material for $20), see Two Guys Fossils 2
- For a very large selection of minerals and rocks (plus some fossils and other items) at competitive prices, go to Geosource
- For a very large selection of meteorites at competitive prices, go to The Meteorite Market
- For small but inexpensive tektites (terrestrial black glass formed by a meteorite impact), go to American Science & Surplus

Microscope Suggestions:

- For good-quality stereo dissection microscopes at a good price, go to Home Science Tools
- For inexpensive 2x/6x hand magnifiers, go to American Science & Surplus
- To find out what rocks, minerals and fossils you can collect in your area and where to find them, consult books in the Roadside Geology of... series, which are available for most states

Directions:

1. Set up several lab stations with microscopes and/or hand magnifiers.
2. Distribute the rocks, minerals, fossils, meteorites and/or meteorite impact materials. If you only have one or two of each type, you can ask the students to swap samples as they finish with each one.
3. Have the students identify and study each sample and write down their findings. You might provide them with access to identification sheets, books or websites (as previously mentioned).

   a. **For meteorites and impact materials**, ask students to notice the differences in density among iron meteorites, stony meteorites and tektites, and to study those plus K-T boundary material under the microscope.

   b. **For rocks and minerals**, ask students to identify rocks related to the article (limestone, basalt, granite, peridotite) and minerals related to the article (calcite, augite, feldspar, mica, quartz, olivine, hematite).

   c. **For fossils**, ask students to identify what creature it comes from, and to estimate the oldest and youngest possible ages based on the range of times during which such organisms lived. Which organisms went extinct during the K-T event?

SN EDUCATOR GUIDE

February 4, 2017

Dino Doomsday

Teacher's Guide for Build a Bird Activity

Class time: Approximately 60 minutes

Purpose: Students look at traits that connect species over time and theorize about the way adaptations affect survival.

Notes to the teacher: "The lucky ones" presents three ancient bird species, including *Vegavis iaai*, which may be an ancient relative of modern ducks. There is also a feathered dinosaur for comparison. Each species depicted had specific features that had advantages or disadvantages for survival.

There are many sources that discuss the relationship between dinosaurs and birds. For more background information beyond the infographic, see the related information on this University of California Museum of Paleontology page.

Materials:

- Blackline Master 4
- Online access or printed copies of the infographic "The lucky ones"
- Materials for illustrating hypothetical birds

Procedure:

1. Show students this short Melbourne Museum video on the link between dinosaurs and birds. Discuss why scientists think dinosaurs and modern birds are closely related. Discuss similarities and differences between dinosaurs and modern birds.
2. Ask students to read "The lucky ones." Discuss the science of phylogeny and how it helps us classify and relate organisms based on shared characteristics.
3. Tell students that they will be looking at the examples of ancient birds and one dinosaur and hypothesizing about which traits could have been most beneficial to survival.
4. Give students Blackline Master 4. Tell them to work through the following parts:
   a. **Catalog** the features discussed in the infographic and describe ways the feature could have enhanced and would not have enhanced survival (see chart for possible student responses).
   b. **Design** a bird that you think would have the best chance of survival in a particular ecosystem. Your design should incorporate a combination of the cataloged features.
   c. **Answer** the discussion questions about birds and dinosaurs.

Part A: Use the chart below to catalog the features of the ancient birds described in the infographic.

Feature	Example ancient bird that possessed the feature	Hypothesize: Why might this enhance survival?	Hypothesize: Why might this harm survival?
Small size	*Protopteryx fengningensis*	Allow the bird to hide and nest in small spaces, decrease its need for nutrition	Can't catch bigger prey, heat loss in the cold
Flight capable wings	*Protopteryx fengningensis* *Vegavis iaai*	Allow the bird to migrate, find food, escape danger	Flight can limit weight
Teeth	*Protopteryx fengningensis*	Greater range of diet, defense	Might sap nutrients that could be used for forming other body parts
Short tail	*Vegavis iaai*	Harder for predators to catch, helps wading capability	Changes center of gravity when walking
Long tail	*Confuciusornis sanctus* *Protopteryx fengningensis*	Enhances	Would hurt wading capability
Wings with claws	*Confuciusornis sanctus*	Help with grip	Might affect flying capability
Syrinx	*Vegavis iaai*	Greater range of communication with members of species	

Part B: Design your bird

Describe your bird. Consider the following when writing your description:

1. The ecosystem that your bird will be adapted for.

2. The features your bird will have and how they will enhance its survival.

_____

_____

_____

_____

_____

_____

Draw your bird

Part C: Answer these questions:

1. **Biologists generally accept birds as a kind of dinosaur. What are examples of features of modern birds that are similar to features that we believe at least some dinosaurs possessed?** Possible student response: Bipedal stance, wishbones, feathers, hinged ankles and wings are features shared by birds and some dinosaurs.
2. ***Vegavis iaai*** **is the only example given in the infographic with a short tail and is also the example most closely related to a modern bird. Can you think of a possible way that a short tail might enhance survival?** Possible student response: A short tail would have been more beneficial to wading birds, since the feathers on the tail would not have gotten weighed down in water the way a long tail might have. In wetter ecosystems, this would have made movement easier.
3. **How do the diagram and the features that emerged with each species mentioned in the infographic help you hypothesize about what might have been happening to the landscape of the planet?** Possible student response: Adaptations that improve survival under given conditions would be passed on to the next generation. Features that didn't enhance survival might slowly be weeded out. The traits that help an organism survive would depend on the climate and conditions in which it lived and reproduced.

SN IN HIGH SCHOOLS February 4, 2017

Dino Doomsday

Student Worksheet for Build a Bird

Directions: "The lucky ones" presents three ancient bird species, including *Vegavis iaai*, which may be an ancient relative of modern ducks. There is also a feathered dinosaur for comparison. Each species depicted had specific features that had advantages or disadvantages for survival.

Part A: Catalog the features and describe ways the features might enhance or not enhance survival.

Part B: Design a bird that would have the best chance of survival in a selected ecosystem. Your design will incorporate a combination of the cataloged features.

Part C: Answer the discussion questions about birds and dinosaurs.

Part A: Use the information from "The lucky ones" to fill in the following chart

Feature	Example ancient bird that possessed the feature	Hypothesize: Why might this enhance survival?	Hypothesize: Why might this harm survival?

Part B: Design your bird

Describe your bird. Consider the following when writing your description:

1. The ecosystem that your bird will be best adapted for.

2. The features your bird will have and how they will enhance its survival.

_____
_____
_____
_____
_____
_____

Draw your bird

Part C: Answer these questions before discussing your answers with your class.

3. Biologists generally accept birds as a kind of dinosaur. What are examples of features of modern birds that are similar to features that we believe at least some dinosaurs possessed?

4. The *Vegavis iaai* is the only example given in the infographic with a short tail and is also the example most closely related to a modern bird. Can you think of a possible way that a short tail might enhance survival?

5. How do the diagram and the features that emerged with each species mentioned in the infographic help you hypothesize about what might have been happening to the landscape of the planet?