INDIANA GEOLOGICAL & WATER SURVEY
INDIANA UNIVERSITY

INDIANA UNIVERSITY
PALEONTOLOGY COLLECTION

Identifying 3-D Fossil Prints

Lesson Plans and Activities

By Kimberly Cook and Polly R. Sturgeon

Targeted Age:
Middle and High School

Activity Structure:
Individual or Partner Activity

Indiana Standards and Objectives:
8.LS.7, 8.LS.8, Env.5.2, Env.8.3

MATERIALS NEEDED

- Fossil identification chart
- 3-D fossil prints: gastropod, cephalopod, bivalve, brachiopod, crinoid, blastoid, horn coral, colonial coral, bryozoan, foram, trilobite, plant, and/or vertebrate material (*3-D files available for download at http://igws.indiana/edu/lessonplans*)

Introduction

In this lesson, students will identify three-dimensional (3-D) prints of common Indiana fossils to the kingdom, phylum, or class level. Students will observe and record the morphology of specimens and classify organisms based on their observations.

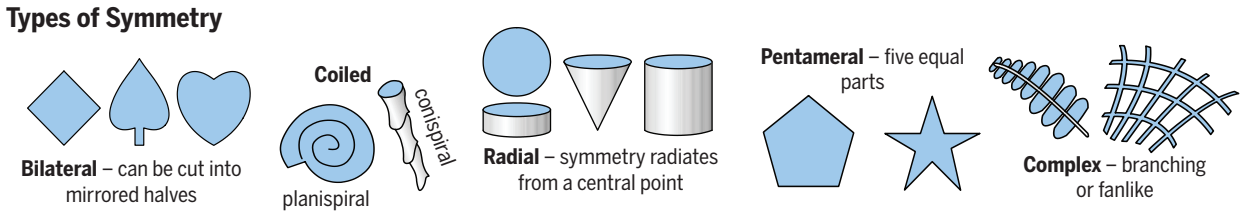
Background Information

A fossil is physical evidence of a preexisting organism through preserved remains or an indirect trace. The most common and obvious fossils are the preserved skeletal remains of animals, such as shells, teeth, bones, and calcareous skeletons. Fossils of any kind are useful in interpreting the rock record. They can help us determine the geologic age and sedimentary environment in which they were deposited, and their study can help scientists better understand patterns in the evolution of life throughout Earth's history.

Fossil organisms have a wide range of sizes and shapes. Brachiopods and bivalves, for example, were two-shelled animals with diverse shapes and textures. The skeletal structure of crinoids and other echinoderms are formed by calcareous plates, while trilobites were composed of three lobes of hard chitin material. Solitary and colonial corals were formed by cups and tubes, and molluscs have a single segmented shell that is coiled or straight. The major taxa, or groups, of fossil organisms can be easily differentiated from one another by the symmetry of their skeletal structure.

The five basic types of fossil symmetry are:

- Bilateral – arrangement of body parts around a central plane, resulting in two mirror-image halves
- Radial – arrangement of body parts around a central point
- Coiled – arrangement of body parts around a spiral or joined sequence of rings
- Pentameral – arrangement of body parts in five equal parts
- Complex – compound arrangement of body parts, such as branching or fanlike



The Indiana Geological and Water Survey and Indiana University Paleontology Collection have partnered to assist teachers in their teaching and understanding of fossils and ancient life. The 3-D prints used in this activity were reproduced from vouchered specimens found in the teaching or research collections at Indiana University. Each fossil was selected as an ideal specimen of the common flora and fauna that existed in Indiana during the Paleozoic Era and Pleistocene Epoch. The fossils were 3-D scanned, converted into digital models, and replicated as 3-D printed objects. The use of 3-D prints in a classroom allows for authentic real-world learning with tangible objects that would not otherwise be readily available to teachers and students. Digitized fossil collections can be made accessible to the broader scientific community to enhance paleontological research.

Vocabulary

3-D scanning – the process by which a real-world object or environment is captured and converted into digital 3-D data. These data can be viewed using various 3-D software programs.
Fossil – physical evidence of a preexisting organism through preserved remains or an indirect trace.
Morphology – the shape and structure of an organism.
Paleontologist – a scientist who studies forms of preexisting life through fossils.
Symmetry – the arrangement of body parts around a point or plane.
Skeletal structure – a solid framework that supports an animal's soft parts (flesh, organs, etc.).

Teacher Reference Page

Fossil	Sketch	Description	Type of Symmetry	Identification
1		No skeletal structure, looks like a plant	None	Fern *Neuropteris* sp. IGWS 0363
2		Has skeletal structure, calcareous plates of armor, nut-shaped, five elaborate grooves	Pentameral	Blastoid *Pentremites hambachi* IUPC 6544
3		Has skeletal structure, bivalved, valves are identical but asymmetrical	Bilateral, both valves same but not symmetrical	Bivalve *Ambonychia* sp. IGWS 0080
4		Has skeletal structure, cone with radiating partitions (septa) inside, looks like a horn	Radial	Horn coral *Aulacophyullum sulcatum* IUPC 2580
5		Has skeletal structure, corkscrewlike	Complex	Fenestrate bryozoan *Archimedes* sp. IUPC 10810
6		Has skeletal structure, twiglike, covered with tiny bumps	Complex	Branching bryozoan *Monticuliporella molesta* IUPC 2717B

Fossil	Sketch	Description	Type of Symmetry	Identification
7		Has skeletal structure, looks like bone and teeth	None	Mastodon (mandible) *Mammut americanum* IGWS 1284
8		Has skeletal structure, calcareous plates stacked, discs with a hole	Radial, Some species can be pentameral	Crinoid Crinoidea IUPC 10590
9		Has skeletal structure, segmented body with three lobes	None	Trilobite *Calymene* sp. IGWS 0203
10		Has skeletal structure, bivalved, one valve is concave, other valve is convex	Bilateral, valves different but symmetrical	Brachiopod *Spirifer murchisoni* Hall IUPC 2400
11		Has skeletal structure, univalved, coils up like an ice cream cone	Coiled, conispiral	Gastropod *Holopea* sp. IGWS 0003
12		Has skeletal structure, univalved, tapered cone with horizontal partitions on exterior	Radial Some species can be coiled-planispiral	Cephalopod Cephalopoda IGWS 0242

Procedure

1. Distribute the 3-D fossil prints and fossil identification chart to each student or partner group. Review the five main types of symmetry (such as bilateral or radial) and emphasize the various morphologies found in fossil organisms (such as segmented body, plates, valves).

2. Instruct students to manipulate each 3-D fossil print. Students should observe the shape and symmetry of each specimen's skeletal structure and sketch the fossil in order to accurately report morphology.

3. Instruct students to carefully record their observations on the student data sheets, making sure to include scale.

4. Once students have observed the fossils, follow the fossil identification chart and identify each 3-D specimen to the kingdom, phylum, or class level. Confirm the correct identity of each fossil with the group.

5. Ask the class about the benefits and drawbacks of using 3-D fossil prints versus real fossil specimens. Students should justify their answers with observations from the activity.

6. Allow students to review the activity through the reflection questions.

What are the benefits and drawbacks of using 3-D fossil prints? Ask students to consider accessibility, research, and authenticity.

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Name:

_____

Class Period:

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Student Data Sheet

1. Observe each fossil carefully and sketch its shape in the spaces below. Describe the morphology and identify the type of symmetry for each specimen.

Fossil	Sketch	Description	Type of Symmetry	Identification
1				
2				
3				
4				
5				
6				

Fossil	Sketch	Description	Type of Symmetry	Identification
7				
8				
9				
10				
11				
12				

Reflection Questions

1. Name one similarity and one difference between the morphology of a brachiopod and a bivalve.

Figure 1: Here, a staff member is 3-D scanning a gastropod from the IGWS Teaching Collection using a Creaform Go!Scan 20.

2. List two modern organisms that have pentameral symmetry.

   Do you think they are related to crinoids and blastoids? Why or why not?

Figure 2: Identifying fossils using 3-D prints.

3. Evaluate the morphological characteristics recorded in 3-D fossil prints versus real fossil specimens. What kinds of information do each provide?

Information that 3-D prints contain	Information that 3-D prints do not contain

4. How can scientists use 3-D scanning to enhance paleontological research or education?
   Hint: think about accessibility and sharing ideas with scientists around the globe.