FOSSIL CASTING

Teacher Resource Guide

Program Overview

TOPIC: Casting

THEME: By using simple chemical reactions, we can create a cast of an original fossil for display.

PROGRAM DESCRIPTION: In this popular program, each student creates a cast of a Museum fossil to take home – complete with details about the fossil's age and where it was found. Participants also learn how moulds and casts are made at the Museum, and they get "hands-on" with some real fossils. Students in grades 5 – 12 examine the chemical reaction involved in the casting process.

AUDIENCE: Grades 2 - 12

Curriculum Connections

Grade 3 **Science:** Physical Changes in Materials

Grade 4 **Science:** Organism Classification and Function

Grade 5 **Science:** Physical Properties of Matter

Grade 6 **Science:** Physical Change

Grade 7 **Science:** Heat and Temperature, Planet Earth

Grade 8 **Science:** Mix and Flow of Matter

Grade 9 **Science:** Matter and Chemical of Changes

Grade 10 **Science 10:** Energy and Matter in Chemical Change

Grade 11 **Science 20:** Chemical Changes, The Changing Earth
Biology 20: Ecosystems and Population Change

Program Objectives

Students will be able to:

1. Name the animal they made a cast of, and identify how old the fossil is by using the geologic timescale.
2. Learn the differences between moulds, casts, and fossils.
3. Discover why casts are made.

Suggested Pre-Visit Activity

1. NOT JUST DINOSAURS

Dinosaurs are usually the first creatures that come to mind when people think of fossils. Can you think of any other things that can fossilize? Hint: Think of different habitats, things that move and things that don't move.

2. HOW OLD ARE THEY REALLY?

How old are fossils? Are they hundreds, millions, or billions of years old? Can they form in a day, a week, or a year? Use reference books and museum websites (see list in the post-visit activities section of this program) to find out the age of the following fossils (when these animals lived) and fill in the chart below.

FOSSIL TYPE	AGE
Mammoth	
Trilobite	
Ammonite	
Tyrannosaurus rex	
Sabre-toothed cat	
Bacculite	
Shark	
Dragonfly	

3. MOLDS, CASTS, MODELS, AND FAKES

What is the difference between a mould and a cast? What is a model? Are we making fakes? Look at the activity below and match the definitions with the terms. After you have matched them, discuss which of the terms apply to what you will be making at the Royal Tyrrell Museum.

1. Mould	a. An exact replica of an object or specimen.
2. Cast	b. A counterfeit or artificial item that is passed off as genuine.
3. Model	c. A small representation of a larger object.
4. Fake	d. A hollow form for giving a certain shape to a fluid material.

Answers: 1d, 2a, 3c, 4b

Teacher's Note: In your Museum fossil casting program, students will be using silicone **molds** to make plaster **casts** which they will take home.

Post-Program Activity

FOSSILIZATION

How are fossils formed? Look at the back of your casting card and do the activity there. Create your own set of pictures using your own creature whose cast you made, showing the different stages of fossilization in each picture.

THINGS TO RESEARCH

Find out about the animal whose cast you made. When did it live? What did it look like? Where was it found? (Use the internet or book references)

ORDER! ORDER!

The casts you made were not just of dinosaurs. They were from creatures that lived both before, during, and after the Age of Dinosaurs. Using your geologic timescale inside your card, make your own "3-D" geologic timescale by placing your casts on the floor or on a table. Make sure you put them in order: oldest creatures at the bottom, youngest at the top!

WHY CAST?

Discuss these questions with others in your class. Can you think of any other reasons that casts are made?

- Why is it important to make casts?
- Why is it easier to display casts?
- What are the limitations for using real fossils in displays?
- Can a palaeontologist study a cast?
- Which is easier to transport: casts or real fossils?

WHERE DID YOU GET THAT FOSSIL?

Coprolites (fossilized poop) are a special type of trace fossil. How did they get fossilized? Find out about these special types of fossils and how they can be formed:

- trackways
- skin impressions
- natural moulds
- natural casts

Hint: See attached document "Types of Preservation"

Types of Preservation with Examples

Fossilization is the alteration of an organism's remains, impressions, or activities by physical, biological, or chemical changes retaining the original material in some form. Fossils are the remnants of something that was once alive. Generally, remains are considered to be fossils if they've survived 10,000 years, but more recent remains may also qualify because of how they've been preserved.

PETRIFICATION:

Both permineralization and replacement are commonly referred to as petrification which means "turned to stone."

PERMINERALIZATION:

As the hard parts lie buried in the sediment, ground water carrying dissolved minerals infiltrates the microscopic pores in bone, shells, or wood, depositing their mineral content. The original structure is preserved.

Example: dinosaur bone, petrified wood, ammonite

REPLACEMENT:

The original hard parts are dissolved by chemical action and other minerals are substituted. The size and shape of the fossil are not disturbed, but the structure is imperfectly preserved. Two common replacement minerals are silica and pyrite.

Example: brachiopod

RECRYSTALLIZATION:

In this process, the original crystal structure of the skeletal material is changed into another form with the same composition. For instance, aragonite may be recrystallized to calcite. Only the crystal structure has changed, both aragonite and calcite are forms of calcium carbonate ($CaC0_3$).

ORIGINAL HARD PARTS:

These are often preserved with little or no alteration.

Example: often teeth and shells, e.g., Albertosaurus tooth

AMBER:

Living things, such as insects, were trapped in the sticky gum of certain conifers and then engulfed in more resin. The resin hardened with time, leaving the insect undamaged and in a perfect state of preservation.

Example: amber pieces with "stuff" inside (insects, plants, small invertebrates).

CARBONIZATION:

As leaves or soft parts of animals slowly decomposed under water, the oxygen, hydrogen,and nitrogen were driven off. The carbon molecules, being very stable, remained behind as a thin carbon film.

Example: graptolites, trilobite (Burgess Shale in galleries), leaves, fish

TRACE FOSSILS/ICHNITES/ICHNOFOSSILS:

Only a trace or an impression of the organism provides evidence of the plant or animal responsible for it.

a) Coprolites: Preserved dung, from insects right on up to the largest mammals/dinosaurs. When sliced, the dung could give ideas of what the animals ate, what plants were growing, etc.

b) Gastroliths (trace fossil): "Stomach stones" are highly polished rounded stones believed to have been an aid in grinding the stomach contents of extinct reptiles. These stones may also have been used for buoyancy and stability in marine reptiles.

c) Moulds – internal/external: A mould is the impression of an organism in the surrounding material. A shell may be buried in sediment and the shell itself may be dissolved away. The impression of the outside of the shell is known as an external mould. Only outside details are preserved. If the inside of the shell had filled with sediment than an internal mould can be formed, showing detail of the inside of the shell.

Example: clam external mould/internal cast in burrowed ironstone
trilobite impression, ammonite impression

d) Casts: If the original plant or animal part dissolves away, the cavity may be in-filled with sediments. If the outer material is removed, what remains is a cast. No internal structures are preserved. Footprints are often preserved this way.

e) Tracks: Footprints made by animals as they walked/crawled over soft sediments. The sediments could harden, then get infilled with other sediments. Both can be preserved as casts or moulds.

Example: large hadrosaur track, insect track/trail

f) Burrows/Trails: Holes or tubes formed in soft sediments (also found in wood) by burrowing animals. They can be infilled with another sediment which may stay or dissolve separately.

Example: ironstone with clam cast/mould, rock with worm trails

g) Borings/root casts, etc. Holes found in wood, shells, maybe even bone, showing evidence of boring by animals in search for food. Infilled root holes could also preserve.

Example: modern day clamshell

PSEUDOFOSSILS:

Specimens that look like they are fossils but are not formed from something that was once alive. They may be formed through chemical processes, erosion, extrusion, etc.

Examples: rock that looks like turtle shell

OTHER FOSSILIZATION METHODS

Tar Pits:

Vast numbers of fossils have been found in the asphalt deposits of Rancho La Brea, California. Prehistoric animals that gathered to drink at certain water pools were trapped in underlying tar seeps. Their accumulated bones have been removed in an excellent state of preservation.

Original Soft Parts:

The fossilization of unaltered soft parts takes place only under exceptional favorable conditions. Examples can be found in the Burgess Shale exhibit. These specimens were buried quickly and fossilized under anaerobic conditions (without oxygen).

Peat Bogs:

Relatively recent fossils of animals preserving flesh, skin and hair have been found in peat bogs where the tannic acid in the water has prevented their decay.

Freezing:

In Siberia and Alaska, animals were frozen so rapidly and are so perfectly preserved that the food remains not chewed in their mouths. They've found mammoths and rhinos frozen this way. Still organic, these can rot once thawed.

Drying:

Fossil mummies of ground sloths and camels, virtually in an unaltered state, have been found in caves in southern United States. Even skin and hair retain their original color. Fossilized mummies of dinosaurs have also been found, but they mummified before fossilization occurred.

Online Resources

BIOLOGY

Digital Morphology:

http://www.digimorph.org

Tree of Life web project:

http://tolweb.org

Encyclopedia of Life:

http://www.eol.org

Keywords: Tree of Life, anatomy, DigiMorph University of Texas, evolution

GEOLOGY

Palaeomap project:

http://www.scotese.com

Keywords: North America Palaeogeography, Alberta palaeogeography, Palaeomap

PALAEONTOLOGY

University of California Museum of Palaeontology:

Burgess Shale Geoscience Foundation:

http://www.burgess-shale.bc.ca/

Ice Age Residents:

http://www.beringia.com/

Palaeos:

http://www.palaeos.com

Zoom Dinosaurs:

http://www.enchantedlearning.com/subjects/dinosaurs

Project Exploration:

http://www.projectexploration.org

Fossil news:

http://www.sciencedaily.com/news/fossils_ruins/

Keywords: UCMP, Nova Scotia fossils, Burgess Shale, Beringia, Ice Age animals, Becoming a palaeontologist, Palaeos, Dinosaur news, Science Daily, Project Exploration)

Links to Other Websites

Links to websites are provided solely for your convenience. The Royal Tyrrell Museum does not endorse, authorize, approve, certify, maintain, or control these external Internet addresses and does not guarantee the accuracy, completeness, efficacy or timeliness of the sites listed.