LEARNING GUIDE

MUMMIES OF THE WORLD THE EXHIBITION

How to Use This Guide

Naturhistorisches Museum Basel, Switzerland

This mummy is a mystery. Scientists know that it is a child from ancient Egypt, but there is still so much to learn.

The Study of Mummies

This standards-based guide is written for students as a supplement to a visit to the "Mummies of the World" exhibition.

Its interpretive passages have been crafted so that they may be read directly by students as an introduction to each unit, or by teachers in preparation for teaching each unit. The activities that accompany the interpretive text have been developed to give students hands-on, inquiry-based learning experiences.

The interpretive passages and activities provide connections to National Education Standards not only for history and science, but for language arts, behavioral studies and life skills for Grades 4-8.

A composite listing of National Education Standards addressed by this study guide appears below, and individual standards are listed with each activity for easy reference.

With minor modifications, these activities may be adapted for younger or older students. Teachers may also modify the activities to meet the individual needs of their classes.

To help teachers make the most of the experience provided by the "Mummies of the World" exhibition, this guide provides a variety of activities that may be used pre-visit, during a visit and post-visit.

The activities on Pages 9 - 16 provide opportunities to prepare students for the exhibition and pique their interest about the study of mummies. (Please note that the results of some experiments in the guide take two weeks to develop.)

The activity on Page 16 is to be started during the visit and finished as a post-visit activity so that students may review and reflect upon what they have learned.

National Education Standards

Following are National Education Standards (McRel) supported by the activities in this Learning Guide.

Life Skills Standards
- Understands the importance of verifying the results of experiments.
- Knows that investigators verify the results of experiments to prove they are valid and not caused by something unexpected, such as a mistake in the procedure.
- Formulates a new hypothesis for study after an old hypothesis has been eliminated.
- Knows that testing an hypothesis can prove it to be wrong.
- Knows that hypothesis can be revised.
- Makes and validates conjectures about outcomes of an experiment.
- Understands and applies basic principles of hypothesis testing and scientific inquiry.
- Understands that there may be more than one valid way to interpret a set of findings.
- Knows that people may interpret findings in different ways.
- Compares different sources of information for the same topic in terms of basic similarities and differences.

Science Standards
- Knows that scientists' explanations about what happens in the world come partly from what they observe (evidence), and partly from how they interpret (inference) their observations.
- Uses appropriate tools (including computer hardware and software) and techniques to gather, analyze, and interpret scientific data.
- Establishes relationships based on evidence and logical argument (e.g., provides causes for effects).
- Evaluates the results of scientific investigations, experiments, observations, theoretical and mathematical models and explanations proposed by other scientists (e.g., reviewing experimental procedures, examining evidence, identifying faulty reasoning, identifying statements that go beyond the evidence, suggesting alternative explanations).
- Knows that scientific investigations involve asking and answering a question and comparing the answer to what scientists already know about the world.
- Designs and conducts scientific investigations (e.g., formulates hypotheses, designs and executes investigations, interprets data, synthesizes evidence into explanations).

Language Arts Standards
- Uses reading skills and strategies to understand a variety of informational texts.
- Uses a variety of resource materials to gather information for research topics (e.g., magazines, newspapers, dictionaries, schedules, journals, surveys, globes, atlases, almanacs, websites, databases, podcasts).

Behavioral Studies Standards
- Understands how language, literature, the arts, architecture, other artifacts, traditions, beliefs, values, and behaviors contribute to the development and transmission of culture.
- Understands how different human communities expressed their beliefs.

History Standards
- Knows different types of primary and secondary sources and the motives, interests, and bias expressed in them (e.g., eyewitness accounts, letters, diaries, artifacts, photos; magazine articles, newspaper accounts, hearsay).

Additional Resources for Students and Teachers

Websites

The "Mummies of the World" website
http://www.mummiesoftheworld.com/index.html
Learn about the science of mummification and get answers to frequently asked questions.

Mummy Tombs
www.mummytombs.com
An educator/children's author provides an overview of the many types of mummies found around the world.

Nova
http://www.pbs.org/wgbh/nova/icemummies/
Nova looks at ice mummies.

ThinkQuest
http://library.thinkquest.org/J003409/
This website featuring mud, bog and ice mummies was created by students and won a Gold in the ThinkQuest Competition run by the Oracle Education Foundation.

Archaeological Institute of America
http://www.archaeology.org/1005/bogbodies/clonycavan_croghan.html
Two bog mummies discovered in Ireland in 2003 have led to a new interpretation of other Irish bog mummies discovered earlier.

The British Museum
www.ancientegypt.co.uk/mummies/index.html
Explore Egyptian mummies with The British Museum.

Discovery Kids
http://kids.discovery.com/fansites/tutenstein/mummymaker/mummymaker.html
Make an Egyptian mummy with Discovery Kids.

Books

Janet Buell, *Time Travelers Series: Bog Bodies; Ice Maidens of the Andes*; The Greenland Mummies; Ancient Horsemen of Siberia. Ages 9-12.
Elizabeth Carney, *Mummies*, National Geographic Kids, 2009. Ages 4-8.
Harriett Griffey, *Secrets of the Mummies*, DK Readers, 1998. Ages 9-12.
Sandra Markle, *Outside and Inside Mummies*, Walker & Company, 2005. Ages 9-12.
Shelley Tanaka, *Mummies: The Newest, Coolest and Creepiest from Around the World*, Henry N. Abrams, 2005. Ages 9-12.
Totally Amazing Mummies, Golden Books, 1998. Ages 9-12.
Charlotte Wilcox, *Mummies and Their Mysteries*, Carolrhoda Books, 1993. Ages 9-12.

Magazines

Dig, an archaeology magazine for children. Ages 9-12.
www.digonsite.com

Introduction

Objectives of this Learning Guide

This Learning Guide has been created to introduce students to the "Mummies of the World" exhibition, to enhance their interest in the scientific and cultural study of mummies and to heighten their interest in the sciences and social sciences in general.

The guide is divided into self-contained units that may be presented as single lessons or as a series of lessons before, during or after a visit to the exhibition. Each unit contains interpretive text highlighting an aspect of the exhibition, why it is important to the study of mummies and how it connects with various fields of science. Units also contain inquiry-based science and social science activities that will further students' understanding of scientific methods of study and the historical and cultural context of mummies.

Note on Respect and Dignity

The human and animal mummies in "Mummies of the World" represent the wide variety of mummies that have been found in different regions of the Earth.

Every human mummy in "Mummies of the World" is treated with dignity and respect.

The mummies were originally acquired at a time when it was common for people to collect human specimens. All of the mummies in this exhibition are assembled from the collections of various museums and institutions in Europe. The mummies were not purchased or otherwise acquired solely for this exhibition.

When modern scientists examine these mummies, they are careful to preserve and keep them as perfectly intact as possible, while still learning all they can about their lives, origins, peoples and histories. In doing so, the scientists – and everyone who sees the exhibition – are ensuring that the living person the mummy once was will be remembered.

The people presenting "Mummies of the World" have attempted to acknowledge the views of the social and cultural groups from which the mummies originated.

What is a Mummy?

A mummy is the dead body of an animal or a human that been preserved after death so that it does not decompose. To be considered a mummy and not just a skeleton, the body must keep some of its soft tissue, such as its hair, skin or muscles.

Unlike mummies in the movies, real mummies don't look alive and cannot come back to life.

Decomposition

To understand mummies, you need to understand what usually happens to dead bodies — or corpses — when they decompose. Every animal and person has lots of bacteria living inside their bodies and on their skin. Don't worry — the living body's immune system keeps them in balance. But when the body dies, that protection is gone.

Corpses rot from the inside and the outside.

On the inside, microbes that live in the intestines start to eat the intestines themselves. Individual cells break down and detach from each other. The acids in the stomach that once helped the body digest food start to eat the insides of the corpse instead.

On the outside, microbes living on the skin start to enter the body. The hair and nails fall out. Fungus grows on the skin.

If the body is left exposed, animals will eat it and insects will lay eggs in it. When those eggs hatch, the larvae will eat the remaining soft tissues.

Most corpses that are left above ground are just bones within a year. If buried in soil, it typically takes a body five to seven years to lose all its soft tissues. Skeletons can take hundreds of years to break down.

The time it takes for decomposition to occur depends upon the environment, so it varies from place to place and may be slower or faster at different times of the year. In general, warm, moist conditions speed decay while cold, dry conditions slow it down.

How Mummies Happen

The natural process of decay is blocked when the living bacteria and fungi that are essential to the process die. They can die from lack of moisture or oxygen. They can also be killed by extreme cold and some chemicals, such as acids and salts.

Bodies mummify when decay is blocked.

In some cases, such as the famous Egyptian mummies, people carefully preserved bodies as part of a burial tradition. During artificial mummification, the internal organs — along with their destructive microbes — might be removed. The corpse could be treated with preserving chemicals, which is called embalming.

Some cultures took additional steps to preserve the bodies of the dead by laying them to rest in a location that would help to mummify them — perhaps buried in sand, or hung in a dry, cool cave or submerged in a peat bog where the stagnant water is very acidic and the thick vegetation on top of it keeps oxygen out.

In other cases, mummies were created naturally. People died in locations where the environmental conditions — temperature, humidity level, chemicals — preserved the remains.

In this Learning Guide you will find out about some natural mummies, including ice mummies, desert mummies and salt mummies. You will do some experiments to see for yourself how freezing, extreme dryness and salinity affect bacteria and the rate at which corpses decompose.

State Natural History Museum, Braunschweig, Germany

This house cat was naturally mummified. It was found in an armory in Schwerin, Germany.

Culture, History & Mummies

Mummies have a lot to tell us about the times and places in which they lived.

Their bodies can tell us how tall people were and how long they lived, the kinds of foods they ate, and the diseases and injuries they suffered from.

Clothing, jewelry and other personal artifacts placed on or with a mummy can tell us about the person's status and lifestyle as well as the values, beliefs and attitudes of the culture in which that person lived.

If the person died in a remote spot and the body mummified naturally, the clothing and objects found with the mummy can tell us about everyday life in that time and place.

Tests Done on Mummies

When scientists study a mummy, they do a visual inspection first. They look closely to see how it is wrapped or dressed, in what position it was buried and what was found with it. If the mummy's geographic origins are unknown, this inspection is sometimes enough to link the mummy with the place the person lived and a time period.

To get more information, scientists have to look inside the mummy, but they don't want to perform any tests that are invasive or destructive.

The modern Computer Tomography (CT) equipment that hospitals use to diagnose problems in living people enables scientists to look inside mummies without harming them. If the body is wrapped, the CT scans can also show any objects hidden under clothing or wrappings.

Scientists can tell how long ago a mummy lived using radiocarbon dating, a test that shows how much carbon-14 is left in the remains. The amount of carbon-14 in a formerly living thing decreases at a steady rate, so knowing how much is left tells you how long it has been decreasing.

Other tests of the chemicals in a mummified body can show what plants and animals the person ate, what toxins or drugs the person consumed in life, and if chemicals were used during embalming.

Moisture & Mummies

Humidity — how moist it is — is a big factor in preserving mummies. Humidity affects how fast bodies decompose, because bodies tend to decay much faster in humid places than in dry places.

In the "Mummies of the World" exhibition, you can see examples of mummies that were created in deserts and in caves where humidity was low. These mummies from the Sahara Desert in Africa and the Middle Eastern country of Jordan dramatically demonstrate how environment affects the creation of mummies.

Desert Mummies

Deserts are great places to study mummies, because if a corpse is left out in a desert, it has a good chance of becoming a mummy.

Deserts are areas that get less than 10 inches of rain a year. They can be very hot, like the Sahara in northern Africa, or very cold, like Antarctica.

The aridity (air-RID-dit-tee) or extreme dryness of a desert sucks out the moisture from a corpse. The sun and wind help, too. As a corpse dries out, it becomes resistant to bacteria. The skin hardens and keeps moisture out while trapping the moisture within the body.

Bodies don't need the sun to dry them out. Hot sand can also remove the moisture from a corpse.

Cave Mummies

The unusual conditions in caves make them a good place to find natural mummies of animals.

After a certain depth, the temperature and humidity inside a cave stay the same no matter what the season is, what time it is or what the weather is like outside.

The complete darkness in caves makes them unfriendly to bacteria that cause decay, and corpse-eating insects can't live in the conditions found in deep caves.

Many caves have natural drafts to keep the air moving, which is particularly helpful to the mummification process in the more humid caves, like those in Central Europe.

Not every body that is left or dies in a cave becomes a mummy, but corpses in dry caves in desert regions have the best chance of being preserved.

What Can You Tell?
Scientists who study mummies have to pay close attention to details. What can you tell from the features of this mummy? What do the teeth tell you? What does the fur tell you? What do other details tell you?

This mummified head of a zorilla was found in Antarctica. A zorilla is a type of striped weasel. Like skunks, they can shoot a foul-smelling spray from glands near their tails.

From the Algerian Sahara State Natural History Museum, Braunschweig, Germany

Freezing & Mummies

You may not realize it, but your family has probably done a little mummifying. Freezing kills bacteria and fungi, which blocks decomposition. So technically, any meat your family has in the freezer has been mummified.

Ice Mummies

"Ice mummies" are created when corpses are frozen. Freezing bodies keeps them incredibly intact. There are specimens of ice mummies that have kept their internal organs and blood 30,000 years after death.

If the cold environment is also humid and low in oxygen, the body fat of corpses can be transformed into a substance called adipocere (ADD-eh-po-SEAR) — or "grave wax." Adipocere helps the body keep a lifelike shape after death — unlike artificially dried out mummies, such as Egyptian mummies, which look shriveled up.

In icy places that are very dry, the soft tissues can be freeze-dried. The arid environment gradually dehydrates the frozen body, as a snow rabbit mummy found on glacier in Italy demonstrates in the "Mummies of the World" exhibition.

It is so dried out that it no longer needs to stay cold. Ice mummies that are not freeze-dried need to be kept frozen. If they thaw out, they will decompose. In fact, they will decompose faster than if they had never been frozen at all. Moisture in a body tissue cell expands as it freezes. The expansion breaks the cell wall. When the tissue thaws, bacteria and fungi quickly invade the cell through gaps in the wall.

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Natural Mummies in Artificial Environments

You have learned that mummies can be created in natural environments when conditions slow down decomposition and preserve tissues.

Mummies also can be created in artificial environments such as buildings — without being embalmed, treated or prepared for mummification by people.

The "Mummies of the World" exhibition has examples of animal mummies created naturally in buildings in Germany.

The best places to find natural mummies have dry air, a constant draft and little variation in temperature. These include attics, closets, dry cellars, inside building walls, inside ventilation shafts, church crypts and castle vaults.

Sometimes people who have died alone in their homes are not found for some time after their death. Though it happens rarely, some of these people become natural mummies.

South American Mummies

Artificial mummies were being preserved in South America long before the Egyptians started experimenting. Mummies were preserved in various ways — wrapped in mummy bundles, dried in the desert or frozen in caves.

The Chinchorros

The Chinchorros, who lived between the border of present-day Peru and Chile, mummified the dead between 7,000 and 4,000 years ago. They had two different ways of doing it.

One method involved cutting the limbs and head off, and removing internal organs and sometimes the skin. After drying the bodies, they then they put everything back together, using sticks under the skin to strengthen the arms, legs and back. The body was packed with clay and feathers where the organs used to be, covered in white ash and then painted black with manganese. A wig of human hair was added.

The second method involved keeping the limbs on a body and removing the organs through incisions. The head was still cut off to remove the brain. The body was dried, sticks were inserted and the trunk was packed to give it back its shape. The face was painted black and the body was painted with red clay.

The Paracas

The Paracas, who lived in the Andes Mountains region of what is now Peru, probably chose the location of their most famous graveyard because they knew the extreme dryness of the desert would mummify bodies buried there. Hundreds of bodies from 900 B.C.E. to 200 C.E. were recovered in the grave field. The Paracas placed the bodies in sitting positions and wrapped them in embroidered fabrics. Some have gold crowns. These mummy bundles have cloth masks with painted faces and jewelry fastened onto them.

The Incas

The Inca civilization, which lasted from 1100 to 1532, stretched from Colombia to Chile and at one time included 12 million people. The Incas may have mummified all their dead, from children to farmers to kings. They used a variety of methods, including making "mummy bundles" and ice mummies.

The mummy bundles were made by wrapping a body (or more than one body, or even whole families) in layers and layers of fabric. Symbolic and practical items important to a person were wrapped up in the various layers. A false head was put on top to give the bundle a human-like shape.

The Incan ice mummies were actually sacrifices to the gods. These children were left in mountain caves with precious objects and given an alcoholic drink to knock them out before they died from the cold. Many of these ice mummies are remarkably intact.

Telltale Pony Tails

Because many South American mummies still have their hair, scientists can learn more about what they consumed during their lives than they could from hairless mummies. Using radio-isotope analysis, scientists can find out if a mummy had a fish- or plantbased diet, for example, or even if the mummy used tobacco.

Salinity, Acidity & Mummies

Salt Mummies

The world's most famous salt mummies were discovered in the salt mine of Hallstatt-Dürrnberg in the European country of Austria. The bodies were those of miners who lived between 7,000 and 10,000 years ago. They had been the victims of a cave-in, and were mummified by the mine's salt.

In the "Mummies of the World" exhibition you can see a salt mummy of a fish from Egypt and learn how salinity works in mummification. It can happen in two different ways.

In one way, salt crystals draw out and dry out the moisture in a body. By taking out liquids, salt helps to stop decaying bacteria in their tracks. In another way, salty water penetrates the body tissues through osmosis. The concentration of salt increases and inhibits bacterial growth, which can stop decay.

The mine mummies were found between the 16th and 18th centuries, taken out of the mine and buried in a cemetery at Hallstatt. The natural process of decomposition that had been blocked thousands of years earlier by the conditions in the mine started up again.

A written record from a person who saw one of these salt mine mummies in 1573 noted "flesh, bone, hair and clothes [were] completely undecomposed albeit somewhat flattened, the flesh looking boiled, yellow and hard as a dried cod."

This salt mummy of a yellow boxfish was found in Egypt on the northwest coast of the Red Sea.

Bog Mummies

The "bog bodies" of Northern Europe are some of the strangest and most interesting mummies. Adding to the mystery, some appear to have been murder victims.

The most famous, "Tollund Man," had a braided leather rope tightened in a noose around his neck. Some others were stabbed, beaten, tortured or beheaded. Perhaps even stranger, many of these victims appear to have been the wealthy — studies of their remains reveal they ate a good diet and had manicured fingernails!

Acid peat bogs are cold wetlands with unusual conditions.

Bogs create and preserve mummies through a material called sphagnan (SFAG-nan). Sphagnan is produced when the plant remains of a moss called sphagnum (SFAG-numb) break down. Sphagnan becomes a brown compost acid.

The acidity produced by sphagnan, its antibiotic qualities and the low amount of oxygen in bog soil combine to keep bog bodies from decaying.

Some peat bogs are alkaline (the opposite of acid). Alkaline peat bogs preserve the bones of corpses, not the soft tissues, so bodies found in these bogs are not mummified.

The "Mummies of the World" exhibition has a mummy to study from a bog in the Netherlands.

Bog Bodies

Bog bodies are one of the rarest types of natural mummies. Although there may have once been hundreds of bodies in bogs in northwest Europe, there are now less than 50 of the bodies in museum collections today. Bog bodies have been found in several countries in Europe, although most of them were in Ireland, England, northern Germany and Denmark. The bodies were usually found while people cut peat to use for fuel in fireplaces. Many of the bodies are around 2,000 years old.

Why do Bog Bodies Preserve?

Bogs are wetlands. All of the water in bogs comes from precipitation, not groundwater. Where the water builds up over a long period of time, vegetation will grow and, eventually decay. This is called peat. Peat is composed of several kinds of plants, but the most common is sphagnum moss. The sphagnum can hold huge amounts of water – if you squeeze a handful of the plants,water will pour out! As the peat builds up in many layers over centuries and millennia, the lower layers become anaerobic (lacking oxygen). Since oxygen is necessary for decomposition, bodies buried in peat sometimes preserve.

Aside from the lack of oxygen, the special chemistry of the peat environment also helps to preserve the body. As the sphagnum moss breaks down to become peat, a special substance, called sphagnan, is released and this might help preserve the bodies. The bogs are also very high in tannic acid, which also helps prevent organic materials, such as skin and leather, from decomposing.

The first bog bodies were studied in the late 1800s. Since that time, scientists have been trying to understand exactly what mechanisms within the bog help to preserve the bodies, but the process is still not fully understood and is a bit of a mystery.

Were Bog Bodies Victims of Ritual Sacrifice?

One very important question is why bodies were put into bogs in northern Europe. It is often said that bog bodies were ritual sacrifice offerings, possibly as offerings to gods and goddesses of fertility. We know that ancient people used to make offerings of animals, pottery, wagons and other items to the gods and goddesses, so it is possible that some people were also sacrifices.

There are lots of other possible explanations for bog bodies, though. Bogs can be treacherous to walk on, especially in the dark. Some of the people in bogs probably sank in the peat accidentally as they tried to cross the wetland or rescue trapped livestock. Other bodies may have been buried in a bog after death, instead in soil. In places where there is very little land for farming, using a wetland to bury bodies and saving land for farming makes sense. It has been suggested that still other people were victims or murder or robbery, or possibility even executed criminals.

It is very important to understand that all of these theories are possible – there is no one single explanation for bog bodies, and each body must be interpreted on a case-by-case basis. As with understanding how bodies preserve in peat, there is no clear explanation for why the bodies were put in bogs in the first place.

Egyptian Mummies

When most people think of a mummy, they picture an ancient Egyptian mummy, complete with linen wrappings and a decorated sarcophagus (sar-COFF-ih-gus), or coffin.

This is because Egyptian mummies were wildly popular in the 18th and 19th centuries. Travelers to Egypt would return with mummies as souvenirs of their trips. Museum exhibits and traveling shows featuring Egyptian mummies were big hits. Novels, legends and stories of Egyptian mummy curses captured the public imagination.

Beyond the science of mummification, Egyptian mummies provide a great opportunity to see how mummies connect with the rituals and traditions of cultures. They were created as part of Egyptian religious beliefs. The Egyptians believed that the body needed to be preserved to keep the soul intact after death. Though mummies were cut open and the internal organs taken out during embalming, all parts of the corpse were buried together so that the person would be complete in his or her journey in the Underworld. Symbolic and personal objects also were placed in a person's tomb to help the soul on its way.

Ritual played a big part in mummification. Bodies were preserved and reunited with their souls by priests in special ceremonies. It was important that the mummy be labeled by name, so that the deceased's identity would remain intact. It was also important that food and drink be regularly offered to the dead. If this weren't possible, pictures of food and drink were put in the tomb, so that the dead could survive in the afterlife.

Senckenberg Research Institute and Nature Museum, Frankfurt am Main, Germany

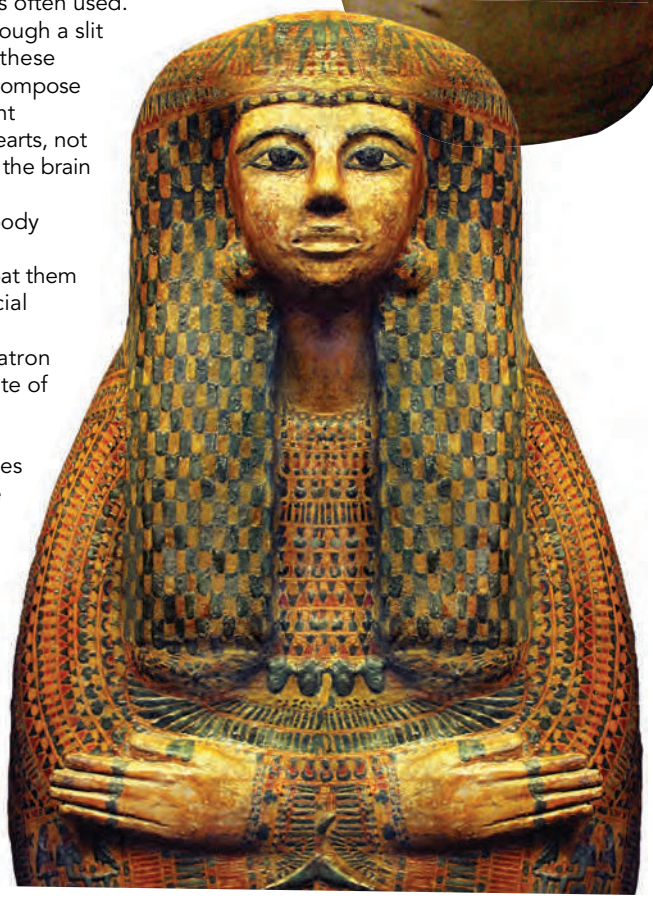
Embalmed organs were placed in canopic jars, like this one.

The Making of a Mummy

The ancient Egyptians made a few million mummies over more than 3,000 years. So how did ancient Egyptian embalmers make a mummy?

There were several approaches, but here is one that was often used.

1. Remove the stomach, intestines, liver and lungs through a slit made in the abdomen. That is important because these organs carry acids, enzymes and bacteria, which decompose the body. Leave the heart in place, since the Ancient Egyptians believed that people thought with their hearts, not their brains. With a long metal, hooked rod, remove the brain through the nose.
2. Wash the body, both outside and in the skull and body cavities.
3. Wash the liver, lungs, intestines and stomach and coat them with resin to embalm them. Then put them in special symbolic vessels called canopic (can-OPE-ick) jars.
4. Dry out the body completely by covering it with natron (NAY-tron), a natural mixture of salts and bicarbonate of soda (baking soda). Let stand for 40 days.
5. Fill the chest and abdomen with linen, spices and sometimes bags of natron. Rub oils, resins and spices over the entire outside of the body. Coat the entire body with a layer of resin.
6. Place decorative and ceremonial jewelry, such as amulets, on the body. Wrap the body in the linen, using resin to keep the bandages stuck together. Tuck amulets and other jewelry within the layers of bandages, not just on the surface of the body.
7. Once the body is wrapped in linen, cover it all with cartonnage (KAR-tonn-ahhjj). Cartonnage was a special layer of linen strips mixed with resin to form a hard shell. It was often elaborately painted.
8. Finally, place the mummy in a sarcophagus, or sometimes in several sarcophagi (sar-COUGH-ih-guy) stacked one inside the other.



Crypt Mummies

In Bavaria, Germany, there is a castle from the late 1300s where several natural mummies have been found in a family crypt.

A crypt is an underground vault in which people who have died are laid to rest. Crypts are often built under churches, but some are located in caves.

You can see the mummies of the Castle Sommersdorf in the "Mummies of the World" exhibition. They most likely were created by the drying effect of a constant draft that blows through the crypt.

The mummy of the Baron von Holz is especially well preserved. He was a relative of the castle's owner and died in Sommersdorf when he found refuge there during the Thirty Years' War between European powers between 1618 and 1648.

He was very tall for the time, and his mummified body still wears the long boots that belonged to him in life.

Mummies of Vác

In 1994, a crypt from the 1700s was discovered in the European town of Vác, Hungary, during the reconstruction of a church.

The crypt, which was mostly forgotten after it was sealed in 1838, held more than 265 natural mummies. You can see some of them in the "Mummies of the World" exhibition. They are in amazing condition, complete with skin, hair, nails and clothes.

The crypt had a constant level of humidity, slight ventilation and a cool temperature, and most of the corpses were laid on wood chips in pine coffins, which may have absorbed bacteria-filled body fluids.

Most of the mummies' names, ages, occupations and causes of death are known because the church kept detailed historical records about its members.

In effect, the crypt is a time capsule from the 18th century.

Meet the Orlovits Family: Three Vác Mummies

Veronica Orlovits, right, was found in a church crypt along with other family members, all mummified naturally.

Here is what is known from **historical research:**

Church records show that Veronica Orlovits (1770–1808) was married to Michael Orlovits, who worked as a miller. She had her first child, a son also named Michael, when she was 15 or 16, but he lived only two weeks. Her second child, daughter Catalina, was born in 1796, but died at age 2 ½. Her third child, son Johannes, died at age one in 1801. Veronica's sister, Klara, died at age 18. Veronica's husband died in 1806 at age 41. Though she was very ill, she remarried. One year later, she died at age 38.

Here is what is known from **scientific tests:**

Modern scientific tests performed on the Vác mummies show that Veronica's illness was tuberculosis, a disease that affects the lungs and other parts of the body. More than half of the mummies in the Vác crypt suffered from tuberculosis. The deadly disease, also known as "consumption" and the "white plague," was at one time a leading cause of death in Europe and the world.

Michael Orlovits (1765–1806) was a miller who died at the age of 41.

Johannes Orlovits (1800–1801) was the third child of Veronica and Michael. He died at age one.

Pre-Visit Activity: The Study of Mummies

Objective: To learn how different kinds of scientists approach the study of mummies.

Standards: Uses a variety of resource materials to gather information for research topics (e.g., magazines, newspapers, dictionaries, schedules, journals, surveys, globes, atlases, almanacs, websites, databases, podcasts)

Knows that scientists' explanations about what happens in the world come partly from what they observe (evidence), and partly from how they interpret (inference) their observations

Materials
- Online and print reference materials

Part 1: Match the scientist with the specialty

Many kinds of scientists study mummies to learn how they lived, how they died and what their world was like.

Procedure: Use reference materials to find out what each type of scientist studies. Draw a line connecting the scientist with that scientist's special area of study.

Scientist	Special Area of Study
Archaeologist	• Studies human cultures, and the similarities and differences between them.
Anatomist	• Studies the structure, composition and properties of substances and how they transform.
Geneticist	• Studies the shapes, parts and workings of the human body.
Biologist	• Examines material evidence of past humans, their cultures and their behaviors. Material evidence includes artifacts like tools, weapons or jewelry, and also buildings, monuments and changes to an area.
Chemist	• Studies the physical human remains from historical and archaeological sites to learn about the person by determining things such as age at death, sex, health and diet.
Biological Anthropologist	• Studies organisms and how they live.
Cultural Anthropologist	• Studies and compares the genes of organisms.

Part 2: What can different scientists teach us?

All types of scientists make observations and interpretations. In other words, they examine the evidence to get the facts, and they draw logical conclusions based on those facts.

Procedure
1. Complete the matching exercise and check answers as a class.
2. Split the class into seven groups.
3. Each group will think like one of the seven scientists above, and answer the seven questions.
4. A student from each group will report the group's answers to the class.
5. Discuss as a class why it is important to have scientists of different specialties involved when studying mummies.

My group's scientist is a:

_____

As a group, write your answers to the following questions on a separate sheet:

1. Write a question about a mummy that this scientist would investigate.
2. What fact could this scientist learn from examining the mummy that would help to answer this question?
3. Describe a tool or test this scientist would use in the examination.
4. Describe a challenge this scientist would face when gathering evidence from a mummy.
5. How could this scientist overcome the challenge?
6. Can this scientist fully answer the question with facts from the evidence?
7. If not, what can this scientist infer from the evidence that would help to answer the question?

THINK LIKE A MUMMYOLOGIST™

Pre-Visit Activity: Traditions, Values and Lifestyles

Objective: To examine how personal artifacts help define cultural traditions, values and lifestyles

Standards: Understands how language, literature, the arts, architecture, other artifacts, traditions, beliefs, values and behaviors contribute to the development and transmission of culture; understands how different human communities express their beliefs.

Personal Artifacts in the Chancay Culture

You have learned that scientists examine the personal artifacts found with mummies to learn about that person's lifestyle as well as the traditions and values of the culture in which the person lived. These scientists have studied the people of that time and place, so they already know a great deal. They are looking for new evidence that confirms, refutes or adds to the accepted facts and theories about these people.

The Chancay culture in Peru produced many mummies. Elaborate burial traditions show preservation of bodies was important to the culture, and the Chancay people may have known that dehydration played a role because they buried the bodies in an extremely dry area.

The Chancay dead typically were bundled with a decorated artificial head and face mask; jewelry; animals such as dogs, llamas and guinea pigs; bags full of plant seeds or coca leaves; and vessels filled with food and other things people used and traded.

While some cultures put food in graves to nourish the dead in the afterlife, scientists who have studied the Chancay culture believe their grave food symbolized a connection between death and fertility. They valued fertility and believed that preserving the dead would contribute to new vigor for the living.

Personal Artifacts in Your Culture

What can the personal artifacts of you and your classmates tell about your culture — the traditions, values and lifestyles of the people living in your time and place?

Procedure:

1. Discuss as a class the meaning of culture and list on the board some of the traditions, values and lifestyles associated with today's culture in the United States
2. Imagine you are going to be mummified. Use the chart below to catalog 10 personal artifacts you would like included in your crypt and a reason for each choice. You can choose things you wear, things you keep with you and things you have at home.
3. Share lists with your classmates. If a future scientist could study all of these artifacts together, what would they tell the scientist about the traditions, values and lifestyles of this cultural group?

Description of My Artifact	How It Reflects My Lifestyle, a Tradition or a Value Important to Me
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Pre-Visit Activity: Humidity and Aridity

Objective: To see how humidity and aridity affect decomposition.

Standards: Makes and validates conjectures about outcomes of an experiment; understands and applies basic principles of hypothesis testing and scientific inquiry.

Materials:
- Two roses of similar size and appearance
- Scissors
- Small scale (triple beam balance or electronic balance, calibrated to 0.1 gram or less)
- Small container of very dry sand
- Non-paper plate

Procedure:
1. Cut the heads off two roses.
2. Examine them closely and fill in the Condition at Start chart.
3. Take one rose head and bury it completely in a small container of dry sand. Place the container in a sunny, dry spot.
4. Take the other rose head home, put it on a small, non-paper plate and place it in a bathroom used regularly for showers or baths. Place it where it won't get direct sunlight and won't get wet from splashes.
5. You have learned that aridity can dry out a corpse so that it becomes a mummy. On a separate sheet, write a hypothesis stating which rose you think will decompose most and why.
6. Fill in the Predictions chart.
7. Leave both roses alone for **two weeks** — no touching, moving or flipping.
8. Gently remove the rose from the sand and retrieve the bathroom rose on its plate. Examine them and fill out the After Two Weeks chart.
9. Was your hypothesis accurate or not? Write a paragraph describing the effects of humidity and aridity on decomposition.

Condition at Start	Arid Rose	Humid Rose
Color		
Smell		
Appearance*		
Weight		
How Petals Feel		

Predictions	Arid Rose	Humid Rose
Color		
Smell		
Appearance*		
Weight		
How Petals Feel		

After Two Weeks	Arid Rose	Humid Rose
Color		
Smell		
Appearance*		
Weight		
How Petals Feel		

*including any bruises or other marks

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Pre-Visit Activity: Freezing and Thawing

Objective: To determine the effects of freezing and thawing on organic materials.

Standard: Makes and validates conjectures about outcomes of an experiment; understands and applies basic principles of hypothesis testing and scientific inquiry.

Materials:
- Two ripe peaches of similar size and appearance
- Two non-paper plates
- Thermometer
- Small scale (triple beam balance or electronic balance, calibrated to 0.1 gram or less)
- Freezer

Procedure:
1. Examine the two peaches gently. Fill out the Condition on Start Date chart to note their original condition. Draw and label an illustration on a separate sheet of paper showing the condition.
2. Put each peach on a plate and put one in the freezer. Leave the other on a counter away from direct sunlight and heat sources.
3. **Wait two days**, then remove the frozen peach from the freezer, examine both peaches, fill out the Condition After Two Days chart to note their condition. Draw and label an illustration on a separate sheet of paper showing their condition.
4. Leave the never-fozen peach on the counter and put the frozen peach on the counter beside it.
5. You have learned how freezing affects the decomposition of a corpse and why ice mummies must be kept frozen. On a separate sheet, write a hypothesis stating which peach you think will decompose fastest and why.
6. **Wait two weeks**, observing the peaches daily but not touching them. Then examine the peaches gently and fill out the Condition After Two Weeks chart. Draw and label an illustrationon a separate sheet of paper showing their condition.
7. Was your hypothesis accurate or not? Write a paragraph describing the effects of freezing and thawing on decomposition.

Condition on Start Date	Counter Peach	Freezer Peach
Color		
Smell		
General description*		
Weight		
Firmness		
Temperature of location		

Condition After Two Days	Counter Peach	Freezer Peach
Color		
Smell		
General description*		
Weight		
Firmness		
Temperature of location		

Condition After Two Weeks	Counter Peach	Freezer Peach
Color		
Smell		
General description*		
Weight		
Firmness		
Temperature of location		

*including any bruises or other marks

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Pre-Visit Activity: Salinity and Decomposition

Objective: To determine how salinity affects decomposition.

Standard: Makes and validates conjectures about outcomes of an experiment; understands and applies basic principles of hypothesis testing and scientific inquiry.

Materials:
- Two lemons of similar size and condition
- Knife
- Small scale (triple beam balance or electronic balance, calibrated to 0.1 gram or less)
- Salt
- Two small jars with tops that each will hold a single lemon snugly

Procedure:
1. Make a vertical cut in each lemon that goes about three-quarters through its thickness. Be careful to keep the two halves attached. Turn the lemon over so that the cut is on the bottom.
2. Make a second cut at a 90-degree angle to the first. Again cut about three-quarters through each lemon's thickness, and be careful to keep the both halves attached. You'll end up with two fully attached, quartered lemons.
3. Examine each lemon and fill in the Condition at Start chart.
4. Place one lemon in a jar, close the lid and put it in a cool, dark place.
5. Rub and pack a tablespoon of salt into both of the cuts in the second lemon.
6. Hold the salty lemon together to keep most of the salt in as you place it in the other jar. Add another tablespoon of salt to the jar. Close the lid and place this jar next to the first jar.
7. You have learned how salt affects the decomposition of a corpse. On a separate sheet, write a hypothesis stating which lemon you think will decompose most and why.
8. Fill in the Predictions Chart.
9. Leave the jars alone for **two weeks**.
10. Remove the lemons from their jars, examine each one and fill out the After Two Weeks chart.
11. Was your hypothesis accurate or not? Write a paragraph describing the effects of salt on decomposition.

Condition at Start	Plain Lemon	Salty Lemon
Color		
Smell		
Appearance*		
Weight		

Prediction	Plain Lemon	Salty Lemon
Color		
Smell		
Appearance*		
Weight		

After Two Weeks	Plain Lemon	Salty Lemon
Color		
Smell		
Appearance*		
Weight		

*including any bruises or other marks

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Pre-Visit Activity: Death and Ritual

Objective: To compare and contrast how different cultures honor and remember the dead.

Standards: Uses a variety of resource materials to gather information for research topics (e.g., magazines, newspapers, dictionaries, schedules, journals, surveys, globes, atlases, almanacs, websites, databases, podcasts); understands how language, literature, the arts, architecture, other artifacts, traditions, beliefs, values and behaviors contribute to the development and transmission of culture.

Materials: Reference materials

Traditions Marking Death

Death is an important and inevitable part of life. Different cultures and communities have different traditions marking deaths. These traditions provide closure for families, reinforce cultural traditions, express community values and demonstrate spiritual or religious beliefs.

Procedure:

1. In pairs or teams, research two different historic or current burial or funeral traditions. They can be from another part of the world or from this part of the world, from an ancient time or from a modern time.
2. Use the Internet, books or other resources to find authoritative sources on the two burial traditions you will study.
3. With your group, fill in the chart below.
   a. Description of ceremonies
   b. Who officiates
   c. Who attends
   d. What attendees wear
   e. How attendees participate
   f. What music is played
   g. How the body is laid to rest
   h. How the burial place is marked
   i. Are some ceremonies private and others public? How are they different?
   j. Other special aspects of the tradition

	Culture 1	Culture 2
a.		
b.		
c.		
d.		
e.		
f.		
g.		
h.		
i.		
j.		
k.		

4. What do the traditions tell you about the cultures that observe them?
5. What hypotheses could you make about what is important in each culture?
6. Share and compare findings as a class.
7. What common practices can you identify among burial rituals of different cultures?
8. Write a summary of the significance of these common practices across cultures.

Pre-Visit Activity: Secrets of the Crypt

Objective: To conduct local historical research based on primary and secondary sources.

Learning Standards: Uses a variety of resource materials to gather information for research topics (e.g., magazines, newspapers, dictionaries, schedules, journals, surveys, globes, atlases, almanacs, websites, databases, podcasts); knows different types of primary and secondary sources and the motives, interests and bias expressed in them (e.g., eyewitness accounts, letters, diaries, artifacts, photos, magazine articles, newspaper accounts, hearsay).

Materials:
- Reference materials
- Archives
- Local records

Mummies in Historical Context

When studying mummies, it is important to put them into the historical context of their time. Gathering historical evidence can enrich and inform data gained by physical examination and testing of mummy remains. Researchers use both primary and secondary sources. Primary sources are written by people directly involved in the subject being researched. Secondary sources are sources produced by researchers writing about the people directly involved.

Procedure:
1. Develop and extend your historical research skills by learning about a crypt or cemetery monument in your community.
2. Use the Internet, books, library resources and the chart below to map a strategy for using primary sources, secondary sources, Internet resources or personal interviews.

Name of Crypt or Monument	
Primary Sources to Seek	
Information They Could Provide	
Secondary Sources To Seek	
Information They Could Provide	
Internet Resources to Seek	
Information They Could Provide	
Interview Subjects to Seek	
Information They Could Provide	

Once you have identified possible sources of information, gather data you will need to create a historical portrait of the crypt, monument or people buried.

Information should include:
- Location of Crypt or Monument
- Description and Sketch of Physical Structure
- Materials Used (Stone, Brick, Etc.)
- Present Condition
- The Names and Dates Listed
- Order in Which They Are Listed, if Significant
- Poems, Sayings or Other Writings Displayed
- Significance of Poems, Sayings or Writings Displayed
- Symbols Displayed
- Significance of Symbols Displayed

With the information you have gathered, write a short paper summarizing your findings for presentation to a historical group or society. Think about what would be the most interesting way to introduce your paper to a live audience. Be sure to include footnotes that explain what sources you used to find your information.

The mummified corpse of the Baron von Holz dates to the Thirty Years War (1618-1648). He was laid to rest in the tall boots he wore in life.

Family crypt from Sommersdorf Castle by Ansbach, Germany. Private loan from Dr. Manfred Baron von Crailsheim.

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Pre-Visit and Post-Visit Activity: Two Ways to Learn About Mummies

Objective: To examine the importance of both scholarly research and field research in scientific inquiry.

Standard: Uses reading skills and strategies to understand a variety of informational texts; compares different sources of information for the same topic in terms of basic similarities and differences; knows that scientists' explanations about what happens in the world come partly from what they observe (evidence), and partly from how they interpret (inference) their observations; evaluates the results of scientific investigations, experiments, observations, theoretical and mathematical models and explanations proposed by other scientists.

Scholarly Research and Field Research

Scientists who study mummies gather information in a variety of ways. They gather information through scholarly research using books, journals or digital resources at libraries, archives or websites. They also gather information through field research in which they examine and study specimens or situations in person. Both have advantages as sources of information.

Studying mummies through resources like this Student Guide is a kind of scholarly research. Going to see the "Mummies of the World" exhibition in person is a kind of field research.

Use the chart below to compare what you have learned about mummies through this Student Guide with what you learn when you visit the exhibition in person.

Procedure:

1. Review the scientists and their special areas of study listed on Page 5 of this guide. In the chart below, list the most interesting or significant thing you have learned from this guide in each area of study.
2. While you are at the exhibit, list the most interesting or significant thing you learn there in each area of study. For instance, under Anatomy, you might say that some South American cultures bound the skulls of their children to make them pointed.
3. After you return from the exhibit, review the data you have catalogued in the chart.
4. Name something you could only learn by field research — seeing the mummies in the exhibition.
5. Name something you could only learn by relying on the expertise of others who have conducted scholarly research.
6. On a sheet of paper, write a paragraph discussing the strengths and weaknesses of both scholarly and field research and how both are needed to explore scientific topics comprehensively.

Field of Study	Learned from Student Guide	Learned at "Mummies of the World" Exhibit
Archaeology		
Anatomy		
Genetics		
Biology		
Chemistry		
Biological Anthropology		
Cultural Anthropology		

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Credits

The "Mummies of the World" Learning Guide was produced for American Exhibitions, Inc., www.americanexhibitions.com, by Hollister Creative, www.hollistercreative.com.

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