EXPERIMENT MANUAL

ARCHAEOLOGY PYRAMID DIG

THAMES & KOSMOS

WARNING — For use only by children over 8 years of age and under adult supervision. Eye protection must be worn at all times. Eye protection for supervising adults is not included.

WARNING!

Only for use by children over 8 years of age.

CAUTION! Individual parts in this kit may have sharp points, corners, or edges. Do not injure yourself!

- → Read the instructions before use, follow them, and keep them for reference.
- → To protect your eyes from airborne particles while excavating, you must wear the safety goggles.
- → Do not inhale the plaster dust or sand.
- → Keep young children and pets away from experiments.
- → Store the kit out of the reach of young children.
- → Do not eat or drink in the work area.
- → Do not work near an open flame. Adults: Do not smoke.
- → Wash hands after completing the experiment, and clean all equipment after use.
- → Eye protection for supervising adults is not included.

- → Save packaging and instructions, as they contain important information.
- → We reserve the right to make technical changes.

Instructions for using the safety glasses

USE
- → The safety glasses are only to be used with the experiment kit. No other type of application is permitted.
- → Wear the glasses in such a way that the eye area is protected. If necessary, adjust the elastic band to the head circumference of the child.
- → The safety glasses should be used together with contact lenses. Wearers of corrective eyeglasses need special safety glasses (not included).

DURATION OF USE
- → Always wear the safety glasses when performing your experiments. They are not intended for long-term use. The duration of wear should not exceed the time of the experiment.

STORAGE
- → Store safety glasses at room temperature in a dry place. After the experiment, return them to their place in the kit box to keep them from being scratched.

CLEANING
- → Do not clean the safety glasses in a dry state. Clean them with water and, if necessary, a mild household liquid detergent, and then dry them off with a soft cloth.

MAINTENANCE
- → In case of defective safety glasses or scratched lenses, exchange them for an equivalently constructed pair.

INSPECTION
- → Check the safety glasses to make sure they are in good condition, and replace them if they are damaged.

WARNING
- → Some extremely sensitive individuals may, under some circumstances, experience an allergic reaction to skin contact with some materials in these glasses.

REPLACEMENT
- → These safety glasses are available as a replacement part.

The safety glasses are tested per EC guideline 89/686/EWG (personal protective equipment) and EN 166, as well as EC guideline 88/378/EWG and EN 71-4.

TEST CENTER :
Certification Center 0197, TÜV Rheinland Product Safety GmbH, Am Grauen Stein, D-51105 Cologne, Germany

Franckh-Kosmos Verlags-GmbH & Co. KG, Pfizerstraße 5-7, 70184 Stuttgart, Germany

Dear Parents,

This experiment kit is intended only for children over eight years of age.

Please supervise your children and offer them support while they are performing the excavations and experiments in this kit. Before starting an experiment, read through the instructions together. Follow the instructions and directions carefully. Please be careful that none of the kit parts gets into the hands of young children.

Read the instructions, safety rules, and first aid information with your child, and ensure they follow them, keep them on hand for reference, and perform only those experiments that are described in the manual.

Conduct the experiments on a sturdy table with a washable work surface. It should be well lit and ventilated, and away from foods. The area around the table should be free of obstacles. When performing the experiments, your child should wear clothes that can take a little abuse (or an old smock) and safety glasses. After completing the experiments, he or she should clean up the work area and thoroughly wash his or her hands.

Please make sure that no one inhales any plaster dust or sand from the pyramid that may become airborne during the excavation.

We wish you and your child a fun and interesting time with these experiments!

Introduction

With this kit, you can play the role of archaeologist as you track down your pyramid's secrets. This manual will give you instructions and tips for unlocking your pyramid and discovering what lies inside. You will also find other experiments, activities, and information related to archaeological science. Be sure to follow the instructions in this manual carefully, so that the pyramid and its treasures are not harmed by careless or incorrect methods. You must use the care of a real archaeologist when excavating your pyramid.

About 4,600 years ago, ancient Egypt's Old Kingdom began. During this time, Egypt was ruled by kings called pharaohs. The pharaoh Khufu, also known by his Greek name, Cheops, built a pyramid at Giza now referred to as the Great Pyramid, because it is the largest of the more than a hundred pyramids discovered in Egypt to date. This enormous pyramid is also called Khufu's Pyramid or the Pyramid of Cheops. The pyramid in your kit was modeled after the Great Pyramid.

Most people believe that the Great Pyramid was built as a tomb for Pharaoh Khufu, but because it was built so long ago, many questions, puzzles, and secrets about the pyramid linger. Some of the questions have been answered by archaeologists, researchers, and scientists from all over the world, but others are still unsolved.

What's in your experiment kit:

Checklist: Find – Inspect – Check off

✔	No.	Description	Qty.	Item No.
☐	1	Pyramid with artifacts inside	1	713215-A
☐	2	Sarcophagus (inside pyramid)	1	713215-B
☐	3	Canopic urn (inside pyramid)	4	713215-C
☐	4	Hammer and pick tool	1	704372-A
☐	5	Brush	1	704372-B
☐	6	Chisel	1	704372-C
☐	7	Sponge	1	704372-D
☐	8	Plastic peg	1	704372-E
☐	9	Safety glasses	1	052297
☐	10	Cardboard sheet with pyramid cross section and scales	1	713216

Additional things you will need:

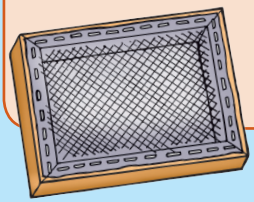
Old newspaper, old spoon, old wooden picture frame, window screen material, staple gun and staples, spool of string, ruler, notebook, shoebox, scissors, adhesive tape, glue, paper and pencil, apple, knife, glass or jar, baking soda, table salt, wire, awl, permanent marker, soil, plastic bag, 80 pennies, markers or crayons, sand, plaster, spatula, plastic tub, modeling clay, cup, food coloring

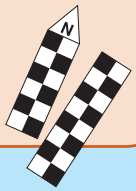
Any materials not contained in the kit are marked in *italic script* in the "You will need" boxes.

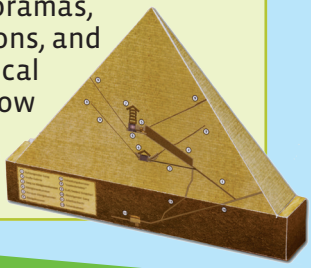
→ Before doing anything else, please check all the parts against the list to make sure that nothing is missing.

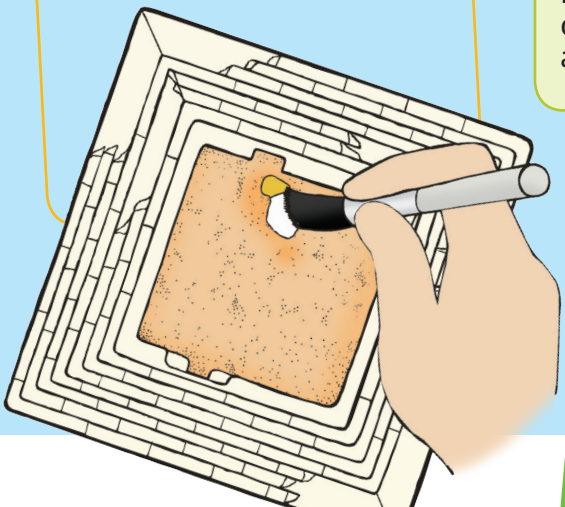
→ If you are missing any parts, please contact Thames & Kosmos customer service.

CONTENTS



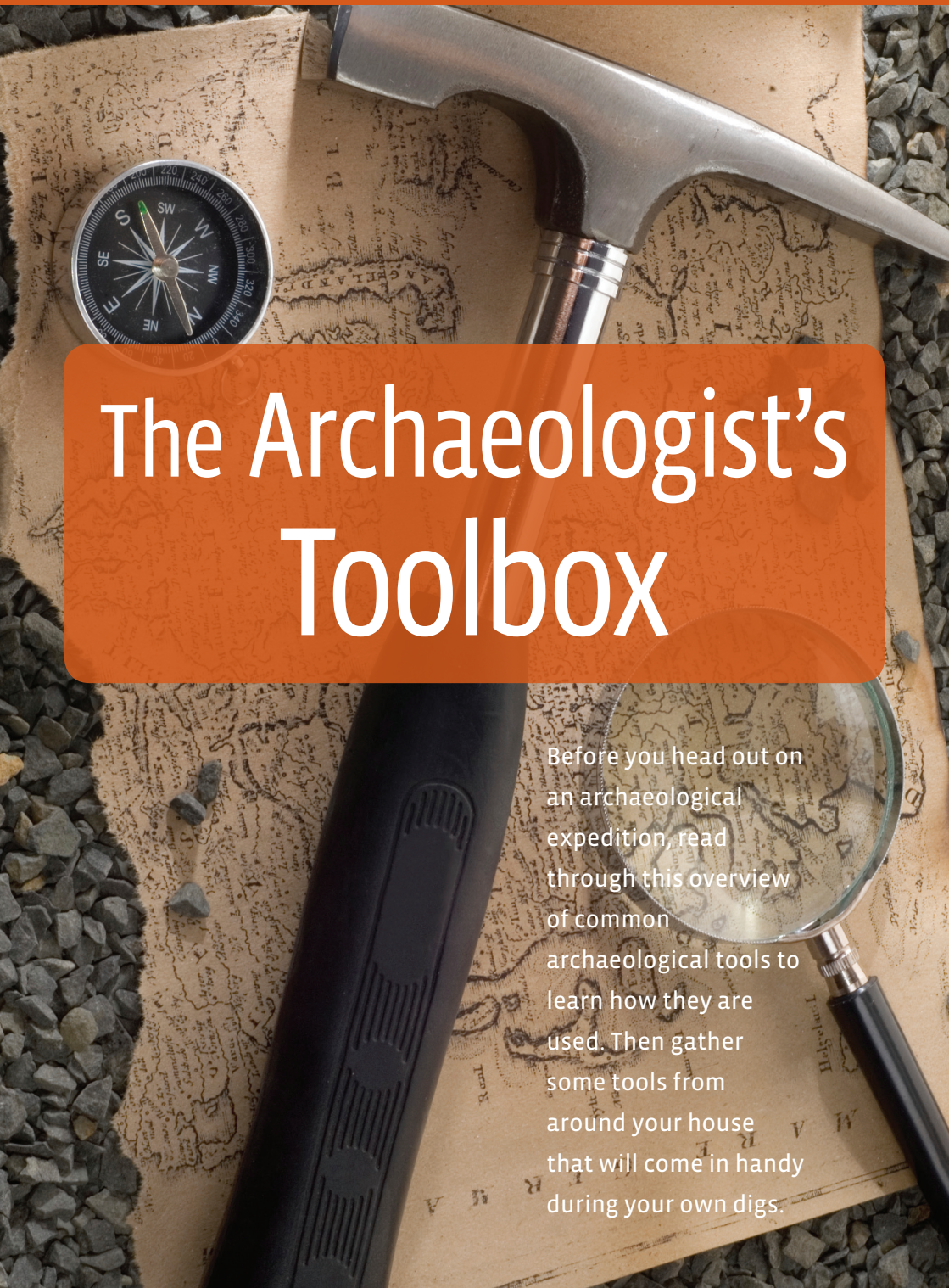






CHECK IT OUT

You will find supplemental information on pages 18, 21, 24, 26, and 32.



The Archaeologist's Toolbox

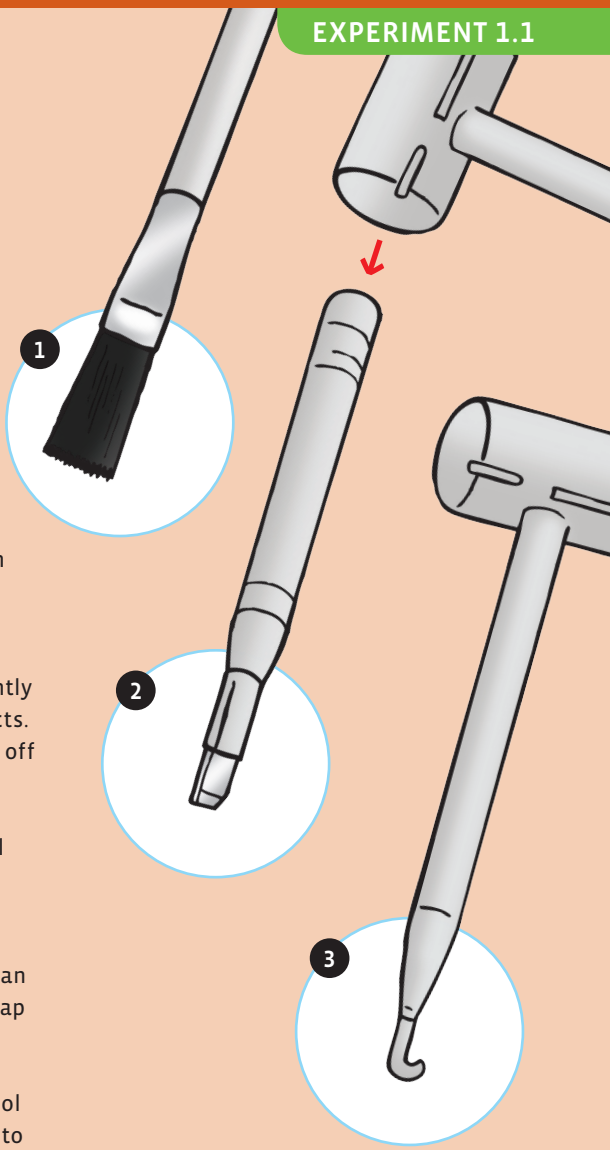
Before you head out on an archaeological expedition, read through this overview of common archaeological tools to learn how they are used. Then gather some tools from around your house that will come in handy during your own digs.

EXPERIMENT 1.1

Preparing your archaeology toolbox

YOU WILL NEED

→ brush
→ hammer and pick tool
→ chisel
→ sponge



HERE'S HOW

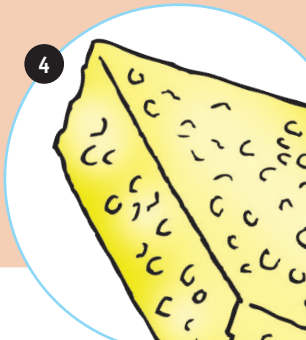
Gather the tools you are going to use on your archeology expedition, and learn how to use them properly.

1. The brush is used to carefully and gently move away loose soil covering artifacts. The brush is also used to further dust off artifacts after they have been excavated. Brushes of all sizes are indispensable tools at archaeological sites.

2. A chisel can be used to gently scrape away hard, packed material covering an artifact. You can use the hammer to tap gently on the end of the chisel, or use the chisel on its own. Archaeologists use tremendous care when using a tool like this, because it has the potential to permanently damage a fragile artifact.

3. On the other end of the hammer tool is a pick, which can be used to carefully scrape material out of small crevices and details in an artifact, just like a dentist's pick cleans plaque from the tiny places between teeth.

4. The sponge, when dampened, is used to clean artifacts, but only when the water will not damage them.



EXPERIMENT 1.2

Shaker sieve

YOU WILL NEED

→ *old wooden picture frame*
→ *window screen material*
→ *staple gun and staples*

HERE'S HOW

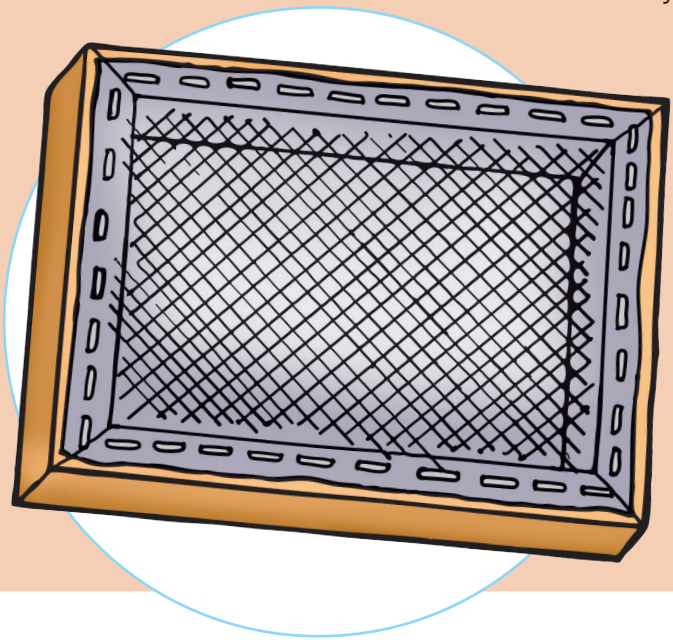
These instructions will show you how to build an optional tool called a shaker sieve. This tool is used to separate small artifacts from loose sand and soil.

1. Find an old wooden picture frame or a similar rectangular form that can act as a frame for your sieve.

2. Cut a piece of window screen material, which you can find at hardware stores and home centers, to fit the frame.

3. Have an adult help you staple the screen to the frame with a staple gun, so that the screen is taut across the frame. Turn the frame over, so the screen is on the bottom, and you have a sieve!

4. To test the sieve, place a handful of sand or dirt, with some small artifacts or other items hidden inside, in the center of the sieve. Hold the sieve by the frame and shake it from side to side so the sand falls through the screen, revealing the artifacts left behind. Do this outside, and be careful not to breathe in any of the dust.

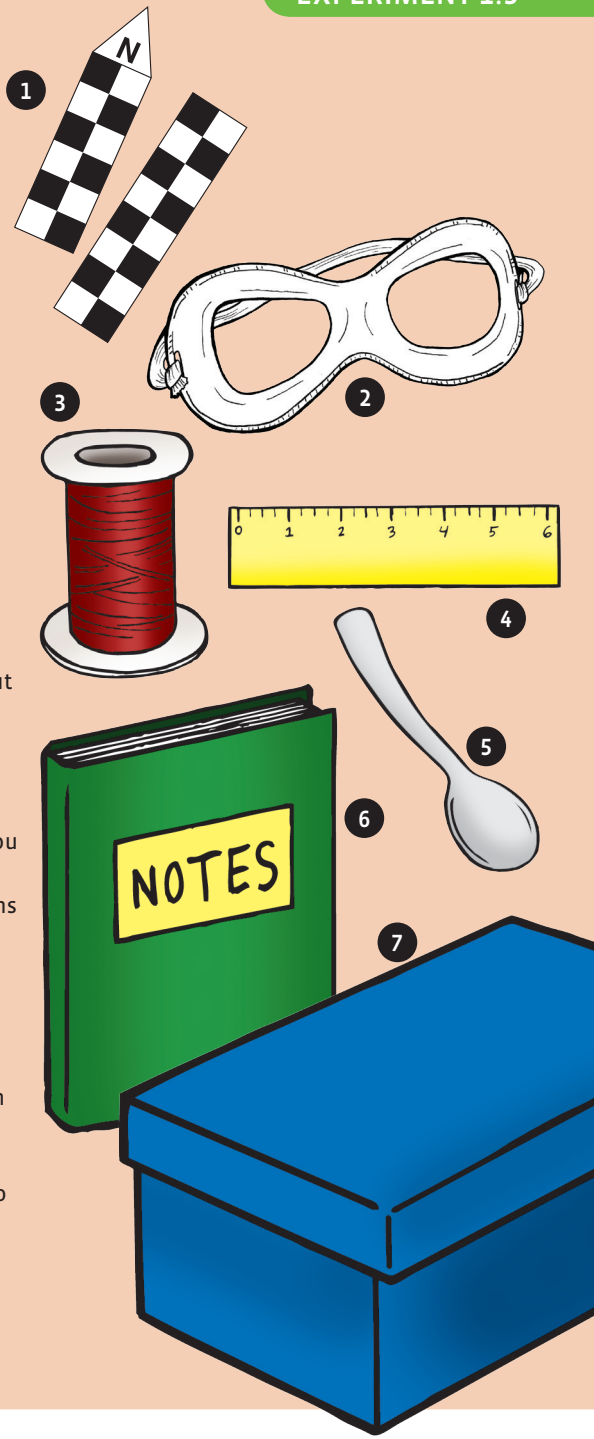


EXPERIMENT 1.3

Gathering tools

YOU WILL NEED

- → north pointer and scales from the cardboard sheet
- → goggles
- → *old spoon*
- → *spool of string*
- → *ruler or tape measure*
- → *notebook*
- → *shoebox*



HERE'S HOW

Assemble an archaeologist's toolbox full of all the tools you will need on your expeditions.

1. As you unearth a site, you can't help but disturb it. A lot of information can be surmised from the relative locations and orientations of the objects you uncover. Therefore, it is important to take a lot of photographs of a site as you excavate it, layer by layer. Placing the north pointer and scales in photographs you take records the relative size and orientation of the objects in the photographs. The scales are printed with one centimeter squares.

2. The goggles will protect your eyes from debris.

3–6. You will also want a spool of string to mark grid lines, a ruler to measure distances, an old spoon for digging, and a notebook for notes.

7. Put all your tools inside a shoebox, which will act as your toolbox.

Your PYRAMID Expedition

Now it's time to start your first archaeological dig! Even though you won't be flying to Egypt or crawling through a real pyramid, you will be able to test out a lot of tools and techniques as you uncover artifacts from inside your model pyramid.

Note

This table shows a transliteration of Egyptian hieroglyphs into the English alphabet. A transliteration is a method of representing the letters of one alphabet with the letters of another. Transliteration is not the same is translation or transcription.

EXPERIMENT 2

Unlocking the pyramid, part I

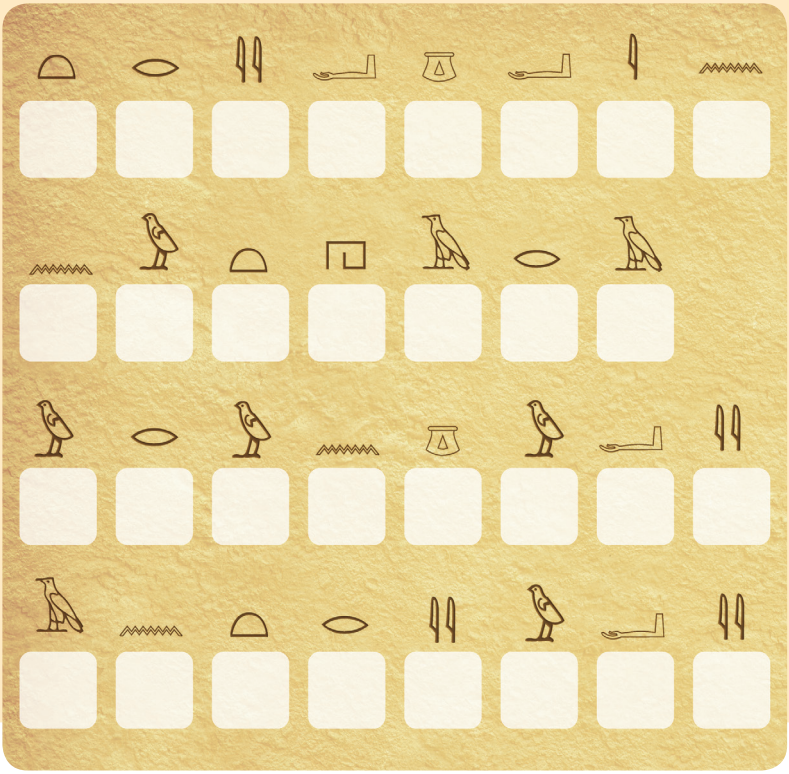
YOU WILL NEED

→ pyramid model
→ hieroglyph key on page 8
→ *pencil*

HERE'S HOW

1. Use the hieroglyph key on the previous page to translate the inscriptions on your pyramid. The inscriptions are reproduced below. Write the corresponding letter from the key beneath each hieroglyph.

2. After you have translated the inscriptions correctly, you will find the side that hides the opening mechanism. If you have trouble deciphering a hieroglyph, or if it could stand for two different letters, just write down all the letters you think it might be, and move on to the next hieroglyph. Once you translate the rest of the inscription, the correct letter will be apparent.

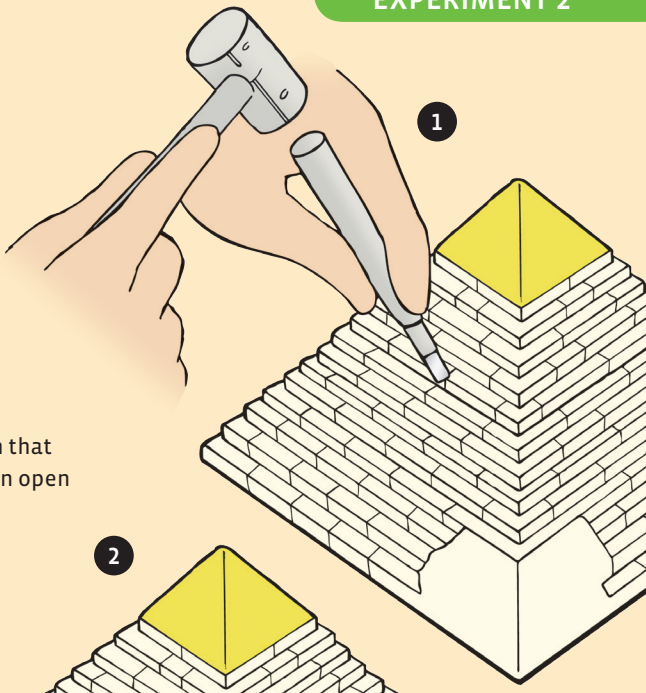


EXPERIMENT 2

Unlocking the pyramid, part II

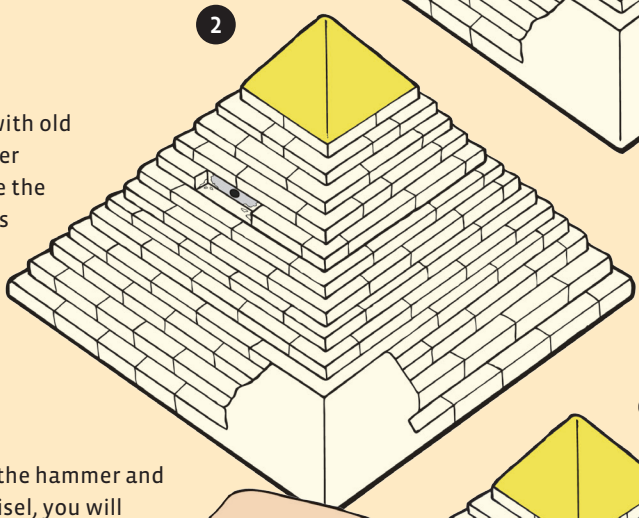
YOU WILL NEED

→ hammer and pick tool
→ chisel
→ plastic peg
→ safety glasses
→ *old newspaper*



Once you have found the inscription that marks the pyramid entrance, you can open the pyramid.

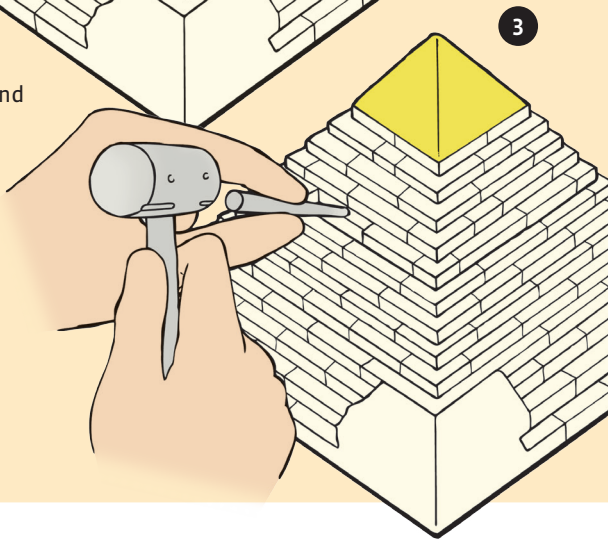
HERE'S HOW



1. Cover your work table with old newspaper or some other protective covering. Use the hammer and chisel tools to carefully expose the opening mechanism. It will be located behind the inscription, between the third and fourth hieroglyphs.

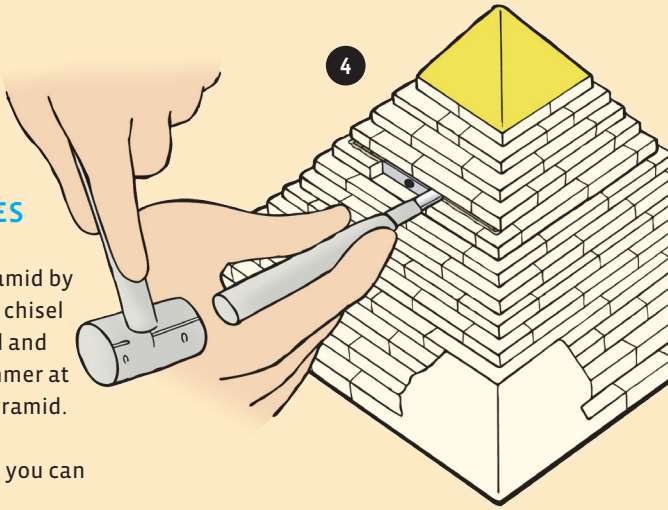
2. After a few soft taps of the hammer and a quick scrape of the chisel, you will reveal the round indentation of the opening mechanism.

3. Insert the plastic peg into the round indentation, and gently tap the peg with the hammer to unlock the pyramid's lid.



EXPERIMENT 2

Unlocking the pyramid, part II

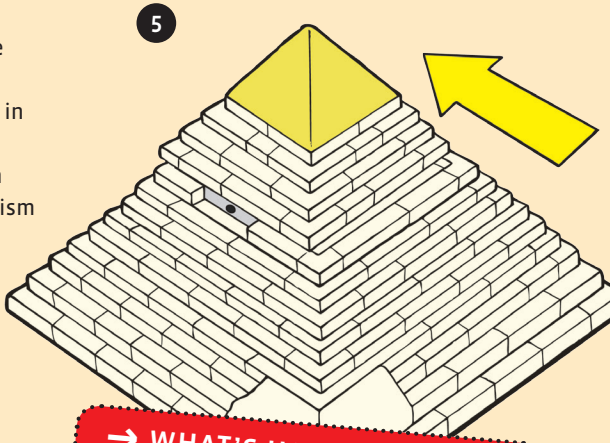


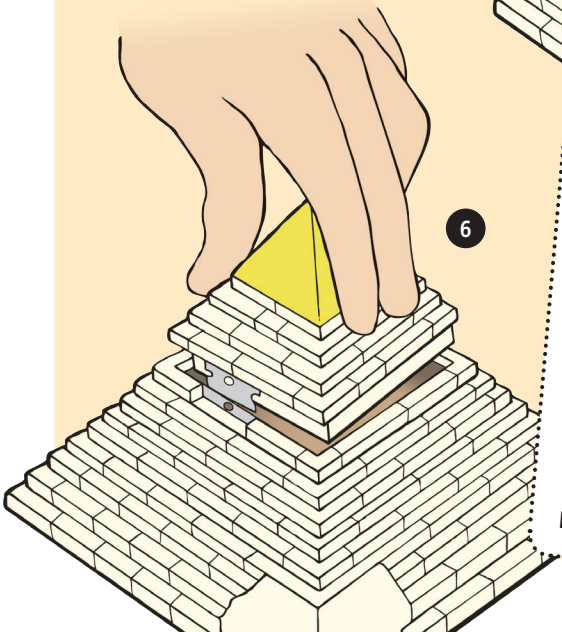
HERE'S HOW IT CONTINUES

4. Loosen the entire lid of the pyramid by gently inserting the edge of the chisel between the pyramid and its lid and tapping the chisel with the hammer at several locations around the pyramid.

5. Once you have loosened the lid, you can slide it to the left.

6. Now carefully lift off the lid. You have opened the pyramid! Save the small plastic peg that fell into the pyramid, in case you want to seal your pyramid again. You can insert the peg through the two holes of the opening mechanism to lock the lid in place.





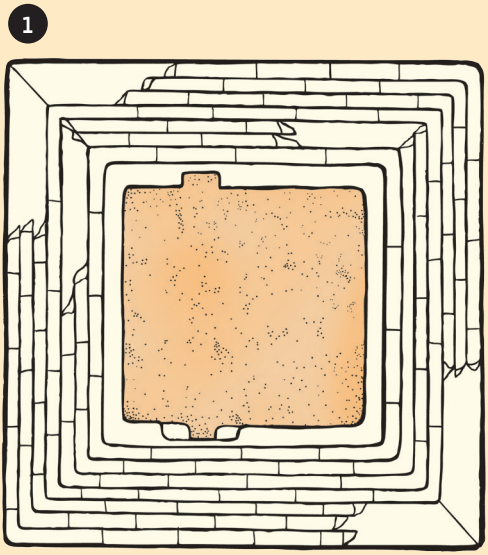
→ WHAT'S HAPPENING?

The pharaoh's concern about grave robbers prompted Khufu to equip his pyramid with numerous security measures, although none of these were exactly like the locking peg in your pyramid. Security features in Khufu's Pyramid included huge stone slabs weighing many tons, some of which were positioned in front of the burial chamber, while others blocked a long, ascending passageway up to the burial chamber.

Pyramid excavation

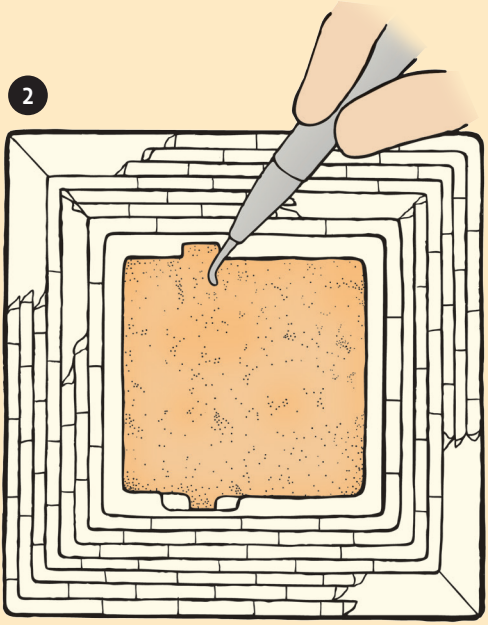
YOU WILL NEED

- → pyramid
- → hammer and pick tool
- → brush
- → chisel
- → sponge
- → safety glasses
- → *old newspaper*
- → *old spoon*
- → *string*
- → *adhesive tape*
- → *paper and pencil*



HERE'S HOW

1. Inside your pyramid, you will discover artifacts reminiscent of those found in the tombs of ancient Egyptian pharaohs. Imagine that over thousands of years, the hot desert wind has blown sand through the slits between the stones that form your pyramid. Now everything inside is buried deep under packed sand. To excavate the artifacts, you will use the hammer, chisel, pick, and brush tools included in this kit. Before you begin excavating, it's a good idea to cover your work table with old newspapers or some other protective covering, because you will be creating a lot of loose sand.



2. Pick a starting point. Gently scrape some of the sand away from the area with the pick tool. Work slowly and carefully, keeping in mind that at any moment, your pick could strike a delicate artifact hidden below the surface.

EXPERIMENT 3

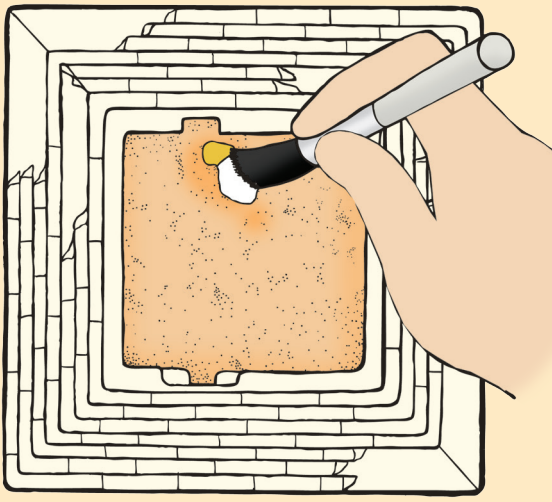
Pyramid excavation

HERE'S HOW IT CONTINUES

3. When you hit your first white or golden object, stop using the pick tool and start using the brush. Gently start brushing the sand away from the object. Little by little, the object will be revealed. Occasionally, you may have to scoop some of the loose sand out of the excavation area. You can dispose of this excess sand in the trash.

4. Once you have uncovered a good portion of the first artifact, repeat steps 2 and 3 again in another area of the excavation site, until you have uncovered the top surface of a second artifact.

3



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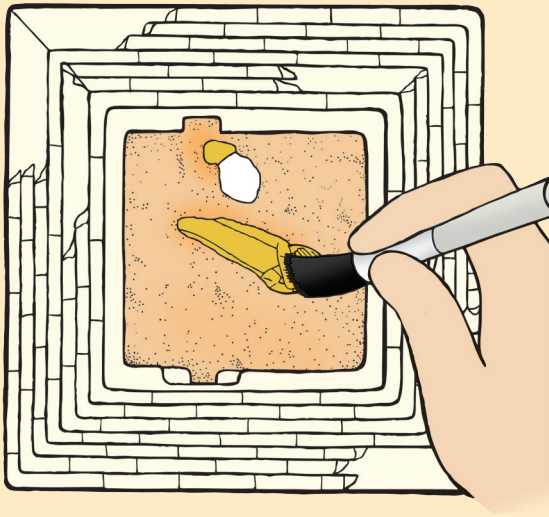


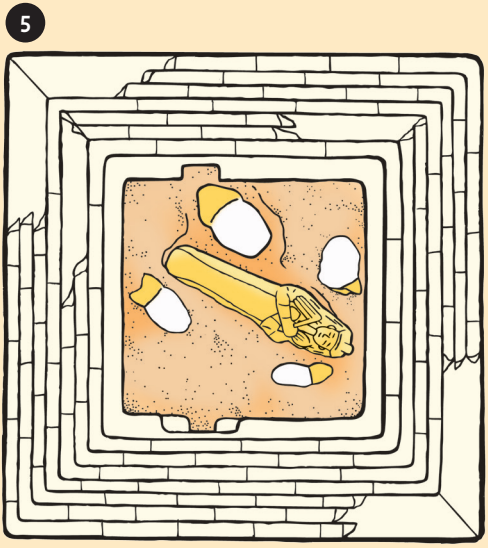
Note

The illustrations here do not necessarily show the orientations and locations of the artifacts in your pyramid.

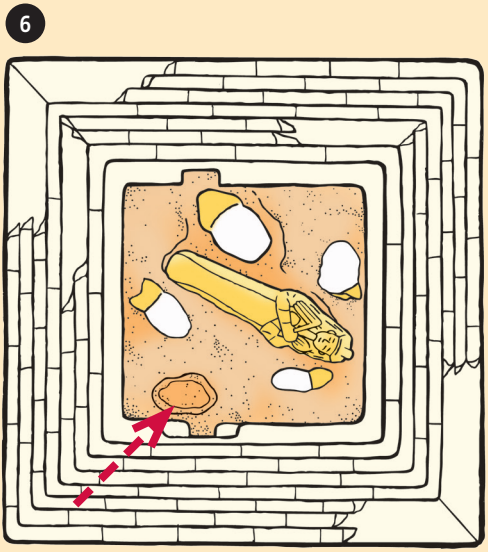
Pyramid excavation

HERE'S HOW IT CONTINUES

5. Continue repeating steps 2 through 4 until you have uncovered the top surfaces of five artifacts.



6. Dig a few final holes to be sure that you have found all the major artifacts buried in the pyramid.



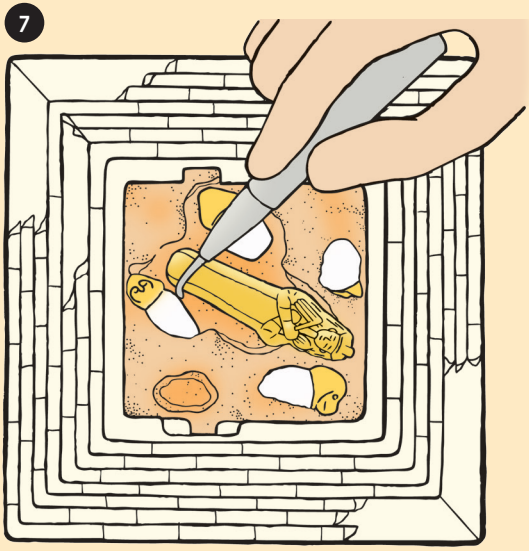
EXPERIMENT 3

Pyramid excavation

HERE'S HOW IT CONTINUES

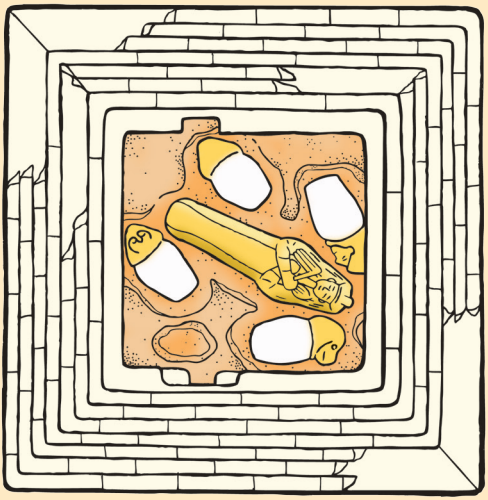
7. Now it is time to carefully remove all of the sand from around the artifacts. Touch the artifacts as little as possible while removing the sand with the pick and brush. Try to keep the artifacts in their original resting places. Do not push them out of place yet.

7



8. This illustration shows what your site might look like once the sand has been removed from around the artifacts. Do you notice anything important about the relative positions of the artifacts?

8



Pyramid excavation

HERE'S HOW IT CONTINUES

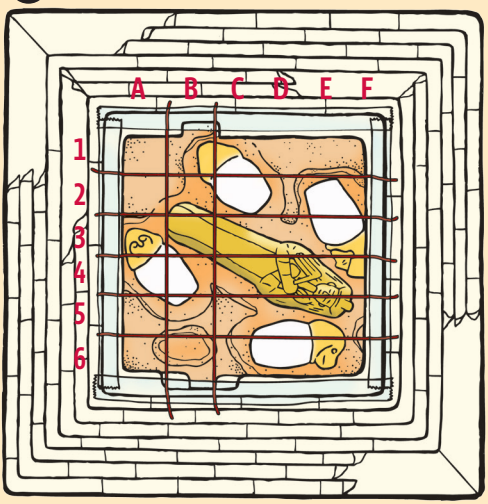
9. Before moving your artifacts for cleaning and restoration, make a detailed record of their positions at the site. Once you move the artifacts, information about their original positions will be lost unless you write it down.

   One way to produce a precise record of the artifacts' locations is to use string and tape to create a grid over your site. Then you can sketch the artifacts, with the grid to help you accurately record the objects' relative positions. You can also use the grid itself to describe the artifacts' positions. For example, in the illustration, the foot of the sarcophagus is located in 2-B and 3-B.

10. After you have recorded their positions, you can remove the artifacts from the pyramid. Clean them carefully with the damp sponge. You can also restore them by painting or coloring them with markers. Ordinary felt-tip markers will work well on the white surfaces, but a blue or black permanent marker will work better on the golden surfaces.

11. After you have excavated all of the artifacts from your pyramid, you can put the top back on your pyramid and keep the model to display alongside your treasures.

9



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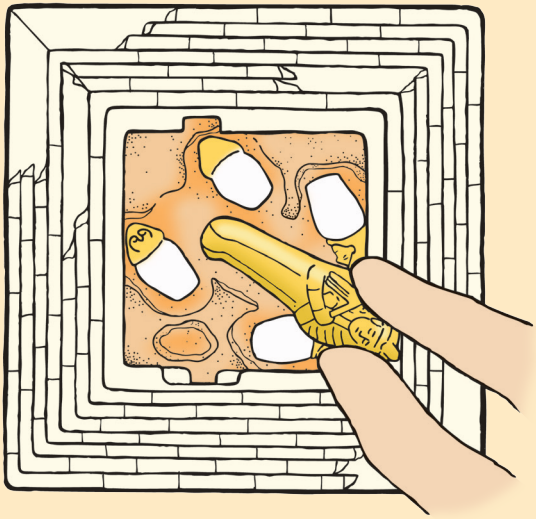

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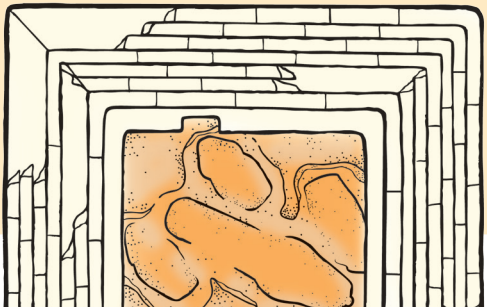
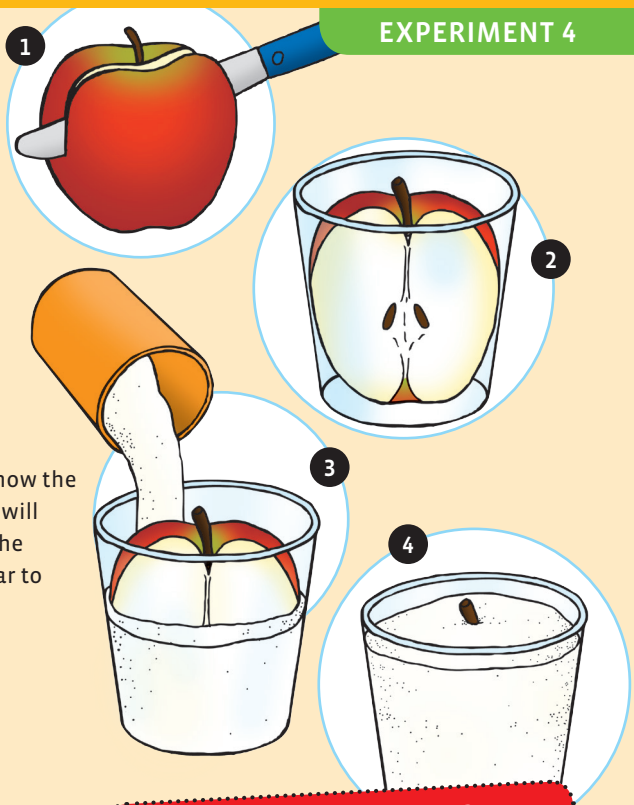


EXPERIMENT 4

Mummify an apple

YOU WILL NEED

→ *apple*
→ *knife*
→ *glass or jar*
→ *baking soda*
→ *table salt*



Carry out this experiment to learn how the mummification process works. You will preserve an apple by removing all the water from it, using a process similar to the one ancient Egyptians used to mummify bodies.

HERE'S HOW

1. Cut an apple in half.

2. Put one apple half in a clean glass or jar.

3. Cover the apple with a mixture of half baking soda and half table salt.

4. Store the glass in a dry place for one week. After one week, remove the apple, dust it off, and inspect it.

→ WHAT'S HAPPENING?

The baking soda and salt absorbed the water from the apple. Early on, the Egyptians simply buried their dead in the desert sand. Since the sand was dry, hot, and salty, the dead mummified in the ground. This means that their bodies were preserved. When coffins were used for the burial of certain people, it was determined that these bodies decayed, meaning that the bodies gradually fell apart in their coffins. This was something that the ancient Egyptians wanted to avoid, so they began to experiment. Dead people were rubbed with a special salt, which promoted the dehydration and drying of the body. Then bandages were added to further preserve and protect the body inside its sarcophagus.

In archaeology, an **artifact** is an object made by humans in an earlier time and usually has some cultural significance. Examples of artifacts include stone tools such as arrow heads and axes, pottery such as urns and clay bowls, and jewelry such as beads and necklaces. Obviously, fragile objects that deteriorate over time, such as paper and cloth, are less likely to last through the ages to be found by archaeologists. Trying to understand how these objects were used by past peoples is an important part of archaeology.

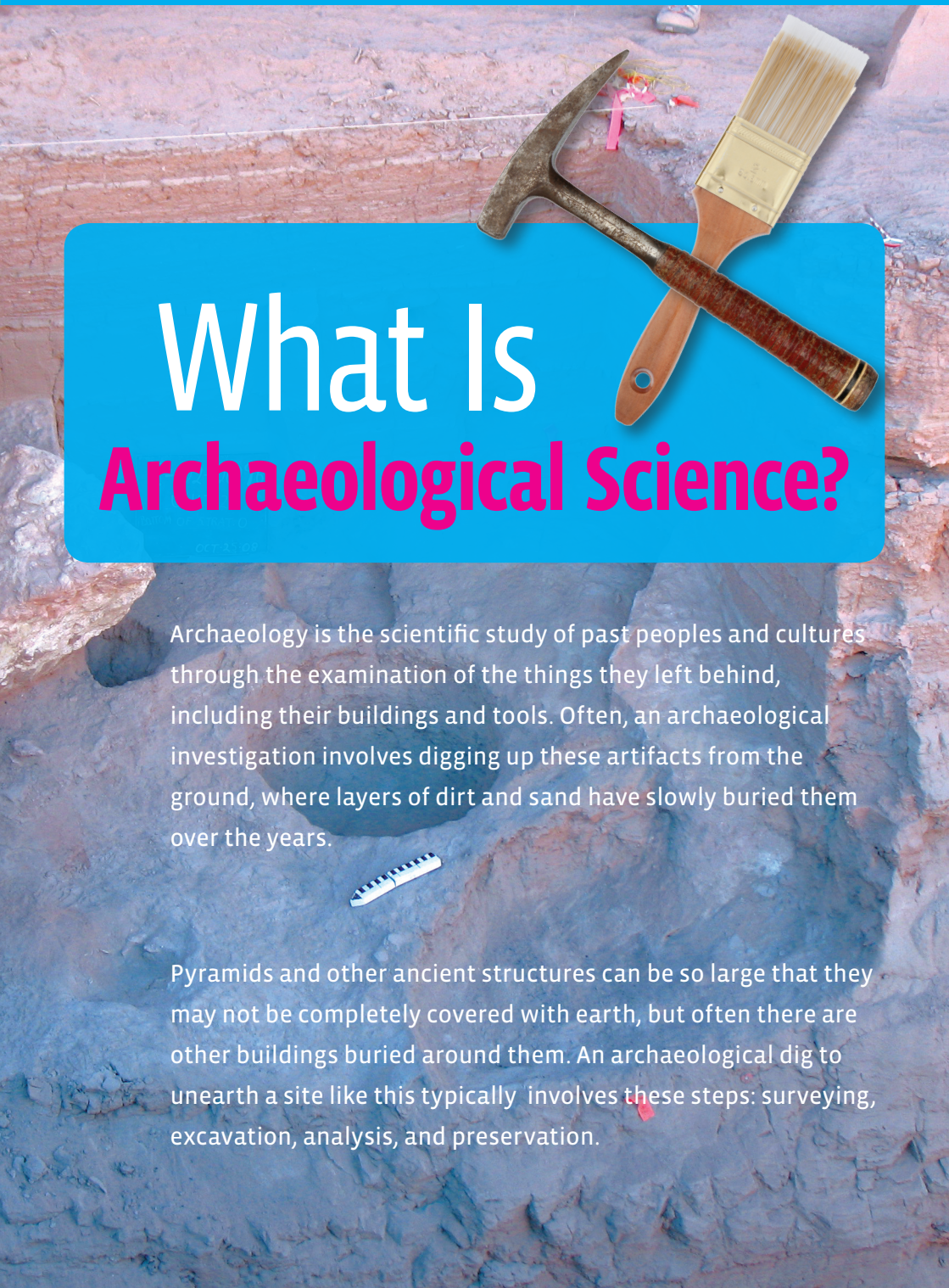
The **sarcophagus,** or sculpted stone coffin, in your pyramid is modeled after that of the pharaoh Tutankhamun. Pharaohs like Tutankhamun were often entombed inside several sarcophagi nested inside one another. Tutankhamun's innermost sarcophagus was made out of pure gold. The beautiful decorations on the casket and the sheer abundance of gold and jewels were intended to emphasize the importance of the deceased individual. In addition to their richly decorated coffins, a lot of pharaohs were buried with valuable masks covering the faces of their mummies.

CHECK IT OUT

Hieroglyphs are symbols that compose a writing system used by the ancient Egyptians called hieroglyphics. For a long time, the meanings of the Egyptian hieroglyphs were lost to human civilization. Some people suspected that the symbols weren't written characters at all, but just decorations. However, some researchers didn't accept that explanation, and they worked tirelessly to unlock the hieroglyphs' secrets.

Jean-François Champollion was a scholar who deciphered the meanings of Egyptian hieroglyphs, with the help of his predecessors. Through years of comparing, pondering, and testing, he was finally able to recognize the connections between familiar Greek writing and the hieroglyphs. As a basis for deciphering the hieroglyphs, he used a famous tablet known as the **Rosetta Stone,** on which text had been carved long ago in the two languages and three different scripts.

Have you found the four mysterious containers with the animal heads buried inside your pyramid yet? What do you think they are? They are **canopic urns,** which were used to hold the internal organs of the dead pharaohs. When a body was mummified, the liver, lungs, stomach, and intestines were removed from the body and wrapped up, covered in oil, and preserved in these containers.



What Is Archaeological Science?

Archaeology is the scientific study of past peoples and cultures through the examination of the things they left behind, including their buildings and tools. Often, an archaeological investigation involves digging up these artifacts from the ground, where layers of dirt and sand have slowly buried them over the years.

Pyramids and other ancient structures can be so large that they may not be completely covered with earth, but often there are other buildings buried around them. An archaeological dig to unearth a site like this typically involves these steps: surveying, excavation, analysis, and preservation.

EXPERIMENT 5

Remote sensing

YOU WILL NEED

- → *shoebox with lid*
- → *straight piece of wire*
- → *awl or pointed knife*
- → *ruler*
- → *permanent marker*
- → *various objects*
- → *adhesive tape*
- → *paper and markers*

HERE'S HOW

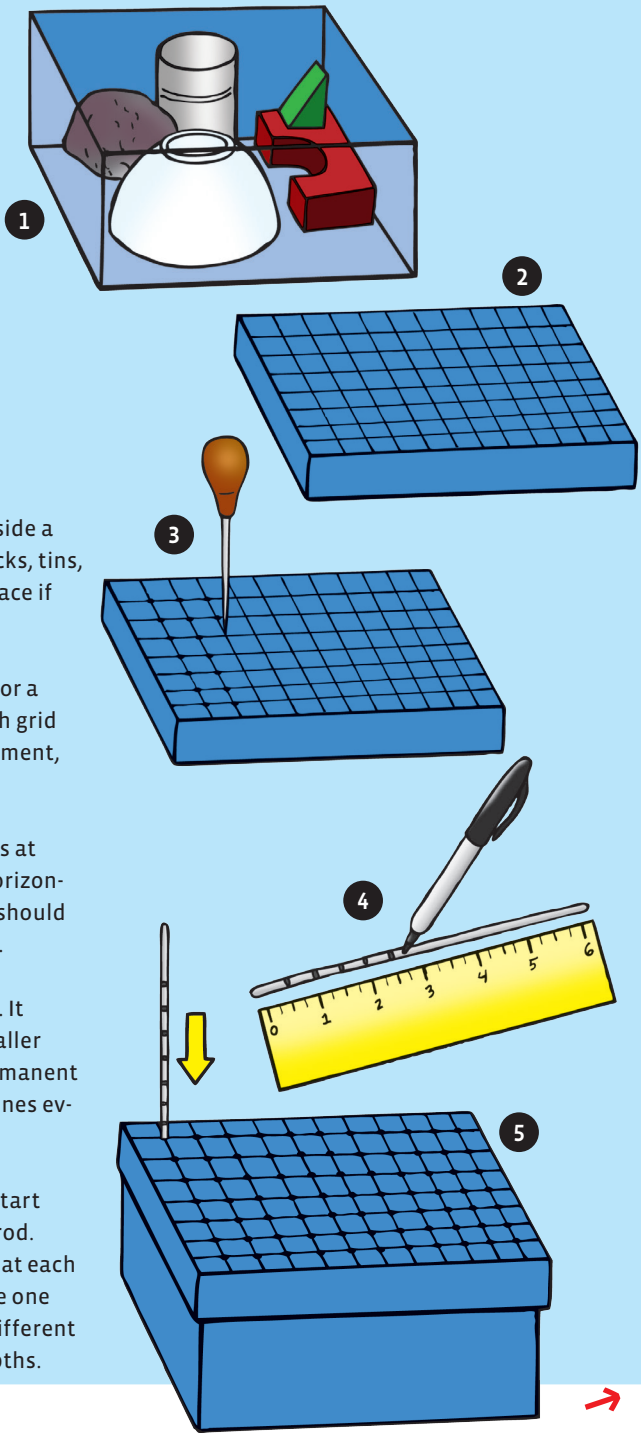
1. Position various solid objects inside a shoebox: blocks, bowls, cans, rocks, tins, and small boxes. Tape them in place if they move easily.

2. Draw a grid on the shoebox lid. For a faster experiment, draw one-inch grid lines. For a more accurate experiment, draw half-inch grid lines.

3. Using the awl or knife, poke holes at each point where vertical and horizontal grid lines intersect. The wire should be able to pass through the hole.

4. Cut a long, straight piece of wire. It should be at least a few inches taller than your shoebox. With the permanent marker, mark the wire rod with lines every inch or half inch.

5. Put the lid on the shoebox, and start probing the holes with the wire rod. Measure the depth of the object at each point and plot it on a grid like the one shown on the next page, using different colors to represent different depths.



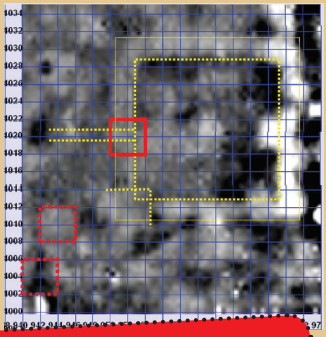
CHECK IT OUT

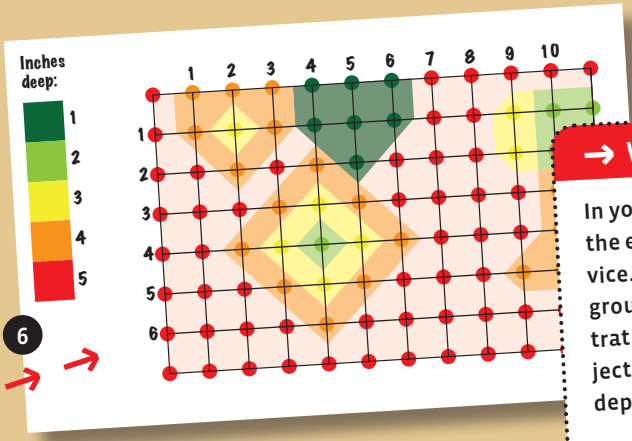
Surveying the Site

An archaeological dig starts with a survey of the site. A **survey** is an organized way of mapping a site and determining where interesting artifacts might be buried, and thus where to dig. Surveying can be done with minimal disruption to the site. Scientists use maps, aerial photographs, and satellite images to document their surveys. Core samples and small test pits may be used to determine where to dig.

Remote sensing devices are also used in surveys. These are tools that can give data about what is hidden underground, without requiring any actual digging. Metal detectors and magnetometers can locate metal artifacts by sensing their magnetic fields. **Ground-penetrating radar (GPR)** can give archaeologists a look into the ground, through rock, soil, ice, and other materials. GPR devices send electromagnetic waves into the ground, and then detect the waves that bounce back, creating an image from that information. The image can often reveal hidden artifacts, materials, and voids beneath the surface, without requiring an excavation.

Sonar uses sound waves to detect objects and terrains, usually underwater. Much like radar, a sonar device can create images by interpreting the sound waves that bounce back from objects. Infrared imaging uses light with a longer wavelength than visible light to detect materials hidden under other materials, for example, line drawings made with a carbon pencil underneath an old oil painting.





6

→ WHAT'S HAPPENING?

In your experiment, the wire represents the electromagnetic waves of a GPR device. Pretend the shoebox is solid ground, and the wire is the wave penetrating into the ground, hitting an object, and bouncing back to tell you the depth of the object it hits.

Gridded excavation site

YOU WILL NEED

- → hammer and pick tool
- → brush
- → chisel
- → *shoebox*
- → *potting soil*
- → *old spoon*
- → *plastic bag*
- → *old newspaper*
- → *various "artifacts" (small toys, coins, stones, shells, and other small objects)*
- → *string*
- → *adhesive tape*
- → *ruler*
- → *paper and pencil*

HERE'S HOW

Instructions for parents, teachers, or other supervising adults:

1. Cover the work area with newspaper. The area may get messy.

2. Fill the shoebox with one-half inch of potting soil.

3. Place some of the artifacts around the shoebox, in the soil.

4. Add another half inch of soil on top of the artifacts, and press the soil down a little.

5. Put a few more artifacts in the box, and add another layer of soil.

6. Continue adding artifacts and soil until the box is at least half full.

7. Press down on the soil to compact it.

8. Give the box to your child so they can proceed with the instructions below.

Instructions for the junior archaeologist:

1. You have just discovered a new site that is suspected to have great archaeological significance — the shoebox full of soil. You must perform a careful archaeological investigation of this site, and document your findings.

2. Start by making a grid over the site. Divide the box into three equal sections on the short side and four or five equal sections on the long side. Cut pieces of string to fit the box, and tape them in place as shown in the illustration on the next page. Since shoeboxes come in many sizes, your grid may look a little different than the one shown.

3. On a piece of paper, draw a scale plan of your shoebox, looking down from the top, as shown in the illustration on page 23.

4. Starting in one of the squares, use the spoon to carefully remove soil from the square until you have dug a square hole about half an inch deep. Neatly place the soil you remove in a plastic bag or on the newspaper, so you don't make a mess. Did you run into any artifacts while digging?

5. The instant your spoon touches something you think might be an

EXPERIMENT 6

Gridded excavation site

object of interest, stop digging with the spoon. With the pick end of the hammer tool, carefully scrape soil away from the object, touching the object as little and as lightly as possible. With the brush, clean the object off with a light sweeping motion. Above all, be careful that you do not move or damage the object!

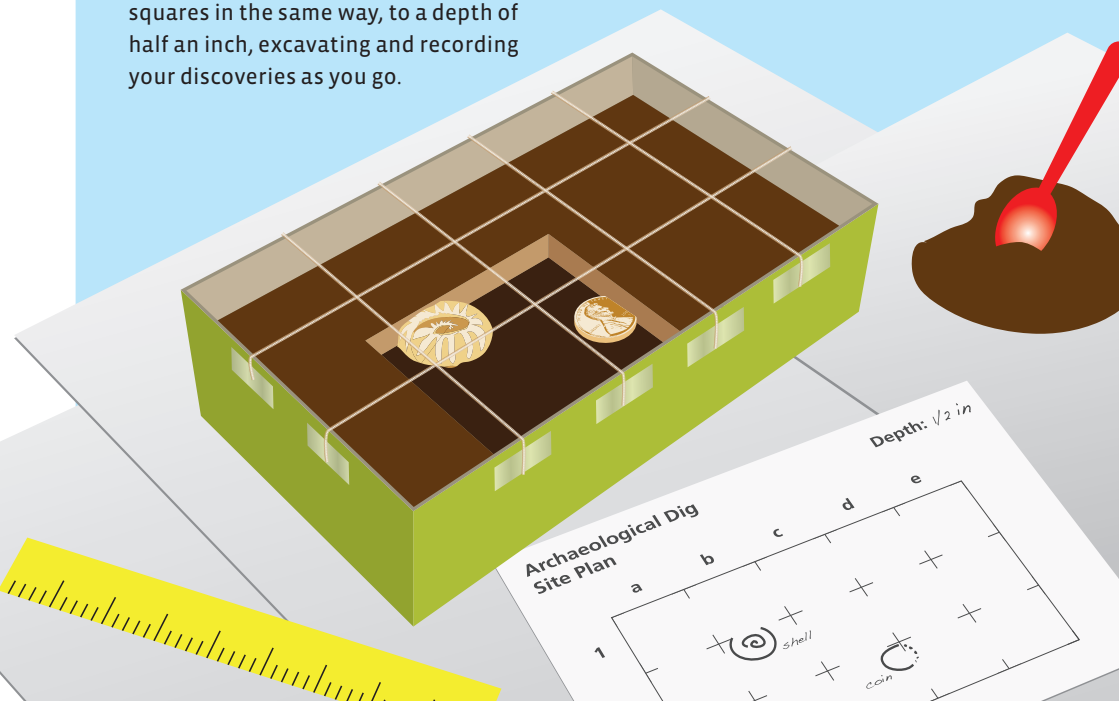
6. When you have cleaned off the object enough to see what it is, draw a picture of it in the corresponding location on your site plan. Make sure you draw it oriented in exactly the same way as you found it. Label the drawing of the object on the site plan.

7. Continue to excavate the rest of the squares in the same way, to a depth of half an inch, excavating and recording your discoveries as you go.

8. Once you have excavated a half inch from the entire box, move down to the next layer. Before you begin, carefully remove each object you already uncovered from the shoebox, and store all objects in an organized way off to the side, on a piece of paper, for example.

9. Repeat steps 4 through 8, excavating layer by layer, until you have found and documented all of the objects and reached the bottom of the box. Start a new site plan drawing for each layer you excavate.

10. Analyze your findings: How many objects did you find? Which object is the "oldest"? (That is, which object was placed in the box first?) Which object is the "youngest"? (That is, which object was placed in the box last?) What can you conclude about the people who left these objects here? Check your answers with the person who prepared the box.



Excavation

Excavation simply means digging up and removing soil from an archaeological site. When done correctly, it is a meticulous and slow process. If you just start digging into the ground with a shovel or a backhoe at a sensitive site, you might destroy priceless artifacts below the surface, and important information about them and their locations will be lost forever. Instead, an excavation is usually done by carefully removing soil, layer by layer, from a precisely chosen area.

An **archaeological site plan** is used to record the positions in which artifacts are found in the horizontal plane, as viewed from above. It is a map of the dig site. A grid is used to help archaeologists accurately determine where an object is found. The grid is actually laid out above the excavation site with string and stakes, and it corresponds exactly to a grid drawn on the plan.

Documentation is crucial during the entire process of an archaeological dig. It is especially important to record the position in which artifacts are found. Once removed from a site, there is no way to know for sure where some artifacts were found unless the information is recorded. The relative location in which artifacts are found is crucial to understanding the site and the objects' use and importance. This is why the site plan is so important.

The vertical location in which an artifact is found is also important. Archaeologists excavate sites in layered stages, so that the relative vertical location of an object can be determined. **Stratigraphy,** or the study of the layering of rock and soil in the ground, helps to determine the relative age of objects in the ground. Layers of earth are deposited in ascending order, with the oldest layers on the bottom and newer layers on top. Layers are horizontal and continuous, unless some disturbance changes the orientation of the layers. Thus, if an artifact is found in a distinct layer of soil that is above a layer in which another artifact is found, we can generally assume that the artifact in the upper layer is younger than the artifact in the layer below.

CHECK IT OUT

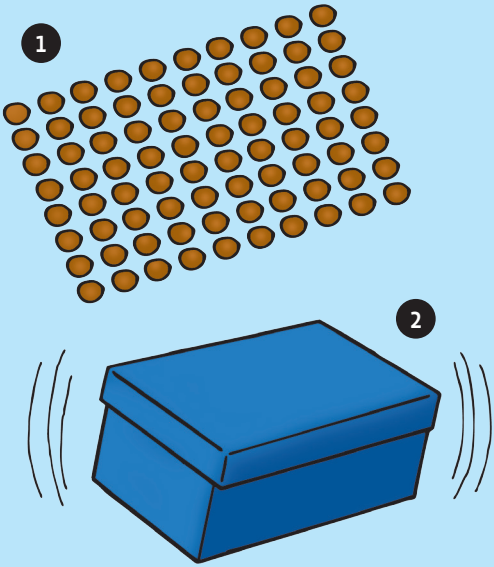
EXPERIMENT 7

Carbon-14 half-life

YOU WILL NEED

→ *80 pennies*
→ *shoebox*
→ *paper and pencil*

Carbon-14 is used to estimate the age of artifacts because it has a relatively short half-life. Understanding the concept of half-life is important to understanding this dating technique. The half-life is the time it takes for half of a radioactive substance to change, or decay, into another substance.



HERE'S HOW

1. Count out 80 pennies.
2. Put the pennies in a shoebox and shake it up.
3. Open the shoebox and remove the pennies that are facing heads up. Count the remaining pennies. Record the number below.
4. Repeat steps 2 and 3 until one penny remains.

Half-lives	Pennies remaining	Example data: pennies remaining
0	80	80
1		39
2		24
3		11
4		5
5		2
6		1
7		1

→ WHAT'S HAPPENING?

This example models the probability of decay of a radioactive substance. If you pretend the pennies represent carbon-14 atoms, then after each half-life, or each time you shake the box, the probability is that half of the carbon-14 atoms will have decayed, or that half the pennies will land heads up. The half-life for carbon-14 is approximately 5,730 years. Every 5,730 years, the amount of carbon-14 in a sample decreases by half.

Analysis

After an archaeological excavation, all of the data recorded about the site and the objects found in the site are analyzed by the archaeologists, so that they can make conclusions about the past cultures that inhabited the site.

One very important aspect of this is **dating,** or determining the ages of the artifacts found. Knowing the age of an artifact can help archaeologists relate the object to other information about the time in which it was made, and thereby answer questions about that time.

There are two types of dating: relative and absolute. Relative dating tells us the age of an object in relation to another object, while absolute dating tells us the exact age of an object. Relative dating is mostly done by stratigraphy, which you just read about. Absolute dating involves analyzing chemicals in an artifact to determine its age.

There is much more to post-excavation analysis than just dating. Because the number of questions about ancient civilizations is almost endless, the analytical methods employed to answer those questions are also virtually limitless.

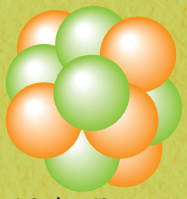
CHECK IT OUT

Preservation

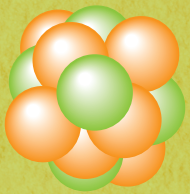
After artifacts and buildings are excavated from their safe resting places underground or underwater, it is important to preserve them properly, so that they do not disintegrate or fall apart. There are many ways to do this, depending on the artifact, but preservation often involves protecting the artifact from the damaging effects of light and air with special coatings, containers, or storage methods. Some artifacts are put into museums, so that the public can get a glimpse into the way past civilizations lived.

CARBON DATING

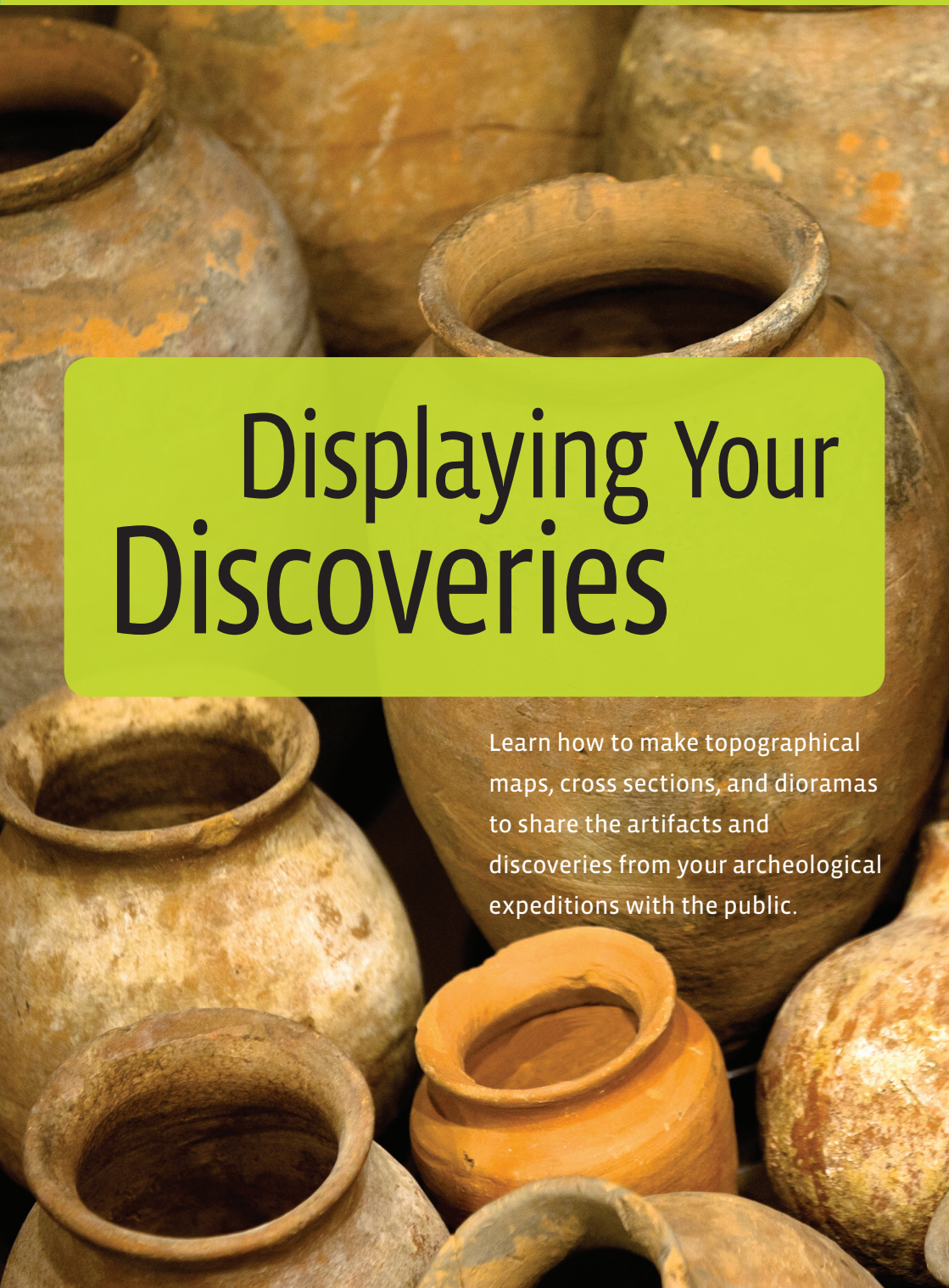
Carbon dating is one method of absolute dating for carbon-containing materials. Because all living things contain carbon, this method can be used to scientifically estimate the age of old plant and animal remains. It uses **carbon-14,** a radioactive form of carbon that is constantly being produced in the atmosphere. Plants and animals breathe in a small amount of carbon-14 with each breath while they are alive. After they die, the supply of new carbon-14 atoms inside their bodies stops, and the level of carbon-14 in the plant or animal remains starts to decrease at a fixed exponential rate. Carbon-14 has a half-life of about 5,730 years. That means that every 5,730 years, half of the carbon-14 in a sample decays into nitrogen-14. Scientists can therefore measure the amount of carbon-14 in a sample, such as a fossilized plant leaf, and compare that amount to the amount of carbon-14 they would expect to find in the sample. By comparing the levels, they can theorize how old the sample is based on the known rate of decay.



↑ Carbon-12
(6 protons, 6 neutrons)



↑ Carbon-14
(6 protons, 8 neutrons)



Displaying Your Discoveries

Learn how to make topographical maps, cross sections, and dioramas to share the artifacts and discoveries from your archeological expeditions with the public.

Pyramid model

YOU WILL NEED

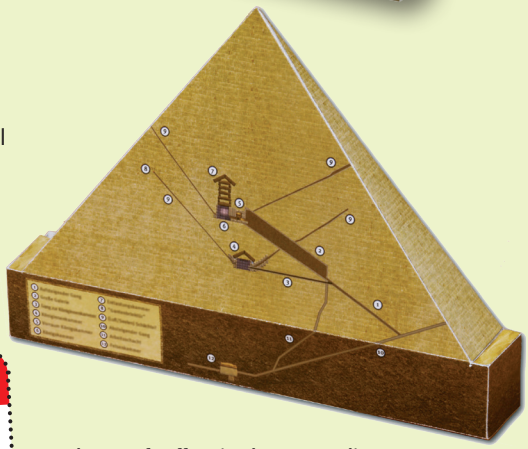
→ cardboard sheet with pyramid cross section
→ *scissors or utility knife*
→ *straight edge (ruler)*
→ *glue or adhesive tape*

HERE'S HOW

1. Cut out the pyramid cross section from the cardboard sheet. Cut along the solid lines. Do not cut along the dotted lines.

2. Fold the cardboard model along the dotted lines to form a three-dimensional pyramid shape.

3. Glue or tape the white flaps to the insides of the cardboard edges at the spots where they meet.



→ WHAT'S HAPPENING?

Cross sections like this are used to show how buildings and objects would look if you were to slice them in half. This cross section helps you picture how the corridors, chambers, and air shafts are positioned inside the pyramid.

The **King's Chamber** is made of massive pink granite blocks stacked to form a tall stone house with a pitched roof inside the pyramid. It holds a huge stone coffin that indicates the pharaoh was buried here.

The **King's Antechamber** is located directly in front of the King's Chamber and is blocked by 4,000-pound stone slabs.

The **Grand Gallery** is a long, ascending passageway leading up to the burial chamber. It was built as a chute for huge stone blocks to slide into place as soon as the pharaoh was laid to rest.

The **Queen's Chamber,** located below the King's Chamber, is not actually for a queen. Instead, it is thought to have been a temporary burial chamber for the pharaoh, should he have died before his final chamber was constructed.

The **Subterranean Chamber** is located in the ground underneath the pyramid. It has a rough, unfinished appearance compared to the other chambers. Archeologists do not know the purpose of this chamber.

EXPERIMENT 9

Diorama

YOU WILL NEED

- → pyramid and artifacts
- → *paper*
- → *markers or crayons*
- → *sand*
- → *tape and glue*
- → *plaster and old spatula*

HERE'S HOW

1. Draw a background for your diorama showing a scene in which you think your pyramid and artifacts would be found.

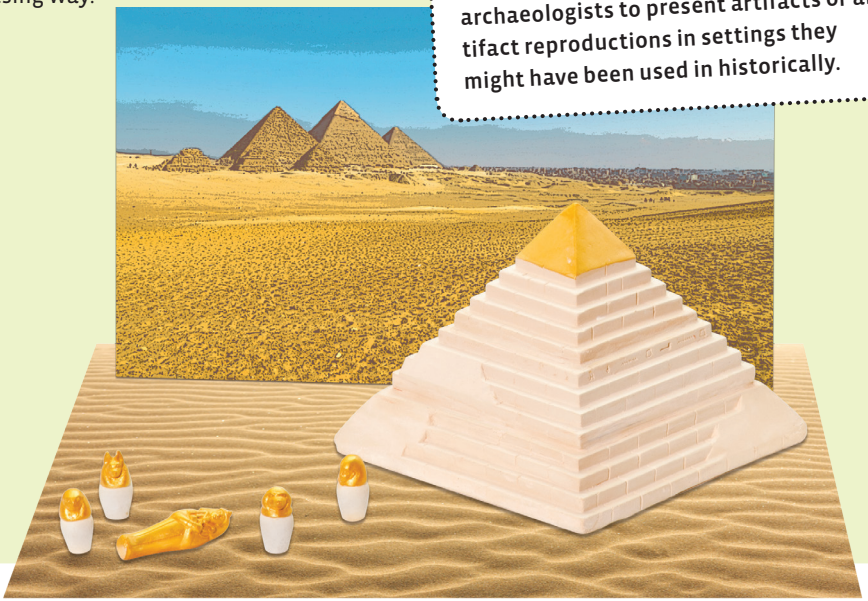
2. Cover a piece of paper with glue and then a layer of sand to create a sandy diorama base on which to place your objects.

3. Arrange your background, base, artifacts, and pyramid in a visually pleasing way.

4. If you wish, you can even glaze the sides of your pyramid with plaster. Buy the standard, commercially available plaster that you mix with water to form a thick paste. Pay attention to the instructions and warnings on the package. Using an old spatula, spread the plaster over the surface of the pyramid. When all the sections are covered, your pyramid will look like a model of Khufu's Pyramid shortly after its completion about 4,500 years ago.

→ WHAT'S HAPPENING?

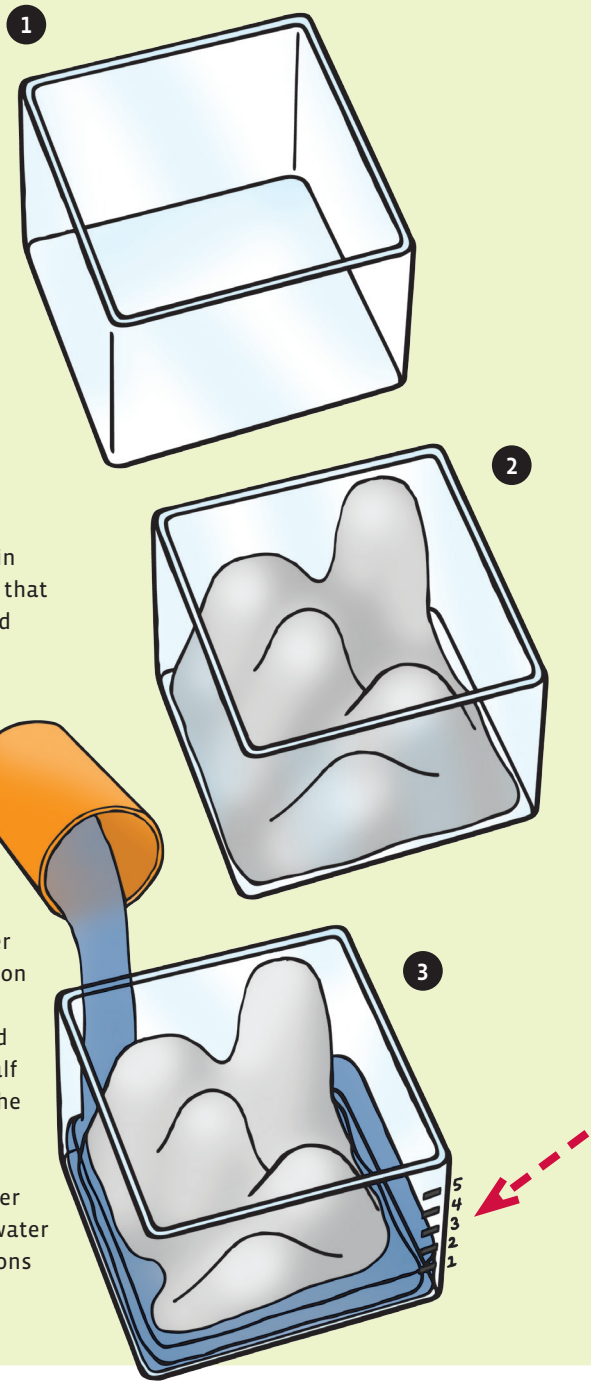
An important part of an archaeologist's job is to interpret the artifacts they uncover and present their interpretations to their colleagues and the general public, so we can all better understand the past. One of the fun ways archaeologists do this is by making dioramas. Dioramas are three-dimensional models that depict scenes from the natural world or another time period. These models allow archaeologists to present artifacts or artifact reproductions in settings they might have been used in historically.



Topographical maps

YOU WILL NEED

- → *clear plastic tub with straight side walls*
- → *modeling clay*
- → *cup*
- → *water colored with a few drops of food coloring*
- → *permanent marker and ruler*
- → *pencil and graph paper*



HERE'S HOW

1. Start with a clear plastic tub or basin with fairly straight side walls. A tub that is between the size of a loaf of bread and a shoebox will work well.

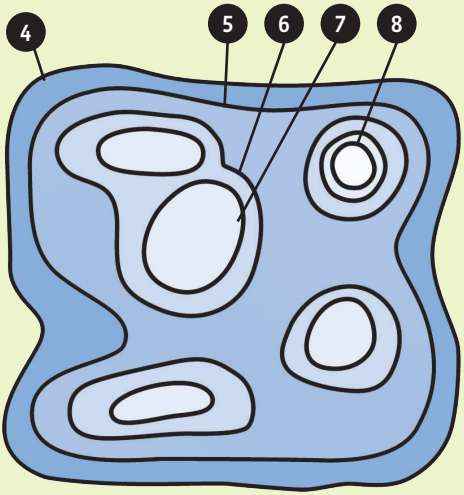
2. Create a landscape inside the basin using the modeling clay. You can make peaks, valleys, flat plains, craters, plateaus, or any other shapes you can imagine.

3. Use the ruler and permanent marker to measure and mark the elevation on the side of the tub. Hold the ruler vertically against the tub's side, and make a mark every inch (or every half inch for a small tub) up the side of the tub.

   Now, fill the basin with colored water up to the first elevation mark. The water will begin to cover the lowest portions of the clay terrain.

EXPERIMENT 10

Topographical maps



HERE'S HOW IT CONTINUES

4. On the graph paper, draw the outline of your tub. Then draw a line that resembles the line formed by the edge of the water against the clay when you look down on it from above. If the water has formed some "lakes" or "islands," make sure you include their outlines too. The lines you drew indicate all the points at which your landscape is one inch above sea level, where sea level is at the base of your tub. These lines are called **contour lines.**

5. Add colored water up to the second elevation mark. Draw the second contour line to match the new water-clay boundary line.

6. Add colored water up to the third elevation mark, and draw a third contour line.

7. Add colored water up to the fourth elevation mark, and draw a fourth contour line.

8. Add colored water up to the fifth elevation mark, and draw a fifth contour line.

9. Continue adding water and drawing contour lines until the tub is full of water.

→ WHAT'S HAPPENING?

Look at your drawing. It should have five or more levels of contour lines. You have created a topographical map of your terrain. Where the lines are closer together, the terrain is steeper, and where the lines are farther apart, the land is more flat.

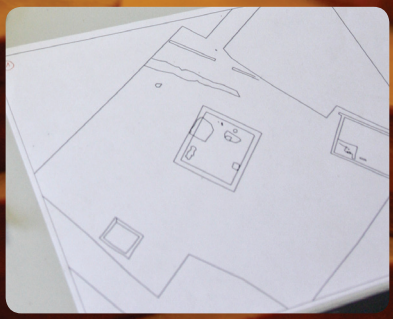
CHECK IT OUT

Topographical Maps

Topographical maps are used to show elevation on a two-dimensional plane. They use contour lines, which connect all the points on the land that are at a specific altitude above sea level. The contour lines are set at regular intervals. For example, contour lines could be drawn for every 10 meters or every 100 meters above sea level.

By definition, contour lines can never intersect, because the same place can never be at two different elevations at the same time. However, contour lines may appear very close together, which indicates that the slope, or change in elevation, is very steep in those places. Conversely, contour lines that are very far apart indicate a very flat area with little change in elevation, such as a plain.

Archaeologists often make small-scale topographical maps of their excavation sites to record the various depths at which artifacts are found, and to communicate information about the physical layout of the site to their colleagues and the public.



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