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I

PAST TO PRESENT

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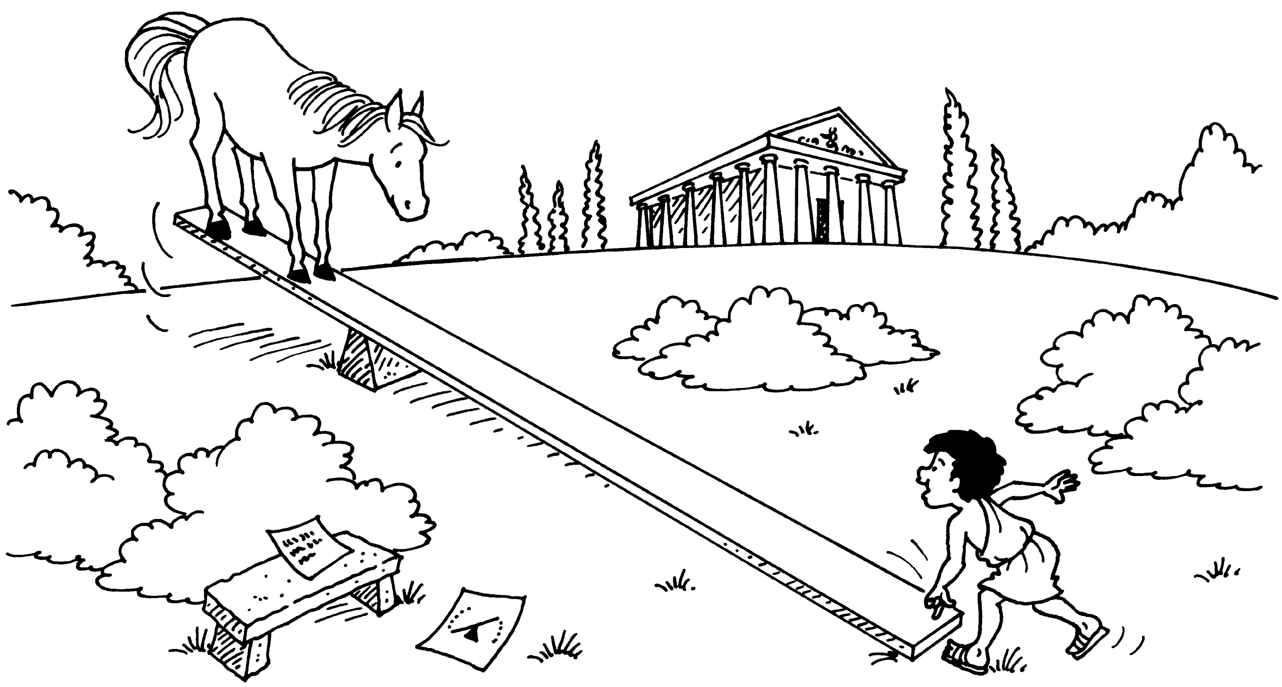
History of Science



DID YOU KNOW?

You could lift a horse with your finger!

Science is a system of knowledge about the nature of the things in the **universe** (Earth and all natural objects in space regarded as a whole). **Astronomy** is the study of **celestial bodies** (natural things in the sky, such as stars, suns, moons, and planets). **Biology** is the study of **organisms** (living things, such as plants and animals). **Chemistry** is the study of the materials that substances are made of and how they change and combine. **Earth science** is the study of the Earth. **Physics** is the study of energy and matter and how they interact. **Energy** is the ability to cause motion, and matter is anything that can be moved. **Matter** takes up space and has **mass** (an amount of material).

People began thinking about and doing science thousands of years ago, before they even developed a system of writing. So there is no written record of the first investigations. But some of the earliest drawings indicate observations of the natural world, such as the rising and setting of the Sun, phases of the Moon, and fire. (See chapter 7 for more on phases.) Like many of today's scientific discoveries, the "discovery" of fire was serendipitous, which means it was accidental. The first observed fire was most likely created by lightning. One can only guess at the observations made at the time, but getting burned was probably one of them. Fire was one of humans' most important early discoveries. It changed the way people lived and the way societies developed. With fire, not only could people stay warm, but they could also cook and keep their food longer.

The ancient people who made the greatest contributions to Western science were the Greeks. Greek **philosophers** (people who study the meaning of life, problems of right and wrong, and how we know things) made many observations of the natural world and developed theories (ideas) to explain things they saw. Pythagoras of Samos (c.580–c.500 B.C.), a Greek philosopher and religious leader, was responsible for important developments in the history of mathematics and astronomy. Aristotle (384–322 B.C.) was the most influential philosopher in the history of Western thought. Centuries after his death, the writings of Aristotle were considered the truth by the Christian church, and to disagree with his ideas was a crime punishable by imprisonment or death. The study of the natural sciences was dominated by Aristotle until early modern times. While Aristotle and most other Greek scholars were thinkers, some, such as the Greek mathematician Archimedes (c.298–212 B.C.), also performed experiments.

In the past as well as now, scientific advancements occurred out of the need to solve problems. One common problem was the movement of heavy objects, such as large rocks. A **machine** is a tool used to make it easier to move things. One of the first simple machines used to move a load was the lever. A **lever** is any rigid bar, such as a tree limb, that turns about a support called a **fulcrum.** The lever was used for thousands of years before Archimedes explained how it worked. From his investigations, Archimedes determined that if you had a long enough lever you could lift anything, even a horse by pushing down on one end of the lever with one finger. (The problem, of course, is getting a lever strong enough and long enough, but in theory it is true, as you'll see in the investigation that follows.)

From the fall of Rome in A.D. 476 until about the mid-1500s, there was little advancement in science. Most contributions to science during this period were made by people interested in **alchemy** (a mixture of science and magic that dealt with changing less valuable metals into gold and finding ways to prolong life indefinitely). **Alchemists** were people who practiced alchemy. The results of the investigations of many alchemists became the foundations for chemistry and **pharmacology** (the study of medicines).

The rebirth of science occurred around 1543 with the publication of two books. The first book was written by the Polish astronomer Nicolaus Copernicus (1473–1543). Before his book, many scientists thought the Earth was the center of the universe. Copernicus suggested that it was not. (See chapter 6 for more on Copernicus and models of the universe.) The second book was about human **anatomy** (the study of the structure of organisms). This book was written by the Belgian **anatomist** (scientist who studies anatomy) Andreas Vesalius (1514–1564). Before Vesalius, human anatomy was based on thoughts rather than observations. Vesalius dissected human **cadavers** (dead bodies) and his careful descriptions of human anatomy helped establish modern observational science. (See chapter 12 for more on Vesalius and anatomy.)

In the late sixteenth century, the English philosopher Francis Bacon (1561–1626) made a lasting contribution to science. He described what he called the inductive method, now commonly called the **scientific method** (the process of thinking through possible solutions to a problem and testing each possibility to find the best solution). The scientific method involves the following: doing **research** (a process of collecting information about a topic being studied), identifying the **problem** (a scientific question to be solved), coming up with a **hypothesis** (an idea about the solution to the problem), designing and conducting an **experiment** (a procedure to test the hypothesis), collecting and organizing **data** (observations

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and/or measured facts), and reaching a **conclusion** (a statement relating the results to the hypothesis).

Today, scientists have sent people to the Moon and, with various instruments, can look inside a living human body. But in spite of all the advancements of science, there are still many unsolved problems. There is so much more to be learned about the universe and organisms in it. Maybe you will make your own great discoveries.

FUN TIME!

Purpose

To demonstrate a lever.

Materials

egg-size piece of modeling clay
ruler
index card

Procedure

1. Break the clay into four pieces as close to the same size as possible.
2. Mold the clay into four balls.
3. Lay the ruler on a table. Place one clay ball at one end of the ruler and two clay balls, one in front of the other, at the opposite end.
4. Lay the index card on the table and the fourth clay ball in the center of the card. The clay is a support.
5. Position the ruler on the clay support so that it balances. Make note of the length of the ruler on both sides of the clay support. *NOTE: If you have difficulty balancing the ruler, slightly flatten the top of the clay support.*

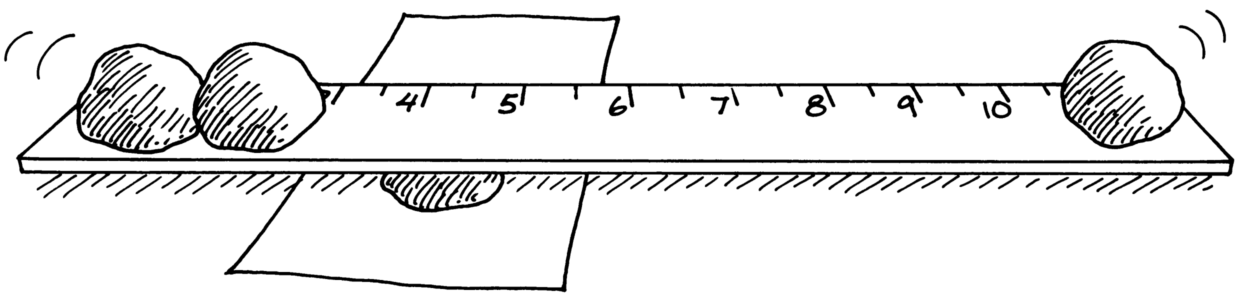
Results

From the point where the ruler balances, it is longer to the end with one clay ball than to the end with two clay balls.

Why?

The place where the ruler is supported by the clay represents a fulcrum, the point about which a lever (the ruler) turns. If equal weights were placed on opposite ends of a lever, the lever would balance with the fulcrum in the center. But if unequal weights were place on the ends of the lever, as in this investigation, the fulcrum would have to be closer to the heavier weight to balance the lever.

The distance a weight is from the fulcrum is called the **lever arm.** When the fulcrum is not in the center of the lever, but is placed closer to one end, the result is two unequal lever arms, one short and the other long. It takes less weight on the long lever arm to bal-



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ance a heavier weight on the short lever arm. Archimedes said that if he had a place to stand and a long enough lever, he could lift the Earth.

MORE FUN WITH BALANCE!

Make a balancing bee by copying or tracing the bee pattern on this page. Glue the pattern to stiff paper, such as poster board. When the glue has dried, cut out the bee.

Make two separate chains with three paper clips in each chain. Attach one chain to the end of each wing. Take a new pencil with a flat eraser and hold it vertically in one hand (eraser end up). Hold the bee horizontally in the other hand. Place the tip of the bee's nose in the center of the eraser and release the bee. The bee stands on its nose. If it leans to one side, adjust the position of the paper clip chains. This will change the length of the lever arms, the distance the chains are from the fulcrum (the bee's nose). As with the ruler in the original investigation, the length of the lever arms affects how the bee balances.

BOOK LIST

Hann, Judith. *How Science Works.* Pleasantville, N.Y.: The Reader's Digest Association, 1991. Interesting facts and activities about levers and other science topics.

Richards, Roy. *101 Science Tricks.* New York: Sterling, 1990. Fun experiments about levers and other science topics with everyday materials.

VanCleave, Janice. *Janice VanCleave's Machines.* New York: Wiley, 1993. Experiments about levers and other machines. Each chapter contains ideas that can be turned into award-winning science fair projects.