How Do Scientists Study Living Things? U-1 L-2

Exploring Science / Historical Steps

Life Comes From Life "Where did I come from?" asks the young child. "From us," say her parents. Today, all scientists agree that living things come from other living things. Young flies, frogs, mice and humans all have parents like themselves. But this wasn't always known.

Long ago, people thought that some living things came from nonliving things. This belief was known as **spontaneous generation** (spon-TANE-e-us jen-ur-A-shun). Believers in spontaneous generation felt that rotting meat produced maggots (young flies). They thought that mud could turn into frogs. Placing wheat on dirty shirts was believed to produce mice.

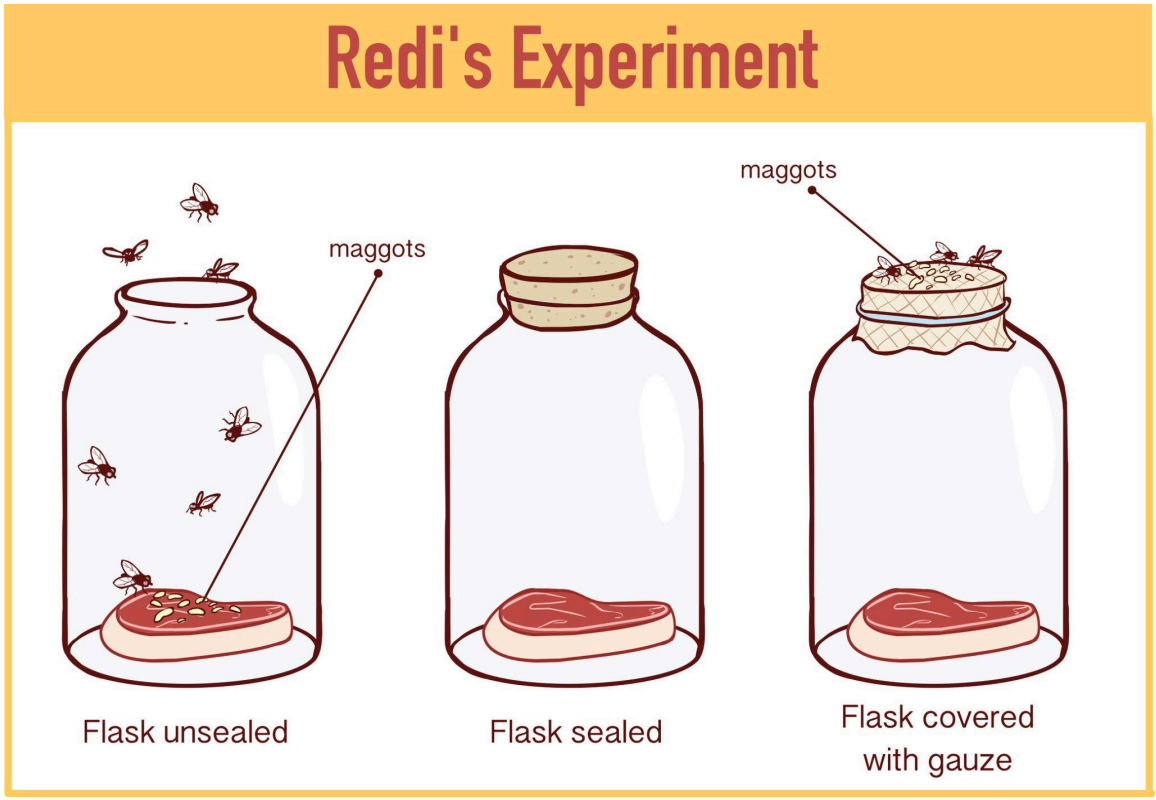
Some people doubted such beliefs. They wanted proof. In the 1660s, **Francesco Redi**, an Italian doctor, did an experiment to test spontaneous generation of maggots. Redi put some rotting meat in an open jar and watched it closely. He soon saw some adult flies near the meat. Three days later, maggots covered the meat.

After 19 days, the maggots stopped moving. Then they turned into small hard "footballs." Redi placed some of the footballs into another jar that was empty. After eight more days, the footballs broke open. Out came adult flies!

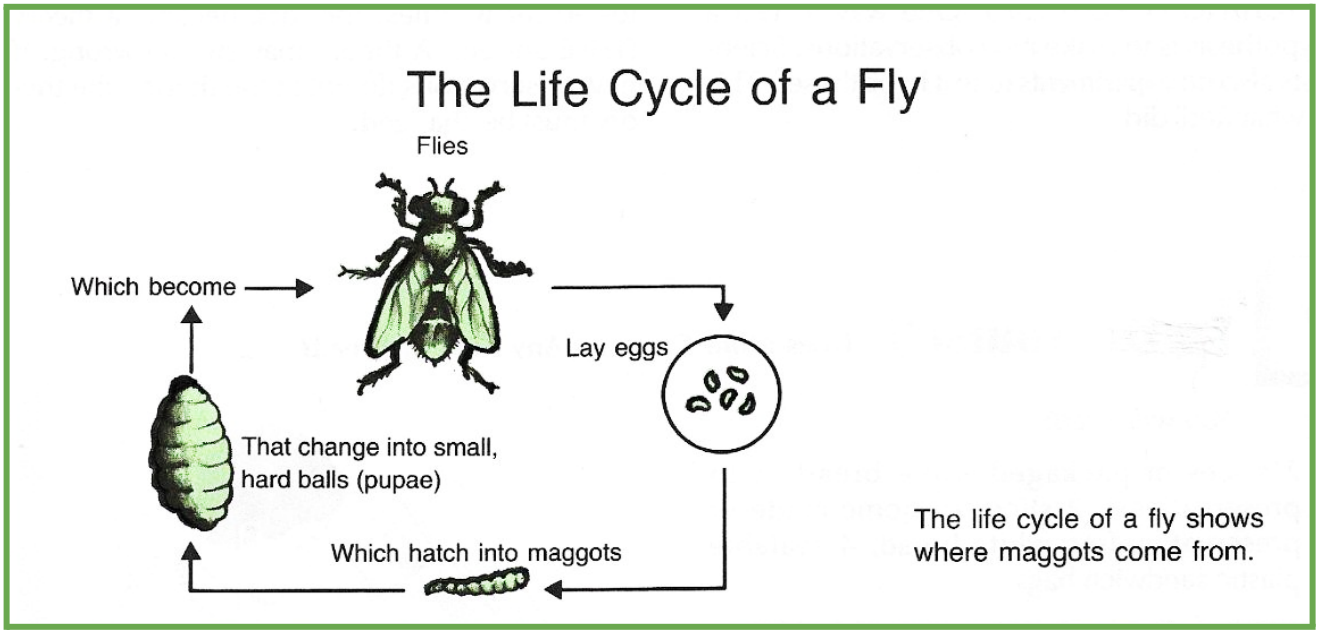
The flies had laid eggs on the meat. The eggs then hatched into **maggots**. The maggots became "footballs." Finally, the maggots developed into adult flies.

Redi set up more jars of rotting meat. He sealed some; others he covered with netting. He left more jars open. No maggots appeared in the sealed jars or the jars covered with netting. As before, maggots soon appeared in the open jars. Redi had shown that baby flies come only from eggs laid by the parent flies.

Redi's work helped to change beliefs about where living things come from. Other scientists showed that frogs come from eggs laid by other frogs. They showed that all baby mice come from other mice; it just happens that mice like to eat wheat and to nest in dirty shirts.



Note: In the jar at the right, the flies could not reach the meat, so they laid eggs on the netting.



Soon after microscopes were invented, microorganisms were found. These are also called **microbes** (MY-krobes). By this time, scientists no longer believed that *animals* could come from nonliving matter. However, some people thought that *microbes* could!

Louis Pasteur with a child

Then, late in the 1800s, one of history's most famous scientists, **Louis Pasteur** (Loo-ee pah-STUR) of France, decided to settle the matter. Using special flasks that he designed, Pasteur proved that spontaneous generation of microbes does not occur. Microbes definitely come from other microbes.

No one has shown that *any* living thing comes from nonliving matter. All organisms have parents.

➢ Want more? Research this phrase: "Pasteur's swan neck flask."

➢ Eels are long rounded fish that are sometimes mistaken for snakes. Scientists long wondered where a certain kind of eel, which lives in rivers, comes from. Which statement below is more likely correct?

A. River mud can turn into eels.

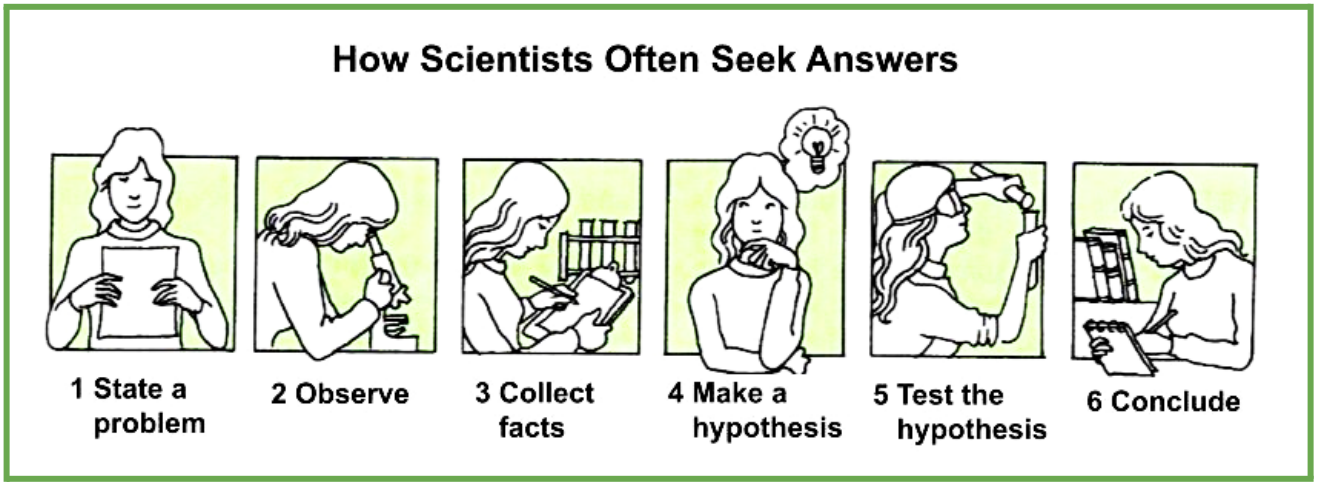
B. Eels lay eggs in the ocean. The eggs hatch, and the baby eels swim into a river.

The Ways of the Scientist

The study of living things is life science - also called **biology**. Scientists who study biology are **biologists** (by-OL-uh-jists). Some biologists are **ecologists** (ih-KOL-uh-jists). They study **ecology** (ih-KOL-uh-jee), the relationship of living things to their environment.

Like other scientists, biologists may work in laboratories. Or they may work outside - in forests, in fields, or in freshwater or saltwater. They may work anywhere in the **biosphere** (BY-uh-sfeer). The biosphere is the part of the Earth in which life exists. A layer of soil, water, and air makes up the biosphere.

Some biologists even work outside of the biosphere - in space, aboard spacecraft or in space suits.



Scientists have many ways of working. Often, however, their work follows a general pattern, called the **scientific method**. The parts of this method are described below.

• **STATING A PROBLEM** Scientists are curious. They ask many questions. For example, Redi's problem could be stated, "Where do maggots come from?"

• **OBSERVING** Using one's senses to gain information is called observing. Observing can involve seeing, hearing, touching, smelling, or tasting. All scientists use **observation**. When Redi saw maggots appear on rotting meat, he was observing. Using a microscope helped Pasteur observe and study microbes.

In science, **measurement** is a way of observing. Counting is a simple kind of measuring. Redi was measuring when he counted the days between changes he saw in his jars.

Scientists also measure with tools. Their tools include balances, thermometers, and meter sticks. You probably know that nearly all scientists use **metric** units to measure length, mass, volume and temperature. Do you remember why scientists prefer metric units?

• **COLLECTING DATA** While they are observing, scientists often collect information - which they call **data**. Data usually includes numbers. To organize their data, scientists use charts called **data tables**. (See two data tables on page 88).

Scientists also read reports of other scientists. This helps them build on each other's work.

Of course, scientists know that they can not simply believe everything they read. This is especially true for information from the internet. The sources of all information must be checked and compared with trusted sources.

• **MAKING HYPOTHESES** Scientists use the information that they collect to make hypotheses (hy-POTH-ih-seez). A hypothesis is a guess or possible answer. Redi's hypothesis was that maggots come from flies.

• **TESTING HYPOTHESES** One way to test a hypothesis is to make new observations. Scientists also do experiments to test hypotheses. This is what Redi did. You will learn more about experiments in the next lesson.

• **PRODUCING A CONCLUSION** From the results of tested hypotheses, scientists make **conclusions** (explanations). Redi concluded that maggots come from flies, not from rotting meat. Pasteur concluded that microbes could grow only from other microbes.

Help in Writing a Conclusion -- Using **C E R**

These three letters stand for **C**laim, **E**vidence and **R**easoning. Scientists often use the CER method to write a good conclusion for their experiment. They ask themselves, "What does my conclusion *claim* is true?" They then point out the specific pieces of *evidence* that support their claim. Finally, they explain their *reasoning*; that is, they describe *why* they feel that the evidence supports their claim.

"That's Just a Theory!"

Unfortunately, among non-scientists (often called **laypeople**), you may hear someone say, "That idea is just a theory!" Many people think that the word theory is simply another word for a "guess." But this is not the way that scientists use the term theory. To scientists, an explanation becomes a **theory** only when they have very strong evidence that it is true.

Today's scientists accept that living things come only from other living things. Before this idea was tested, it was a hypothesis. After it was tested many times, the idea became a **theory** (THEE-uh-ree).

Of course, even a solid theory may later be shown to be incorrect. If new observations and data do not fit the theory, it must be changed.

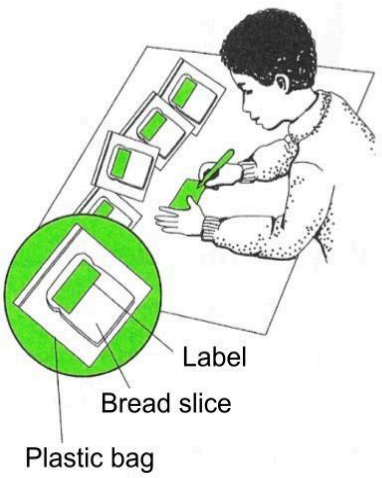
➢ To Do Yourself

Does mold grow on any kind of bread?

You will need:

2 slices of packaged white bread (with preservatives); 2 slices of home-made or preservative-free white bread; 4 sealable plastic sandwich bags

1. Place the four slices of bread inside of the plastic bags, one slice per bread.
2. Dampen each slice of bread with a few drops of water. Seal the bags.
3. Label each bag's bread type and the date.
4. Keep the bread in a dark, warm place.
5. Make a hypothesis about which bread will become moldy first.
6. Looking through the plastic, observe your bread slices every day. Do not open the bags.
7. Record your data in a notebook.
8. Dispose of the sealed bags properly.



Questions

1. Which kind of bread became moldy first? _____

2. Make a hypothesis about where the bread mold came from. _____

_____

3. What can you conclude about the two types of bread? _____

_____

---------- REVIEW ---------- U-1 L-2

I. Fill each blank with the word that fits best. Choose from the words below.

biosphere **measuring** **theory** **biology** **observing**
hypothesis **ecology** **guessing** **biologists**

Life science is also called_____. Scientists who study biology are _____. The _____ is the part of the Earth in which life exists. Using one's senses is _____. Counting or using a tool (such as a meter stick) is _____. A possible explanation is a _____. A hypothesis that is repeatedly tested and fits all observations may become a _____.

II. Show the order of events in developing a scientific theory. Place 1, 2, 3, or 4 in front of each item.

A. ___ testing hypotheses
B. ___ making hypothesis
C. ___ conclusion
D. ___ stating a problem

III. Write the word that matches each statement.

observation **measurement** **hypothesis** **data table**

A. _____ Used to organize information

B. _____ A guess that maggots come from flies

C. _____ Looking at microbes with a microscope

D. _____ Counting the days it takes for maggots to appear

IV. Here is an example of the **CER** method at work.

At Pedro's school, the drama teacher needed a character with a deep voice. Pedro won the role. The next day you hear Ricardo state, "Pedro has the deepest voice in the school!"

You are not convinced that Ricardo's conclusion is correct. Use CER to make your case. [Hint: Include what was claimed, what evidence was used to back the claim, and how the reasoning was weak (and could be improved).]

_____

_____

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