

Spontaneous Generation

For thousands of years, humans have asked the question: “How does life emerge?”

Some early ideas from the time of Aristotle (doesn't it always start with Aristotle?) included life coming from other life by reproduction, organisms reproducing by fragmentation such as when you start a new plant from a leaf cutting, or **spontaneous generation** - inanimate objects turning into living things.

The first 2 ideas seem pretty viable, but how about the idea of spontaneous generation? Where did that come from?

Aristotle noticed that new wooden boats were barnacle free, but older wooden boats had barnacles clinging to the surface. He did not see any barnacles swimming up to the boat, so he inferred that the wood was turning into barnacles. He also noticed that although the desert was devoid of observable vegetation, plants sprung up in the desert quickly without observable delivery of seed or plants themselves, so the sand must be turning into plants!

Pull out the large triangle labeled “A”. Lets say that this triangle is an analogy for information that helps us to generate our hypothesis. This represents Aristotle’s observations.

Before I tell you about the next character in our story, I will give you the next piece of data. Pull out a second large triangle (labeled B). Play with the 2 pieces and determine if you can use these two pieces and still come up with a triangle (representing our initial hypothesis). Can you use these 2 triangles to come up with different shapes (representing different hypotheses)?

Later in the 1600's, a researcher named Francesco Redi decided to learn more about the spontaneous generation hypothesis.

At this time people noticed that meat would only last a few days before it became covered with maggots. Many people thought that the meat was changing into maggots via spontaneous generation. Redi tested this idea using 3 jars, each containing a piece of meat. The first jar was left open, the second jar was plugged with a cork and the third jar was covered with a piece of cloth. Redi found that flies had access to the meat in the first jar and maggots emerged from the meat. He also observed that flies did not have access to the meat in the second jar and no maggots developed. The third jar was visited by flies but they could not get to the meat and maggots appeared on the top of the cloth.

When Redi interpreted his results, he proposed that the meat did not turn into maggots but instead flies laid their eggs on the meat, which hatched into maggots. Other peers of Redi argued that blocking the airflow to the meat prevented a “life spark” that was necessary for the meat to change into maggots. Notice that Redi's evidence was interpreted in different ways, much like you used the 2 triangles to make multiple shapes.

Lets bring in some more evidence before I move on with the story. Pull out pieces C, D, and E, each of which represent a new piece of evidence. Play with these pieces and the first 2 pieces to see if you can still make a triangle. It is a little more difficult but can be done. Now on with our story!

In the 1700's, people such as Antone Van Leewuenhoek and Robert Hooke were perfecting the construction and use of microscopes. This opened a whole new world, as people now were able to learn that tiny organisms could be found in pondwater, saliva samples and many other places!

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Lets count this as piece C - evidence that life exists even though we can't see it. Think back to Aristotole and Spallanzani's opponents, what could this piece of evidence mean?

People noticed that when chicken or beef broth went bad, it turned cloudy. Using microscopes, they could observe that the cloudiness was caused by tiny organisms we later learned were bacteria.

Lets count this evidence as piece D. How could this new knowledge be interpreted in the context of spontaneous generation?

Our next character is John Needham. He constructed an experiment to build upon Redi's experiment and test the hypothesis of spontaneous generation. Needham boiled (boiling was known to kill bacteria) broth and allowed it to cool to room temperature. Then he added lids and sealed the broth to see if bacteria would grow in the broth. Because he boiled the broth and it grew bacteria anyway, he proposed that the broth *turned into* bacteria, further supporting the idea of spontaneous generation. Others argued that he did not boil the broth long enough, or that the bacteria entered the jars before they were sealed. Notice that some interpreted the results one way and others another.

We will count this evidence as piece E. You demonstrated previously that pieces A through E could still be used to construct a triangle, representing our original hypothesis, in a number of ways. You also may have noticed that the pieces could be used to make different shapes.

While there are other experiments and important people in this story, in general the idea of spontaneous generation continued to prevail, which impacted ideas about food preservation and medicine.

One more notable experiment finally put the issue to rest. Before we discuss it, lets pull out the last piece - labeled F - representing evidence from this experiment. Attempt to incorporate it with the other pieces and see if you can make a triangle.

Louis Pasteur, who contributed a great deal of knowledge with his creative experiments, tested the spontaneous generation hypothesis. He made a flask with a long curved extension, allowing air to flow in and out of the vessel, but preventing dust and other particles from entering.

Pasteur added broth to this flask, boiled the flask and noted that even though it had access to air, the broth remained clear and free of bacteria. In other words, the broth was not turning into bacteria because the bacteria did not have access to the broth to contaminate it. This required people to abandon the idea of spontaneous generation and acknowledge that sometimes *unseen processes* are required for life to emerge. Life does not emerge from non-living materials.

Notice that the addition of Pasteur's evidence does not fit into the previous hypothesis of spontaneous generation, and impacts the way that prior evidence is interpreted.

Teaching Note: Students may bring to your attention that evolutionists propose that life came from non-living materials. This is on a different scale and addresses evolution of organic molecules, cells and organisms over millions of years. This does not address the generation to generation reproduction explored in this activity.

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