

Scientific Ways of Thinking

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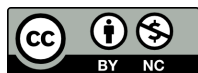
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CHAPTER 1 Scientific Ways of Thinking

- Describe the role of a scientist.
- Describe what is meant by "thinking like a scientist."



What was that noise?

If you let your emotions rule your thinking, you might think a thumping noise was a ghost. If you think like a scientist, however, you ask questions and make observations. You'd observe the shutters are loose and blowing in the wind.

Scientific Ways of Thinking

Modern science is a way of understanding the physical world, based on observable evidence, reasoning, and repeated testing. That means scientists explain the world based on their own observations. If they develop new ideas about the way the world works, they set up a way to test these new ideas.

Thinking Like a Scientist

A scientist is always trying to find the truth and discover new truths. How can you think like a scientist? Thinking like a scientist is based on asking and answering questions. Though you may not know it, you do this all day long. Scientists ask questions, and then make detailed observations to try to ask more specific questions and develop a **hypothesis**. They may design and perform an **experiment** to try to answer their question and test their hypothesis. From the results of their experiment, scientists draw **conclusions**. A conclusion describes what the evidence tells the scientist.

- **Scientists ask questions:** The key to being a great scientist is to ask questions. Imagine you are a scientist in the African Congo. While in the field, you observe one group of healthy chimpanzees on the north side of the jungle. On the other side of the jungle, you find a group of chimpanzees that are mysteriously dying. What questions might you ask? A good scientist might ask the following two questions:

- 1. "What differs between the two environments where the chimpanzees live?"
 - 2. "Are there differences in behavior between the two groups of chimpanzees?"
- **Scientists make detailed observations:** To **observe** means to watch and study attentively. A person untrained in the sciences may only observe, "The chimps on one side of the jungle are dying, while chimps on the other side of the jungle are healthy." A scientist, however, will make more detailed observations. Can you think of ways to make this observation more detailed? What about the number of chimps? Are they male or female? Young or old? What do they eat? A good scientist may observe, "While all seven adult females and three adult males on the north side of the jungle are healthy and show normal behavior, four female and five male chimps under the age of five on the south side have died." Detailed observations can ultimately help scientists design their experiments and answer their questions. From these observations, a scientist will develop a hypothesis to explain the observations. A hypothesis is the scientist's proposed explanation for his observations. The scientist's hypothesis may be that "Young chimps on the south side die due to a lack of nutrients in their diet."

**FIGURE 1.1**

An adult and infant chimpanzee (*Pan troglodytes*).

- **Scientists find answers using tests:** When scientists want to answer a question, they search for evidence using experiments. An experiment is a test to see if their explanation is right or wrong. **Evidence** is made up of the observations a scientist makes during an experiment. To study the cause of death in the chimpanzees, scientists may give the chimps nutrients in the form of nuts, berries, and vitamins to see if they are dying from a lack of food. This test is the experiment. If fewer chimps die, then the experiment shows that the chimps may have died from not having enough food. This is the evidence.
- **Scientists question the answers:** Good scientists are skeptical. Scientists never use only one piece of evidence to form a conclusion. For example, the chimpanzees in the experiment may have died from a lack of food, but can you think of another explanation for their death? They may have died from a virus, or from another less obvious cause. More experiments need to be completed before scientists can be sure. Science is about finding the truth, no matter what. So good scientists constantly question their own conclusions. They also find other scientists to confirm or disagree with their evidence.

Summary

- Modern science is a way of understanding the physical world, based on observable evidence, reasoning, and repeated testing.
- To think like a scientist, you must ask questions, make detailed observations, develop a hypothesis, find answers using tests, and question your answers.

Explore More

Use the resource below to answer the questions that follow.

- **Understanding Science** at <http://undsci.berkeley.edu/article/scienceflowchart>
1. Once an experiment has been conducted and the results analyzed, what 4 possible responses are there when interpreting the data?
 2. How does "peer review" fit into the scientific process? Why is it so important?
 3. In the flowchart, what 5 processes are involved in "Exploration and Discovery"? Do you think any one of these processes is more important than the others? Explain your reasoning.

Review

1. What is modern science?
2. How do you think scientifically?
3. What does it mean "to observe"?
4. What is a hypothesis?

References

1. Derek Keats. [An adult and infant chimpanzee](#) . CC BY 2.0