

Scientific Method

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CHAPTER

1

Scientific Method

- Explain how scientific questions are answered using scientific method.



How many angels can dance on the head of a pin?

This is a question that has been pondered over the centuries. Can it be answered using scientific method? Is it a scientific question?

The Goal of Science

The goal of science is to answer questions about the natural world. Scientific questions must be testable. Which of these two questions is a good scientific question and which is not?

- What is the age of our planet Earth?
- How many angels can dance on the head of a pin?

The first is a good scientific question that can be answered by radiometrically dating rocks among other techniques. The second cannot be answered using data, so it is not a scientific question.

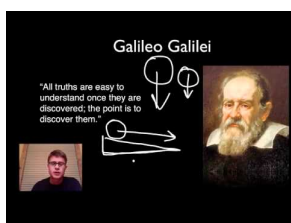
Scientific Method

Scientists use the **scientific method** to answer questions. The scientific method is a series of steps that help to investigate a question.

Often, students learn that the scientific method is a linear process that goes like this:

- Ask a question. The question is based on one or more observations or on data from a previous experiment.
- Do some background research.
- Create a hypothesis.
- Do experiments or make observations to test the hypothesis.
- Gather the data.
- Formulate a conclusion.

The process doesn't always go in a straight line. A scientist might ask a question, then do some background research and discover that the question needed to be asked a different way, or that a different question should be asked.



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Ask A Question

Now, let's ask a scientific question. Remember that it must be testable.

We learned above that average global temperature has been rising since record keeping began in 1880. We know that carbon dioxide is a **greenhouse gas**. Greenhouse gases trap heat in the atmosphere. This leads us to a question:

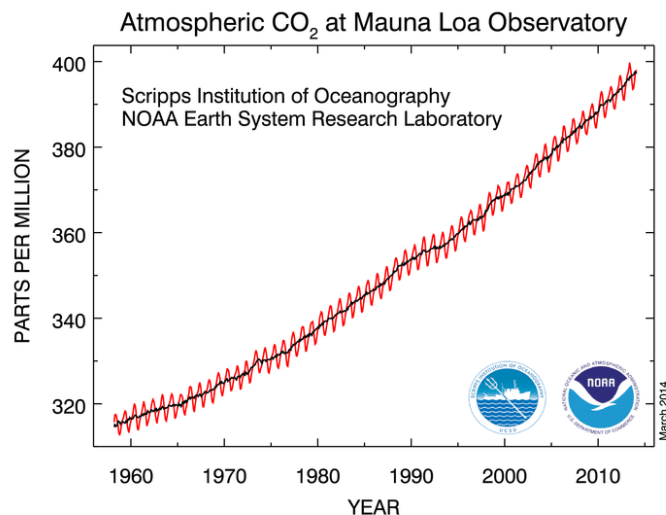
Question: Is the amount of carbon dioxide in Earth's atmosphere changing?

This is a good scientific question because it is testable.

How has carbon dioxide in the atmosphere changed over those 50-plus years (see **Figure 1.1**)? About how much has atmospheric CO₂ risen between 1958 and 2011 in parts per million?

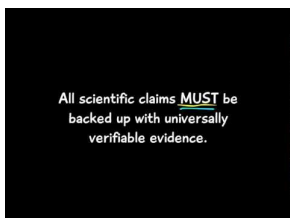
Answer a Question

So we've answered the question using data from research that has already been done. If scientists had not been monitoring CO₂ levels over the years, we'd have had to start these measurements now.

**FIGURE 1.1**

Atmospheric carbon dioxide has been increasing at Mauna Loa Observatory in Hawaii since 1958. The small ups and downs of the red line are seasonal variations. The black line is the annual average.

Because this question can be answered with data, it is testable.

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Summary

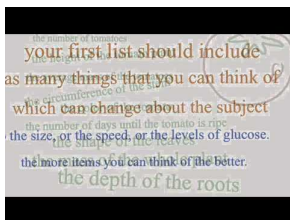
- Scientists use scientific method to answer questions about the natural world.
- First, scientists ask a question that they want to answer.
- Background research is essential for better understanding the question and being able to move to the next step.

Review

1. What features does a question need to have to be a good science question?
2. Create a list of three questions that are good science questions. Create a list of three questions that are not science questions.
3. Look at the graph of atmospheric CO₂ over time in the **Figure 1.1**. As close as you can determine, how much has the atmospheric CO₂ content risen since 1958? Levels are about 400 ppm now.

Explore More

Use this resource to answer the questions that follow.



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1. Why is a scientific question different from any other question?
2. What is an inference? What is an observation?
3. Describe the two types of observations.
4. How does the speaker recommend you do first? Where do you get the dependent and independent variables?
5. Give an example of a question using an independent and dependent variable and the topic of tomato plants.
6. What is a hypothesis?

References

1. Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/) and Dr. Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu/). [Graph of atmospheric carbon dioxide at Mauna Loa Observatory](#) . Public Domain