
Glencoe Science
Earth Science
NATIONAL GEOGRAPHIC
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Chapter: The Nature of Science

1

Mysteries and Problems

- Scientists are often much like detectives trying to solve a mystery.
- One such mystery occurred in 1996 when Japanese scientists were looking through historical records.

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Mysteries and Problems

- They reported finding accounts of tsunami that had smashed the coast of the island of Honshu on January 27, 1700.

- What had triggered these huge ocean waves?

1

The Search for Answers

- The scientists suspected that an earthquake along the coast of North America was to blame.
- Based on the size of the tsunami, the earthquake had to have been an extremely powerful one, sending waves rolling all the way across the Pacific Ocean.
- Could evidence be found for such a large earthquake?

1

Gathering Evidence

- Evidence of a large earthquake in the distant past did seem to exist along the coasts of Washington and Oregon.
- However, dating the earthquake to a specific year would be difficult.

1

A Possible Solution

- One scientist thought he knew how the earthquake could be dated.
- He made an educated guess, called a **hypothesis**, that tree rings in the drowned trees could be used to determine when the earthquake occurred.

1

A Possible Solution

- Data showed that the trees had died or were damaged after August 1699 but before the spring growing season of 1700.

- That evidence put the date of the earthquake in the same time period as the tsunami on Honshu.

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Importance of Solving the Mystery

- In addition to solving the mystery of what caused the tsunami, the tree rings also provided a warning for people living in the Pacific Northwest.
- Scientists warn that it's only a matter of time until another huge quake occurs.

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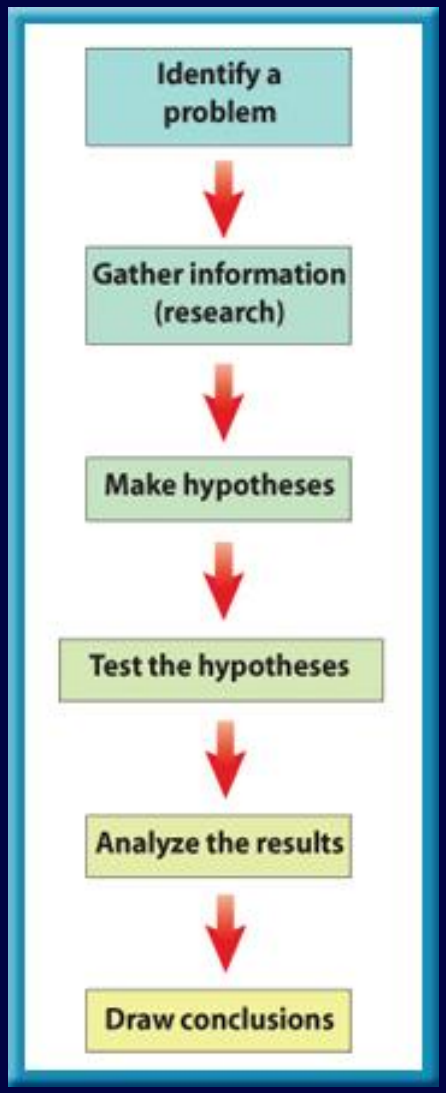
Scientific Methods

- When scientists try to solve a mystery, they perform problem-solving procedures called **scientific methods**.
- When you use methods like these, you are solving problems in a scientific way.



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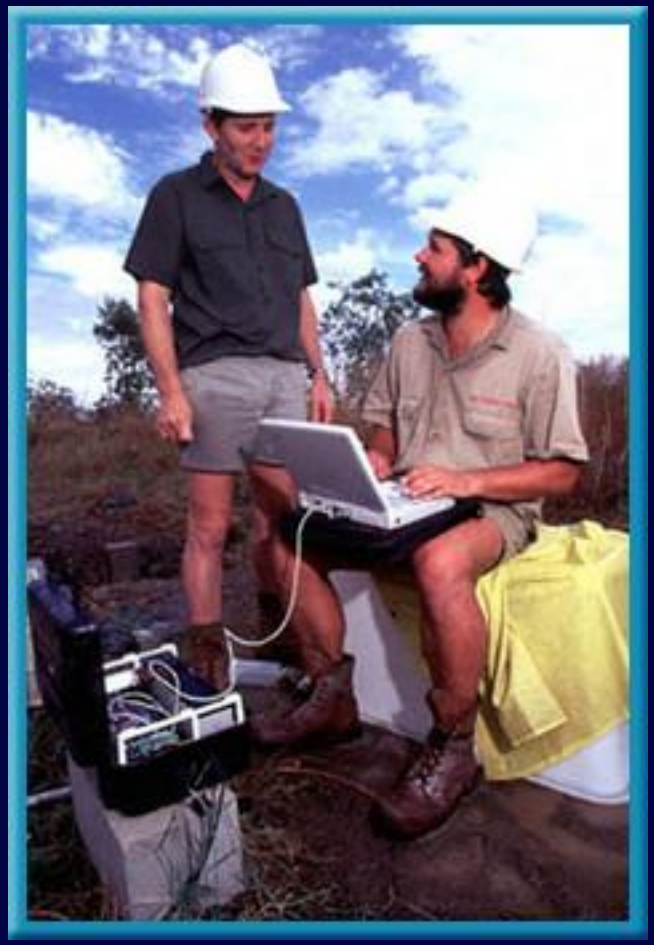
Science

- **Science** is a process of observing, studying, and thinking about things in your world to gain knowledge.
- Every time you attempt to find out how and why things look and behave the way they do, you are performing science.



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Earth Science

- **Earth science** is the study of Earth and space.
- Some Earth science topics include rocks, minerals, soil, volcanoes, earthquakes, maps, fossils, mountains, climates, weather, ocean water, and objects in space.

1

Working in the Lab

- Testing, or experimenting, is an important part of science, and if you really want to learn from an investigation, the experiment must be carefully designed.
- Suppose that after listening to advertisements for several dishwashing liquids, you want to know which brand of dishwashing liquid cleans dishes the best.

1

Working in the Lab

- After researching, several thoughts might go through your mind.
- You might hypothesize that brand X will clean dishes better than any other brand.

1

Working in the Lab

- Next, you would design an experiment that tests the validity of your hypotheses.
- You would need to think about all the factors that can affect the outcome.

1

Variables and Constants

- The different factors that can change in an experiment are **variables**.
- The variable you want to test is called the **independent variable**—the variable that you change.

1

Variables and Constants

- **Constants** are the variables that do not change in an experiment.
- A **dependent variable** is the variable being measured.
- A **control** is a standard to which your results can be compared.

1

Repeating Experiments

- For your results to be valid or reliable, your tests should be repeated many times to see whether you can confirm your original results.
- For example, you might design your experiment so you repeat the procedures five times.
- Also, the number of samples being tested should be large.

1

Testing

- After you have decided how you will conduct an experiment, you can begin testing.

- During the experiment, you should observe what happens and carefully record your data in a table.

1

Testing

- Your final step is to draw your conclusions.
- When you are making and recording observations, be sure to include any unexpected results.
- Many discoveries have been made when experiments produced unexpected results.

1

Technology

- Science doesn't just add to the understanding of your natural surroundings, it also allows people to make discoveries that help others.
- **Technology** is the use of scientific discoveries for practical purposes.

1

Using Technology

- The use of scientific knowledge has resulted in such common yet important things as paper, can openers, buckets, aspirin, rubber boots, locks and keys, microfiber clothing, ironing boards, bandages, and scissors.

1

Using Technology

- Technology also includes calculators and computers that process information.

1

Transferable Technology

- Technology is transferable, which means that it can be applied to new situations.
- For example, many types of technology that are now common were originally developed for use in outer space.

1

Transferable Technology

- Earth scientists rely on information from weather satellites to gather weather data. But biologists also use satellites to track animals.

- A tiny radio transmitter attached to an animal sends signals up to a satellite.

1

Question 1

In science, a testable guess is a _____.

A. constant
B. control
C. hypothesis
D. variable

1

Answer

The answer is C. A hypothesis is an educated guess that can be tested by experimentation.

1

Question 2

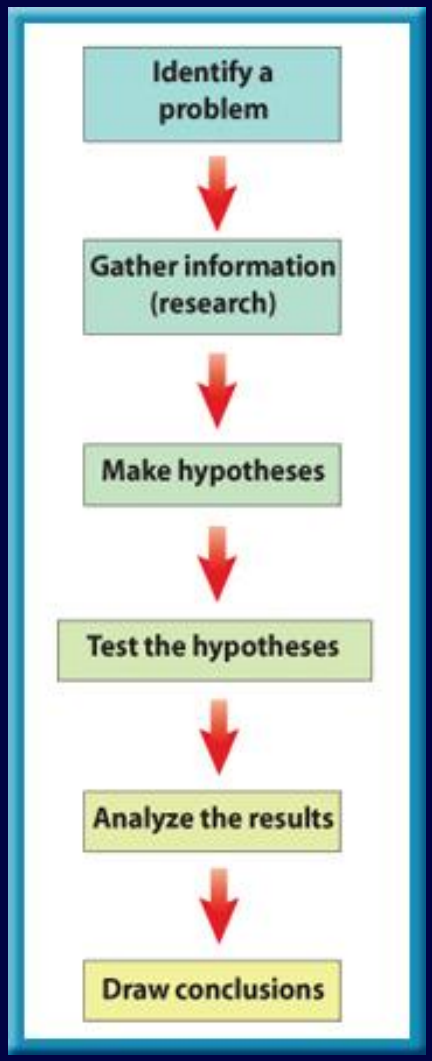
What is the process of observing, studying and thinking about things in the world?

A. controlling
B. science
C. technology
D. testing

1

Answer

The answer is B.
People use science to gain knowledge.
Testing is a part of science.



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Question 3

Which of the following is an example of using technology?

A. asking individuals whether they recycle
B. looking at trees in a forest
C. wondering what type of flowers bees prefer
D. using a hypsometer to determine a tree's height

1

Answer

The answer is D. Technology is the use of scientific discoveries for practical purposes. Making observations and asking questions are part of scientific methods, but do not always include the use of technology.

2

A Work in Progress

- Early people relied on mythology to explain what they observed.
- They believed that mythological gods were responsible for creating storms, causing volcanoes to erupt, causing earthquakes, bringing the seasons, and making comets appear in the sky.

2

Recording Observations

- Some early civilizations went so far as to record what they saw.
- They developed calendars that described natural recurring phenomena.

2

Recording Observations

- Later, civilizations created instruments to measure with.
- As instruments became better, accuracy of observations improved.
- While observations were being made, people made inferences, or conclusions, to help explain things.

2

The History of Meteorology

- The history of meteorology, which is the study of weather, illustrates how an understanding of one area of Earth science has developed over time.

2

Weather Instruments

- The rain gauge was probably the first weather instrument.
- The earliest reference to the use of a rain gauge to record the amount of rainfall appears in a book by the ruler of India from 321 B.C. to 296 B.C.

2

Weather Instruments

- It wasn't until the 1600s that scientists in Italy began to use instruments extensively to study weather.

2

Weather Instruments

- These instruments included the barometer—to measure air pressure; the thermometer—to measure temperature; the hygrometer—to measure water vapor in the air; and the anemometer—to measure wind speed.

2

Weather Prediction in the United States

- Benjamin Franklin was the first American to suggest that weather could be predicted.
- Franklin's ideas were put to practical use shortly after the telegraph was invented in 1837.

2

Weather Prediction in the United States

- By 1849, an organized system of weather observation sites was set up and weather reports from volunteer weather observers were sent by telegraph to the Smithsonian Institution.
- A large weather map was displayed at the Smithsonian and a weather report was sent to the *Washington Evening Post* to be published in the newspaper.

2

National Weather Service

- By the late 1800s, the United States Weather Bureau was functioning with more than 350 observing sites across the country.

- In 1970, the bureau's name was changed to the National Weather Service and it became part of the National Oceanic and Atmospheric Administration (NOAA).

2

National Weather Service

- Today's weather is forecast using orbiting satellites, weather balloons, radar, and other sophisticated technology.

2

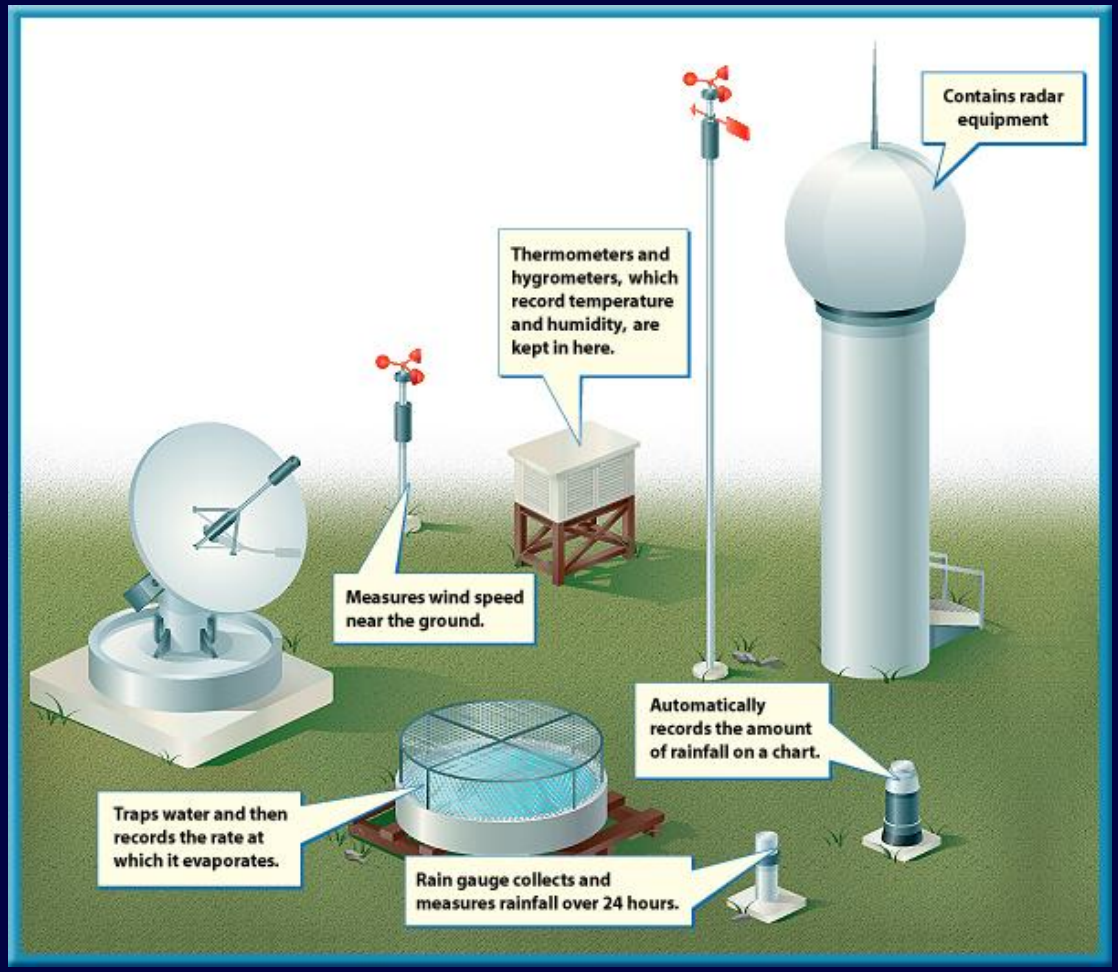
National Weather Service

- Each day about 60,000 reports from weather stations, ships, aircraft, and radar transmitters are gathered and filed.

2

National Weather Service

- Some weather stations are operated by meteor-ologists, but many are now automated.



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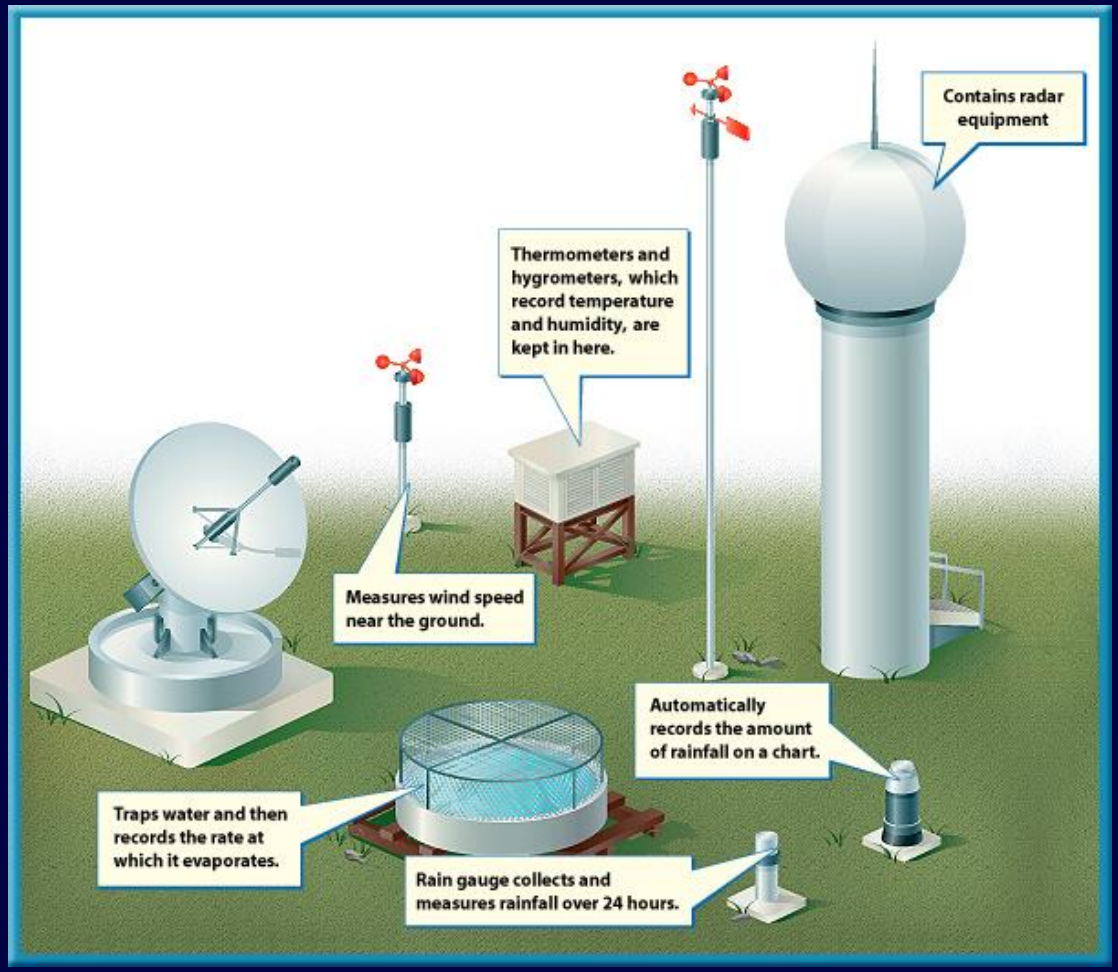
National Weather Service

- Data from automated stations are transmitted to a central office, where they are studied.



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National Weather Service

- Today, if you want to know about the weather anywhere in the world—at any time of day or night—you could watch a television weather channel, listen to a radio news station, or check an internet site.

2

Continuing Research

- Scientific knowledge continues to change as scientists develop better instruments and testing procedures.

- As it changes, scientists have a greater understanding of nature.

2

Continuing Research

- It is impossible to predict the types of instruments scientists will have in the future.
- But it is easy to predict that as research continues and instruments improve, knowledge will grow.

2

Scientific Theories

- If data gathered over a long period of time support a hypothesis, scientists become convinced that the hypothesis is useful.

- A **scientific theory** is an explanation or model backed by results obtained from many tests or experiments.

2

Scientific Laws

- A **scientific law** is a rule that describes the behavior of something in nature. 
- Usually, a scientific law describes what will happen in a given situation but doesn't explain why it happens.

2

Limits of Science

- Science doesn't have answers to all the questions and problems in the universe.
- Problems that deal with ethics and belief systems cannot be answered using these methods.

Should elephants be hunted as trophies?

2

Limits of Science

- **Ethics** deals with moral values about what is good or bad.
- Belief systems deal with religious and/or other beliefs.

Should elephants be hunted as trophies?

2

Doing Science Right

- Although ethical questions cannot be answered by science, there are ethical ways of doing science.

- The correct approach to doing science is to perform experiments in a way that honestly tests hypotheses and draws conclusions in an unbiased way.

2

Being Objective

- When you do scientific experiments, be sure that you design your experiments in such a way that you objectively test your hypotheses.

- If you don't your **bias**, or personal opinion, can affect your observations.

2

Being Ethical and Open

- People who perform science in ethical and unbiased ways keep detailed notes of their procedures.
- Their conclusions are based on precise measurements and tests.

2

Being Ethical and Open

- They communicate their discoveries by publishing their research in journals or presenting reports at scientific meetings.
- This allows other scientists to examine and evaluate the work.

2

Being Ethical and Open

- Scientific fraud involves dishonest acts or statements.
- Fraud could include such things as making up data, changing the results of experiments, or taking credit for work done by others.

2

Question 1

How does a scientific law differ from a scientific theory?

2

Answer

A scientific law is a rule that describes the behavior of something in nature, such as gravity. A scientific theory is an explanation backed by results from many experiments, and does not always describe something in nature.

2

Question 2

_____ deals with moral values about what is good or bad.

A. Data analysis
B. Ethics
C. Hypothesizing
D. Technology

2

Answer

The answer is B. An example of an ethical question that science cannot answer is: Should the federal government regulate car emissions?

2

Question 3

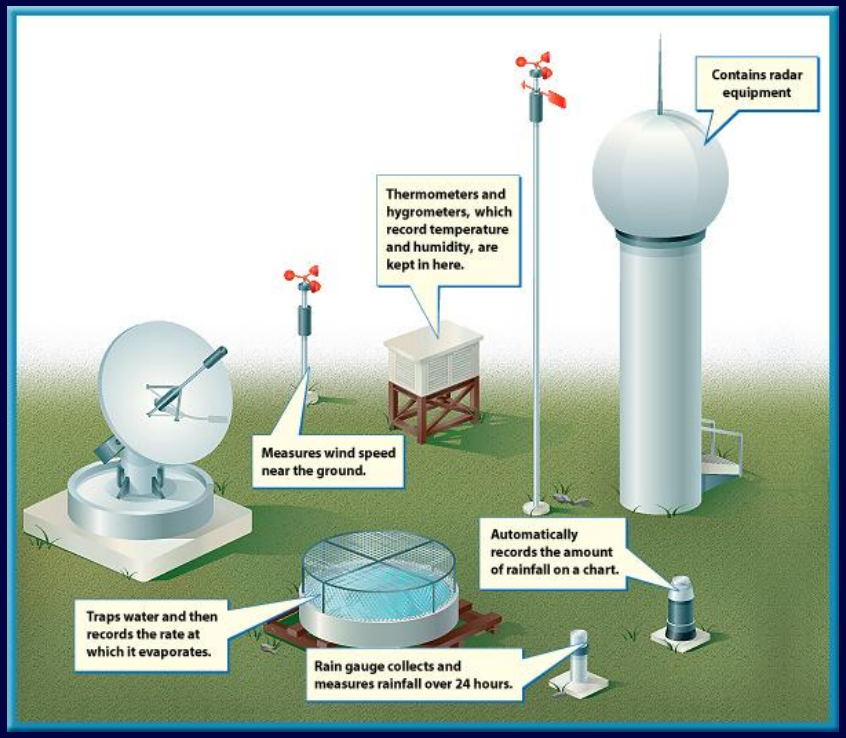
Which of the following instruments is used to measure water vapor in the air?

A. anemometer
B. barometer
C. hygrometer
D. thermometer

2

Answer

The answer is C. Anemometers are used to measure wind speed, barometers measure air pressure, and thermometers are used to measure temperature.



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