

1-2 How Scientists Work



Broth is boiled.



Broth is free of microorganisms for a year.



Curved neck is removed.



Broth is teeming with microorganisms.



How do scientists test hypotheses?

Whenever possible, a hypothesis should be tested by an experiment in which only one variable is changed at a time.

Designing an Experiment

The process of testing a hypothesis includes:

- Asking a question
- Forming a hypothesis
- Setting up a controlled experiment
- Recording and analyzing results
- Drawing a conclusion

Asking a Question

How do organisms come into being?

Forming a Hypothesis

One early hypothesis was **spontaneous generation**.

→ maggots spontaneously appeared on meat.

In 1668, Redi →: that maggots came from eggs that flies laid on meat.

Setting Up a Controlled Experiment

-variable that is changed → manipulated variable.

-variable that is observed → the responding variable.

Redi's Experiment

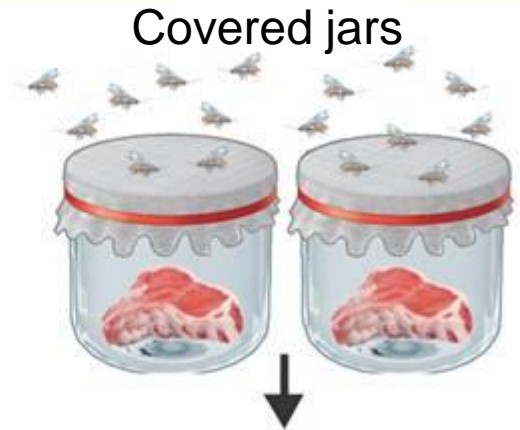
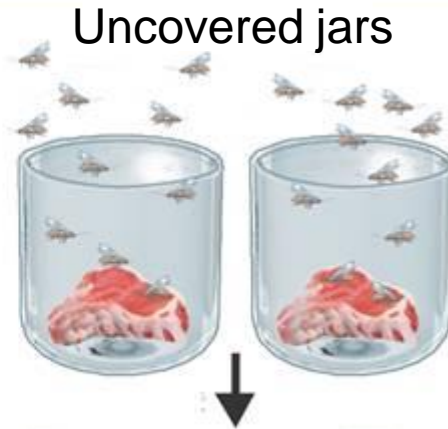
Redi's Experiment on Spontaneous Generation

OBSERVATIONS: Flies land on meat that is left uncovered. Later, maggots appear on the meat.

HYPOTHESIS: Flies produce maggots.

PROCEDURE

Controlled Variables:
jars, type of meat,
location, temperature,
time



Redi's Experiment

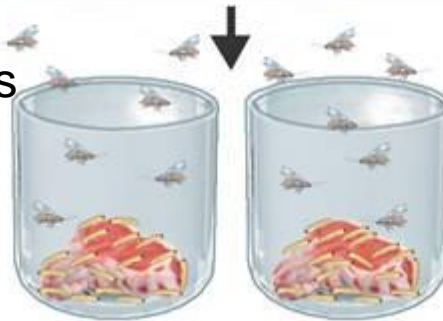
Redi's Experiment on Spontaneous Generation

Manipulated Variable:

Gauze covering that keeps flies away from meat

Responding Variable:

whether maggots appear



Maggots appear.

Several days pass.



No maggots appear.

Redi's Experiment

Redi's Experiment on Spontaneous Generation

CONCLUSION: Maggots form only when flies come in contact with meat.
Spontaneous generation of maggots did not occur.

Recording and Analyzing Results

Scientists keep written records of their observations, or data.

Sometimes drawings are used to record certain kinds of observations.

Drawing a Conclusion

Scientists use the data from an experiment to evaluate a hypothesis and draw a valid conclusion.

Redi's results supported the hypothesis that maggots were produced by flies, not spontaneous generation.

Needham's Test of Redi's Findings

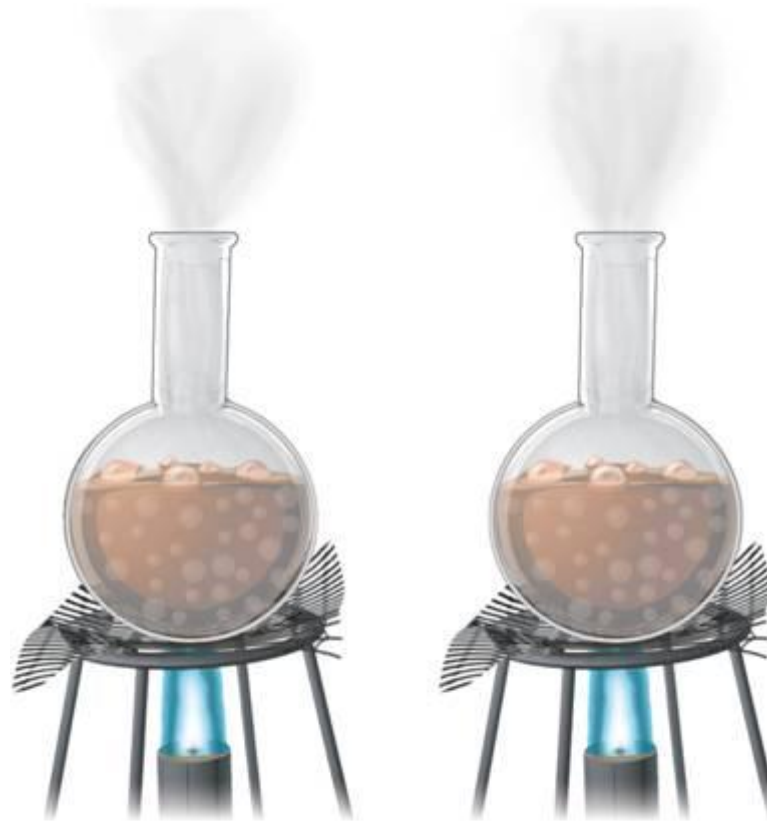
Needham challenged Redi's results by claiming that spontaneous generation could occur under the right conditions.

Needham's Test of Redi's Findings

- Needham sealed a bottle of gravy and heated it.
- After several days, the gravy was swarming with microorganisms.
- Needham concluded that these organisms came from the gravy by spontaneous generation.

Spallanzani's Test of Redi's Findings

Gravy is boiled.



Gravy is boiled.



Spallanzani's Test of Redi's Findings

Flask is open.

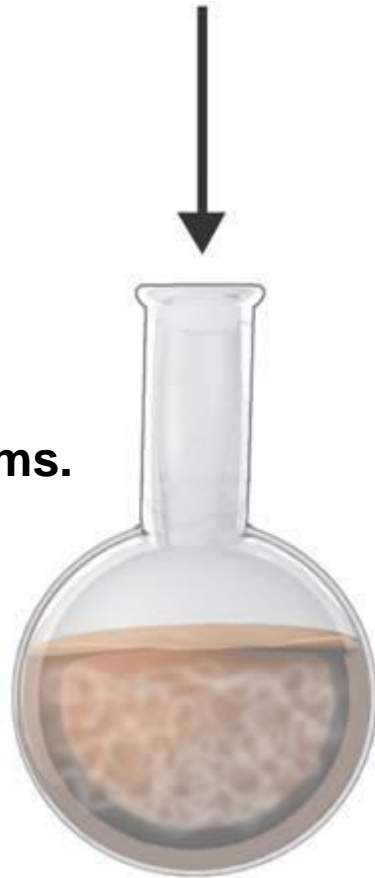


Flask is sealed.



Spallanzani's Test of Redi's Findings

Gravy is teeming with microorganisms.



Gravy is free of microorganisms.



Pasteur's Test of Spontaneous Generation

- Louis Pasteur conclusively disproved the hypothesis of spontaneous generation.
- Pasteur showed that all living things come from other living things.

Pasteur's Experiment



Broth is boiled



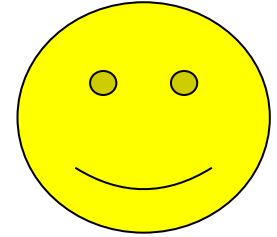
Broth is free of microorganisms for a year.



Curved neck is removed.



Broth is teeming with microorganisms.



The Impact of Pasteur's Work

Pasteur saved the French wine industry, which was troubled by unexplained souring of wine.

He saved the silk industry, which was endangered by a silkworm disease.

He began to uncover the nature of infectious diseases, showing that they were the result of microorganisms.

How a Theory Develops

As evidence from numerous investigations builds up, a hypothesis may become so well supported that scientists consider it a theory.



In science, the word *theory* applies to a well-tested explanation that unifies a broad range of observations.

1-2 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:



1-2 Section QUIZ

1 In an experiment, the variable that is deliberately changed is called the

a. control.

A b. manipulated variable.

c. responding variable.

d. constant control.

1-2 Section QUIZ

2 The mistaken belief that living organisms can arise from nonliving matter is called

a. biogenesis.

b. Pasteur's theory.

A c. spontaneous generation.

d. Spallanzani's hypothesis.

1-2 Section QUIZ

3 Which of the following was the manipulated variable in Redi's experiment?

- a. the kind of meat used
- b. the temperature the jars were kept at

A c. the gauze covering on some jars

- d. the kind of fly that visited the jars

1-2 Section QUIZ

4 A well-tested explanation that unifies a broad range of observations is a

a. hypothesis.

b. variable.

c. control.

A d. theory.

1-2 Section QUIZ

5 A scientific explanation does not become a theory until

a. a majority of scientists agree with it.

A b. it has been supported by evidence from numerous investigations and observations.

c. it is first proposed as an explanation.

d. it is published in a textbook.

END OF SECTION