

The scientific method

- 1. Make an **observation** about nature and ask a **question** about it
- 2. Develop a testable **hypothesis** (= possible explanation)
 - Predicted outcome
- 3. Test the hypothesis with a controlled **experiment**
 - *Control group* – baseline for comparison
 - *Experimental group* – same as control group except for one factor (= *variable*)
 - Independent and dependent variables
 - Large sample sizes are better

The scientific method

- 4. Analyze data (**results**)
- 5. Come to a **conclusion** based on results
 - The data do or do not support the hypothesis
 - If yes, “so far so good,” but...
 - Does not *prove* that hypothesis is correct, just supports it
 - Many related supported hypotheses can develop into a **theory** (= broad-ranging explanation for some aspect of the universe)
 - If no, hypothesis is disproven (incorrect)
 - Could there have been errors with method, data collection, analysis?
- 6. **Report** conclusion in peer-reviewed scientific journal

Scientific method flowchart

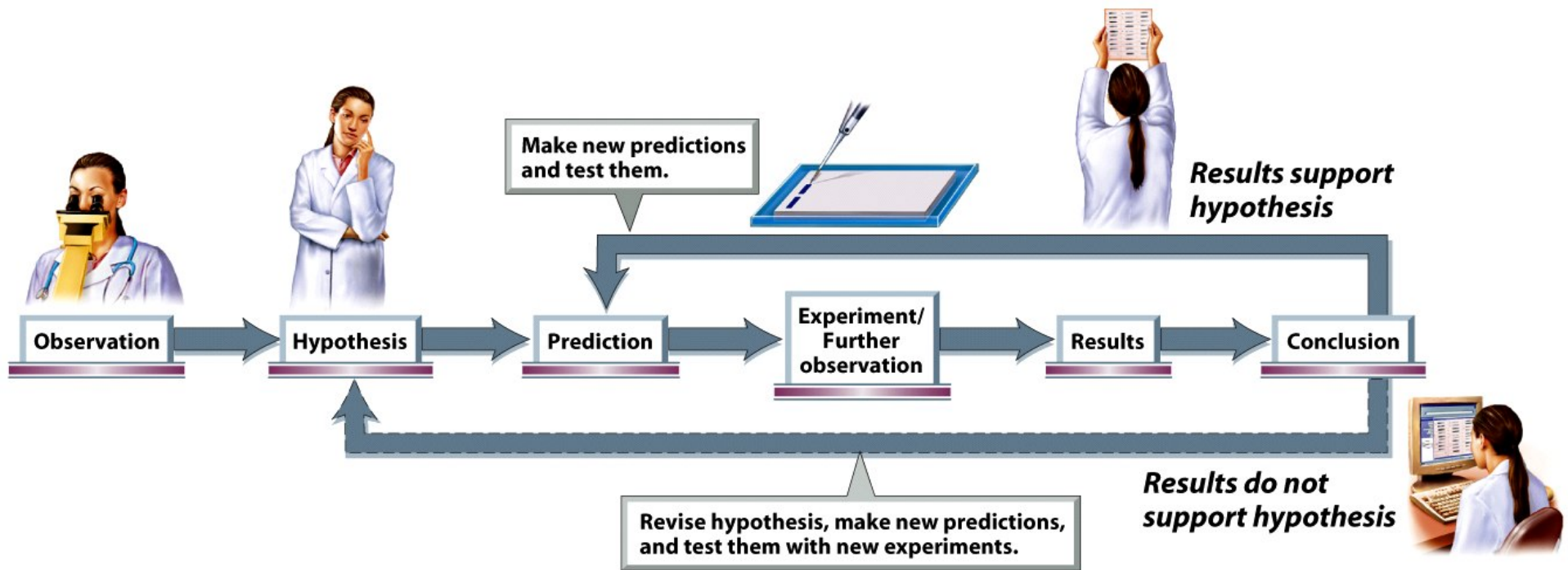


Figure 1-8 Biology of Humans, 2/e
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Scientific method example

- Lemon ant plant

Sow seeds.
Treat with alcohol extract
of lemon ant plant.



No growth

Sow seeds.
Do not treat.



Growth

(a) Experiment 1

Sow seeds.
Treat with alcohol extract
of lemon ant plant.



No growth

Sow seeds.
Treat with alcohol.



Growth

Sow seeds.
Do not treat.

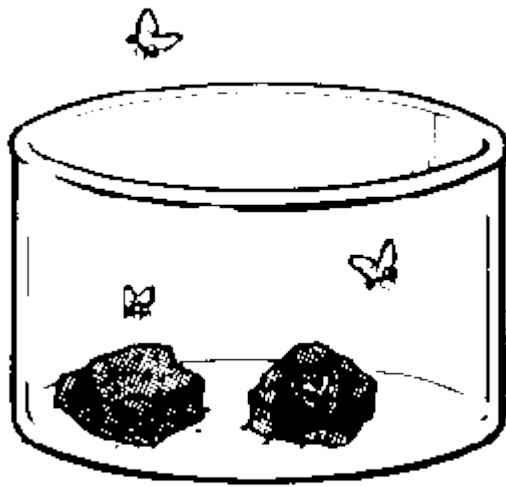


Growth

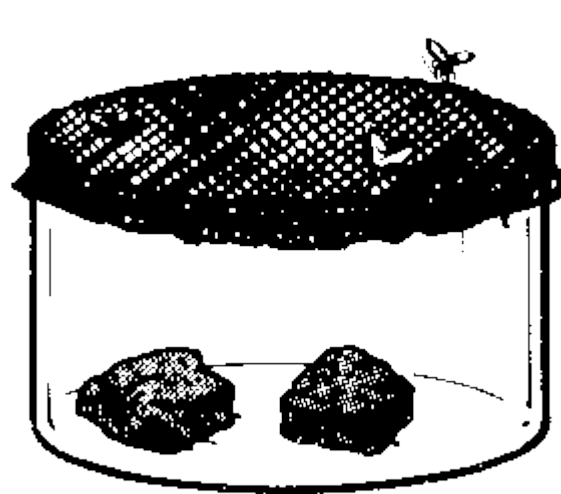
(b) Experiment 2

Another scientific method example

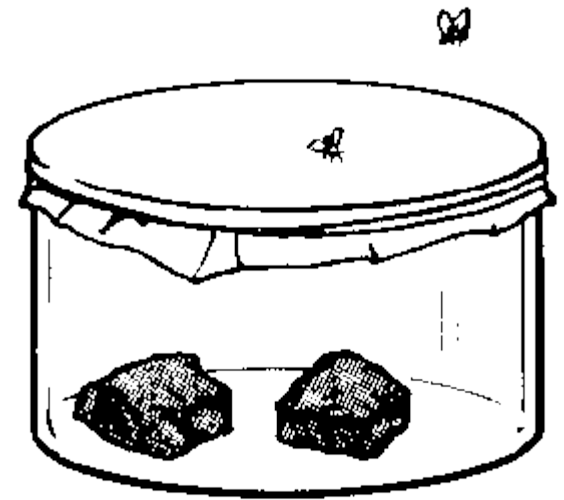
- Francesco Redi's experiment disproving spontaneous generation of maggots on meat (1668)
 - First documented use of a controlled experiment
 - His *hypothesis*: maggots come from flies
 - Later confirmed by Louis Pasteur almost 200 years later



Maggots on meat



Maggots on mesh screen



No maggots