1.3. The Scientific Method

Biology is a science of inquiry. What comes to your mind when you hear the word science? Biologists are always curious about why things happen or how things happen. By asking questions and seeking science-based responses known as the scientific method, they come up with new theories to explain new findings. The scientific method involves a series of steps that guide scientists through such scientific investigations. Biologists study the living world by posing questions about it. The general steps of the Scientific methods are:

Observation

The scientific study begins with careful observations (often a problem to solve) that leads to a question. The observations can be made either directly (e.g. using your sense organs) or indirectly using scientific tools such as microscopes.

Asking Questions

The observations usually lead the scientist to ask questions (inquiry).

Forming of a hypothesis

A hypothesis is proposed scientific explanations (possible answers) for a set of question (s).To solve a problem, one can propose several hypotheses. Scientific hypotheses should be testable.

Testing the hypothesis

Hypothesis can be tested through experimentation. Any scientific experiment must have the ability to be duplicated because the "answer" the scientist comes up with (whether it supports or rejects the original hypothesis) can't become part of the scientific knowledge unless other scientists can perform the same experiment and achieve the similar results. If a hypothesis is not supported by experimental data, one can propose a new hypothesis.

Making conclusions about the findings

Scientists consider their original hypotheses and ask whether they could still be right in light of the new information gathered during the experiment. If so, the hypotheses can remain as possible explanations for how things work. If not, scientists reject the hypotheses and try to come up with alternate explanations (new hypotheses) that can explain what they've seen.

Communicating the findings

When scientists complete some work, they write a paper that explains exactly what they did and the results they obtained. Then, they submit the paper to a scientific journal in their field. In addition, the findings will be printed in scientific journals and assist teachers and students in the field.

Example of a hypothesis testing in everyday life

Suppose you want to use your torch (hand lamp) to find a missing pen in your bedroom. When you switch the torch on, it is not working. The following flow chart will illustrate hypothesis testing for a torch that doesn't work.

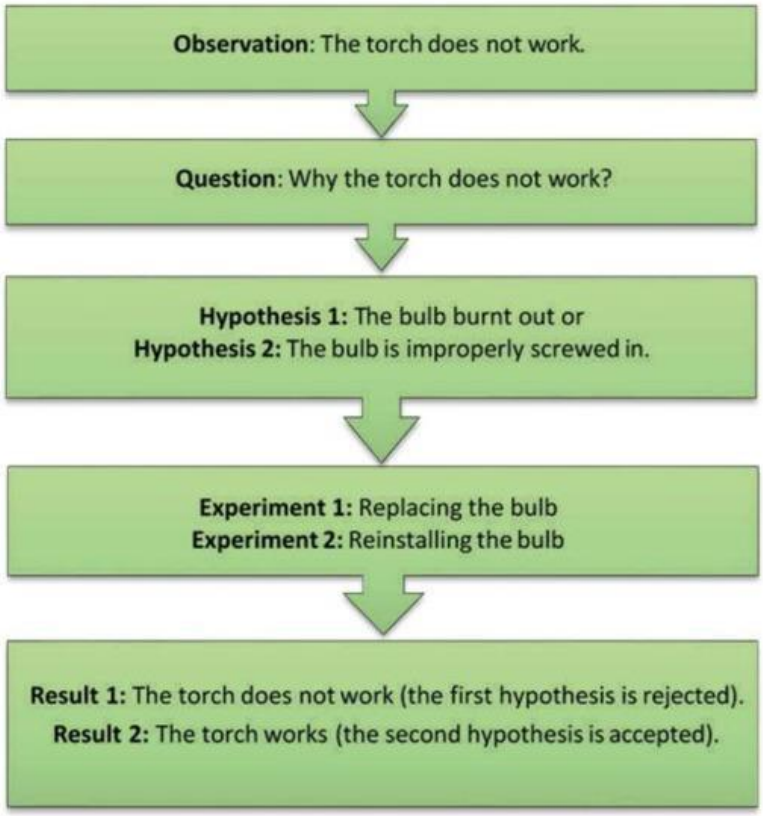

Figure 1.1. Application of the scientific method to common problems in our surroundings

Multiple Choice Questions

1. **Observations in science can be made:**

   A) Only directly with sense organs

   B) Only indirectly with tools

   C) Either directly or indirectly using tools

   D) Without any evidence

2. **After making observations, the next step in the scientific method is:**

A) Asking questions

B) Writing reports

C) Drawing conclusions

D) Communicating findings

3. **A hypothesis is:**

A) An untestable guess

B) A proposed scientific explanation

C) A final proven fact

D) A result of the experiment

4. **For a hypothesis to be scientific, it must be:**

A) Interesting

B) Testable

C) Always correct

D) Based on opinion

5. **Which of the following is true about scientific experiments?**

A) They cannot be repeated

B) They must be duplicated to confirm results

C) They never reject hypotheses

D) They are based on luck

6. **If a hypothesis is not supported by experimental data, scientists should:**

A) Stop investigating

B) Reject science

C) Propose a new hypothesis

D) Still accept the hypothesis

7. **Which step involves deciding whether the hypothesis is supported or rejected?**

A) Observation

B) Making conclusions

C) Communicating findings

D) Asking questions

8. **When scientists complete their work, they usually:**

A) Keep it secret

B) Publish it in scientific journals

C) Announce it on social media only

D) Hide it from others

9. **Communicating findings is important because:**

A) It helps teachers and students learn

B) It hides information from society

C) It prevents further testing

D) It makes experiments private

10. **Which of the following is an example of forming a hypothesis in everyday life?**

A) Writing an exam

B) Guessing why a torch doesn't work

C) Playing football

D) Watching television

11. **In the example of the torch, testing the hypothesis might involve:**

A) Checking the batteries

B) Buying a new torch immediately

C) Ignoring the problem

D) Asking someone else to guess

12. **Which step ensures that scientific results are reliable and not just accidental?**

A) Asking questions

B) Repetition of experiments

C) Writing journals

D) Forming new theories

13. **When scientists reject a hypothesis, they usually:**

A) Stop working

B) Form alternate explanations

C) Accept the wrong answer

D) Avoid sharing results

14. **Which of the following best describes "inquiry" in biology?**

A) Believing without testing

B) Asking questions to seek answers

C) Copying information from books

D) Rejecting evidence

15. **Why is hypothesis testing considered central to science?**

A) It proves all ideas correct

B) It allows explanations to be tested with evidence

C) It avoids the need for experiments

D) It makes science faster without data

16. **If experiments show similar results after repetition, the hypothesis becomes:**

A) A fact that never changes

B) A possible explanation with stronger support

C) Rejected automatically

D) An opinion

17. **Which of the following tools might a biologist use for *indirect observation*?**

A) Eyes

B) Microscope

C) Nose

D) Hands