Chapter 1 The Science of Biology

Summary

1-1 What Is Science?

Science is an organized way of using evidence to learn about the natural world. Scientific thinking usually begins with observation, which is the process of gathering information about events or processes in a careful, orderly way. The information gathered from observations is called data. Quantitative data are expressed as numbers, obtained by counting or measuring. Qualitative data are descriptive and involve characteristics that can't usually be counted. Scientists use data to make inferences. An inference is a logical interpretation based on prior knowledge or experience.

After making first observations, a researcher will propose one or more hypotheses. A hypothesis is a proposed scientific explanation for a set of observations. Scientists generate hypotheses using prior knowledge, logical inference, and informed, creative imagination. Scientific hypotheses must be proposed in a way that enables them to be tested. Hypotheses are tested by performing controlled experiments. The conclusions researchers draw from experiments or data must be valid. To be valid, a conclusion must be based on logical interpretation of reliable data.

1-2 How Scientists Work

Conducting a scientific investigation involves a series of steps. The first step is asking a question. The second step involves forming a hypothesis. The third step in conducting a scientific investigation is setting up a controlled experiment. A hypothesis should be tested by an experiment in which only one variable is changed at a time. All other variables should be kept unchanged. This type of experiment is called a controlled experiment. The variable that is deliberately changed is called the manipulated variable. The variable that is observed and that changes in response to the manipulated variable is called the responding variable.

The fourth step in conducting a scientific investigation is recording and analyzing results. The fifth step is drawing a conclusion. A key assumption in science is that experimental results can be reproduced.

As evidence builds up, a particular hypothesis may become so well supported that scientists consider it a theory. In science, a theory is a well-tested explanation that unifies a broad range of observations.

1-3 Studying Life

Although living things vary greatly, all living things share eight characteristics:

- Living things are made up of units called cells. Cells are the smallest units of an organism that can be considered alive.
- Living things reproduce. In sexual reproduction, cells from two different parents unite to produce the first cell of the new organism. In asexual reproduction, a single cell divides in half to form two new organisms.
- Living things are based on a universal genetic code. The directions for inheritance are carried by a molecule called DNA.
- Living things grow and develop. Multicellular organisms typically go through a process called development. As cells divide, they change in shape and structure in a process called differentiation.
- Living things obtain and use materials and energy. The combination of chemical reactions through which an organism builds up or breaks down materials as it carries out its life processes is called metabolism.

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