Unit one grade 11th note

The science of biology

Definition : Biology is the science of life and living organisms.

1.1 **The method of science**

Science is a systematic knowledge derived from observations and practical experience. Science is derived from Latin word "Scientia" (called knowledge), a unique system of acquiring knowledge based on the the scientific method. It is sometimes called experimental science, because depends heavenly on experimentation to obtain information. There are two ways of gaining knowledge; deductive reasoning and nductive reasoning.

Some important terms in scientific processes

1. Observation - is the process by which perceptions of objectives or events are selected, interpreted and their significance judged.

2. Hypothesis - is a tentative explanation for an observed event. To be scientific a Hypothesis must be tested by means of prediction and investigations.

3. Qualitative data - consists of observations made with out reference to measurements.

4. Quantitative data - are observations made more precise by measurement.

5. An inference is a tentative conclusion drawn from a series of observations. It may be lead to a Hypothesis being formulated.

6. Controls - are the variables which must be controlled by an investigator and not allowed to vary.

The scientific experiment

An experiment is a planned inquiry to obtain facts or to confirm or to deny a hypothesis. The process of planning to conduct an experiment is called experimental design.

Variables - are events or conditions that are subjected to change. Variables are factors which influence observations.

In other words , a variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled.

Independent Variable

In an experiment, you need some type of control. Being able to modify a variable is important to study the effects. The variable you control is called your

independent variable. Speaking of cause and effect, the independent variable is your cause.

This variable doesn't rely on any other variables. It is like an adult in that it is free from outside control of the other variables. Examples of independent variables include:

In an experiment to see what brand of diapers hold the most liquid, the independent variable is the brand.

In an experiment studying plant growth in different types of soil, the independent variable is the soil.

Dependent Variables

The dependent variable is your effect. When it comes to an experiment, dependent variables are what you change or measure. It is dependent on your other variables. For example:

In the diaper experiment, the dependent variable might be how much liquid you add to the diapers to see their liquid capacity.

In the plant experiment, the dependent variable would be the growth of the plant. It is going to change depending on how you change the independent variable (soil) or amount of light.

Control Variables

When doing a science experiment, some variables need to remain constant. These are your control variables . By keeping a variable constant, you ensure your results remain accurate. If you have an experiment without a

control, then you can’t be completely sure of the cause and effect. To help you understand this concept, look at our examples.

The control variable in the diaper experiment could be the size of the diaper you use. When testing how much water the different brands can hold, you’ll want to use all the same size diapers. Varying the size of the diaper could skew your results.

In your plant experiment, the temperature is a control variable. When testing the growth in soil, make sure to keep all the plants at a consistent temperature. Without a constant temperature, you wouldn’t be sure if it was the temperature or soil making the plant grow better.

Confounding variables

A confounding variable is a variable, other than the independent variable that you're interested in, that may affect the dependent variable. This can lead to erroneous conclusions about the relationship between the independent and dependent variables. You deal with confounding variables by controlling them; by matching; by randomizing; or by statistical control.

Identifying Confounding

In other words, compute the measure of association both before and after adjusting for a potential confounding factor. If the difference between the two measures of association is 10% or more, then confounding was present. If it is less than 10%, then there was little, if any, confounding.

What is the difference between confounding variables, independent variables and dependent variables?

A confounding variable is closely related to both the independent and dependent variables in a study. An independent variable represents the suppose cause, while the dependent variable is the supposed effect.

A variable must meet two conditions to be a confounder:

It must be correlated with the independent variable. may be a causal relationship, but it does not have to

It must be causally related to the dependent variable

Why confounding variables matter

To ensure the internal validity of your research, you must account for confounding variables. If you fail to do so,

your results may not reflect the actual relationship between the variables that you are interested in..

For instance, you may find a cause-and-effect relationship that does not actually exist, because the effect you measure is caused by the confounding variable (and not by your independent variable).

Even if you correctly identify a cause-and-effect relationship, confounding variables can result in over- or underestimating the impact of your independent variable on your dependent variable.

What can proofreading do for your paper?

Scribbr editors not only correct grammar and spelling mistakes, but also strengthen your writing by making sure your paper is free of vague language, redundant words and awkward phrasing.

How to reduce the impact of confounding variables

There are several methods of accounting for confounding variables. You can use the following methods when studying any type of subjects – humans, animals, plants, chemicals, etc. Each method has its own advantages and disadvantages.

Restriction

In this method, you restrict your treatment group by only including subjects with the same values of potential confounding factors.

Since these values do not differ among the subjects of your study, they cannot correlate with your independent variable and thus cannot confound the cause-and-effect relationship you are studying.

Matching

In this method, you select a comparison group that matches with the treatment group. Each member of the comparison group should have a counterpart in the treatment group with the same values of potential confounders, but different independent variable values.

This allows you to eliminate the possibility that differences in confounding variables cause the variation in outcomes between the treatment and comparison group. If you have accounted for any potential confounders, you can thus conclude that the difference in the independent variable must be the cause of the variation in the dependent variable.

Statistical control

If you have already collected the data, you can include the possible confounders as variables in your regression models ; in this way, you will control for the impact of the confounding variable.

Any effect that the potential confounding variable has on the dependent variable will show up in the results of the regression and allow you to separate the impact of the independent variable.

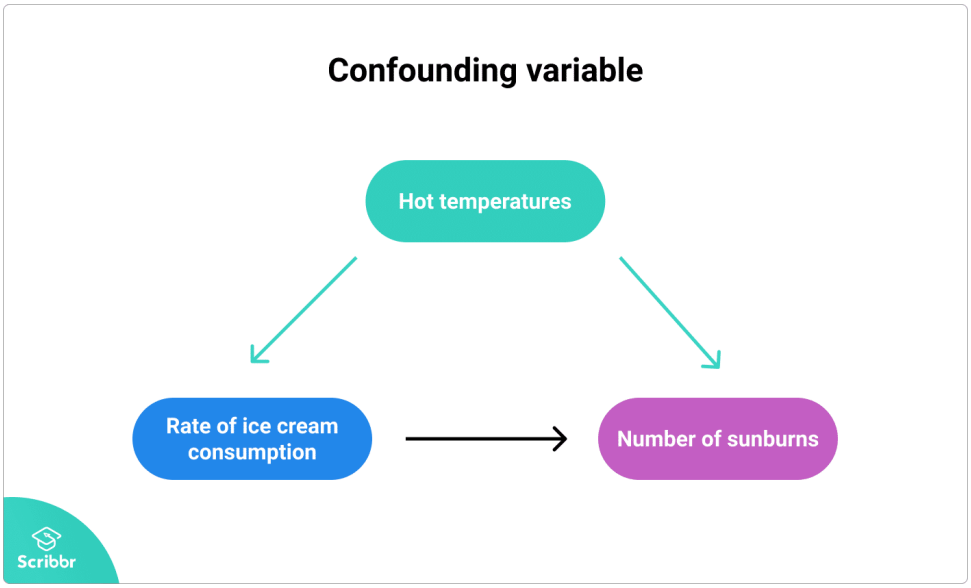
Randomization

Another way to minimize the impact of confounding variables is to randomize the values of your independent variable. For instance, if some of your participants are assigned to a treatment group while others are in a

control group, you can randomly select which participants are assigned to each group.

Randomization ensures that with a sufficiently large sample, all potential confounding variables – even those you cannot directly observe in your study – will have the same average value between different groups. Since these variables do not differ by group assignment, they cannot correlate with your independent variable and thus cannot confound your study.

Since this method allows you to account for all potential confounding variables, which is nearly impossible to do otherwise, it is often considered to be the best way to reduce the impact of confounding variables.



Example of a confounding variable

You collect data on sunburns and ice cream consumption. You find that higher ice cream consumption is associated with a higher probability of sunburn. Does that mean ice cream consumption causes sunburn?

Here, the confounding variable is temperature: hot temperatures cause people to both eat more ice crea and spend more time outdoors under the sun, resultin in more sunburns.

The main steps of scientific method

1. Asking questions (Identify the problem)

- it is something that catches our imagination.

We know that tomato seeds germinate when they are planted. But , why don't tomato seeds grow inside tomatoes?

2. Do background research (review literature)

Before we start trying to do the whole investigation ourselves, we will first check scientific magazines and the Internet to see if anyone else has looked into the problem.

We find out that there are substances in plants that controls growth, called growth regulators.

3. Construct hypothesis

- it should be testable through experiment.

Example - there are chemicals in tomatoes that stop the seeds from growing whilst they are still in the tomatoes themselves. This is testable by an experiment. We think that it is a chemical that is responsible. So how do we prove that? Based on our hypothesis, we can make a prediction: seeds covered in tomato juice will not germinate as well as seeds covered in water.

4. Design and carry out an experiment to test the hypothesis : testing the hypothesis through experiment.

The goal is to control all the variables except the one under the study.

5. Analyse result and draw conclusion - interpret the result.

6. Accept or reject the hypothesis

7. Report results or repeat

Accuracy, reliability and validity in scientific experiment

Accuracy - refers to how precisely you measure or count something. For example, you could measure time with a clock , a wrist watch or a stop-clock accurate to 0.01 second.

Reliability - is a measure of how dependable our results are. If we were to repeat the investigation, would we get more or less than the same results?

Validity - this is about whether or not our experiment measures what it says it is measuring. For our experiment to be valid , we must be certain that our results were only due to the changes in the independent variable and nothing else.

Home work

Review questions

Pp. 14- 15

Q1- Q10

1.2 **The tools of a biologist**

What apparatus do biologists use?

In the laboratory

1. Petri dishes

- round dishes made from glass or plastic.

- used in many different ways, but usually to culture some organisms.

- often filled with a 'jelly' called agar and used to culture bacteria. There are many different a gars containing different balances of nutrients. Each type of agar can encourage her growth of different bacteria.

- can also be used to :- propagate or culture plants.

- show how effective different antibiotics are against certain type of bacteria.

- show how well different concentrations of enzymes digest a substance.

2. Microscope - used to magnify and resolve image of an object.

- two main types 1) optical or light microscope - use beam of light

2) electron microscope - use beam of electrons.

3. Centrifuges

- used to separate solids from liquids, where simple filtration is not adequate for the task.

In the field

1. Quadrat

- to estimate the abundance of organisms in an area.

- made up of a metal or a rope square (a metal square is the simplest).

- placed randomly on the ground and the organisms found inside it are counted and the numbers and types recorded. Can be used under water also.

2. Transact line

- biologist also use it to show how the number of a particular species changes across an area. They lay down a tape measure (a long rope marked off every meter) across the area. Tissue is called transect line.

3. Pit fall traps

- nets to catch insects.

4. Others. You can get from text book.

Home work

Review questions Pp. 23-24.

Q1-Q10

1.3 **The relevance and promise of biological science**

The study of biology has relevance in almost every aspect of life. It would take far too long to analyse all aspects of the relevance of biology. However, there are some which are undoubtedly of great importance.

Biology and agriculture

Many biologists are addressing the problem of how to produce the extra food. However, they have another problem to consider, which is the global warming may alter the way in which crops grow. Many crops that now produce high yields in some countries will not do so if the current trends continue. Some countries will benefit, as they will find that their agricultural out put will increase with global warming.

Biologists are carrying out research into how to produce rope plants that:

- will be adapted to the new conditions .

- are capable of producing their crop quickly so that more than one crop can be obtained per year from a field.

- are disease resistance.

- are drought resistance.

Biology and medicine

Biologists are also able to give advice on ways of reducing the rate of population growth. For example, about the effective methods of contraception.

They are closely involved in medical work, Doctors and nurses specialised biological knowledge. Their work is supported by a whole range of other biologists, such as

medical laboratory technicians, medical researchers, radiographer, specialized researchers and drug development researchers.

Biology and environment

Biologists are actively involved in monitoring the impact of global warming on the environment.

The promise of research in these fields is huge. Among the goals are:

- cures for genetic diseases,

- treatment for degenerative disease,

- establishing biologically controlled industrial processes,

- produce drugs,

- genetically modified plants,

- cloning of productive animals and plants,

- repair damaged organs by using stem cells.