**Pakistan School, Kingdom of Bahrain**

**E- Support and Learning Material / Session 2020-2021**

**Subject: Biology Grade: 9**

**Book: Biology 9th (Pld), Pages no.20,21,22,23. FIRST TERM**

**Chapter-2. Solving a Biological Problem.**

1. Man has always been a Biologist. Justify the statement.

Man has always been a Biologist. He had to be a biologist in order to live. Earlier in history he was a hunter of animals and a gatherer of fruits, seeds, roots etc. The more he knew about animals and their habitat the more successful hunter he was. The more he knew about plants the better he distinguished between edible from non-edible plants.

1. What are biological methods? Give the significance also.

**Biological Method:**

The Scientific method, in which biological problems are solved, is termed as biological method. It comprises the steps a biologist adopts in order to solve a biological problem.

**Significance of biological method:**

The biological method has played an instrumental part in scientific research for almost 500 years. From Galileo’s experiment back in the 1590s to current research, the biological method has contributed to the creation of vaccines and advancements in medicine and technology. The biological method also ensures quality of data for public use.

1. Describe the steps involved in solving a biological problem by a biologist?

**Solving of biological problem:**

In solving the biological problem, a biologist takes the following steps;

1. Recognition of biological problem
2. Observations
3. Hypothesis formulation
4. Deductions
5. Experimentation
6. Summarization of results (create tables, graphics etc.)
7. Reporting of results
8. **Recognition of the Biological problem:**

Biologists go for adopting biological method when they encounter some biological problem. A biological problem is a question related to living organisms that is either asked by someone or comes in biologist’s mind by himself.

1. **Observations:**

As the first step in solving a biological problem, the biologist recalls his/her previous observations or makes new ones. Observations are made with five senses of vision, hearing, smell, taste and touch.

**Types of observations:**

Observations may be both qualitative and quantitative. Quantitative observations are considered more accurate than qualitative ones because the former are invariable and measurable and can be recorded in terms of numbers. Examples of qualitative and quantitative observations are given below;

|  |  |
| --- | --- |
| **Qualitative Observations** | **Quantitative observations** |
| 1. The freezing point of water is colder than the boiling point. | 1. The freezing point of water is 0o C and the boiling point is 100o C. |
| 2. A liter of water is heavier than a liter of ethanol. | 2. A liter of water weighs 1000 grams and a liter of ethanol weighs 789 grams. |

**Note:**

Observations also include reading and studying what others have done in the past because scientific knowledge is ever-growing.

1. **Formulation of Hypothesis:**

The tentative explanation of the observations is called hypothesis. It may bedefined as a proposition that might be true.

**Characteristics of Hypothesis:** A Hypothesis should have the following Characteristics:

1. It should be a general statement.

2. It should be a tentative idea.

3. It should agree with available observations.

4. It should be kept as sample as possible.

5. It should be testable and potentially falsifiable in other words, there should be a way to show the hypothesis is false, a way to disprove the hypothesis.

**Conditions of Hypothesis:** A great deal of careful and creative thinking is necessary for the construction of a hypothesis. Biologists use reasoning to formulate hypothesis.

Types of reasoning: Reasoning may be for two types:

1. **Inductive reasoning:**

In inductive reasoning specific observations are used to draw general hypothesis.

For example: I observed cells in x, y and z organisms, therefore all organisms have cells.

1. **Deductive reasoning:**

Deductive reasoning flows from general to specific. From general observations a biologist constructs specific hypothesis.

For example: If all organisms have cells and humans are organisms, then humans should have cells.

1. **Deduction:**

The biologist draws deductions from the hypotheses. Deductions are the logical consequences of the hypotheses. Deductions are also drawn by using inductive and deductive reasoning. Generally, in the biological method, if a particular hypothesis is true than one should expect (deduction) a certain result. This involves the use of **“if - then”** logic.

1. **Experimentation:**

This is the most basic step of biological method in which biologist performs experiments to see if the hypotheses are true. An experiment evaluates alternative hypothesis. A successful experiment is that which demonstrates one or more alternative hypothesis as incorrect (Inconsistent with excremental or observational result). The incorrect hypothesis are rejected and those which prove consistent with experimental results are accepted. An accepted hypothesis needs to be valid and useful. It makes further predictions that provide an important way to further test its validity.

1. **Summarization of Results:**

Biologist gathers actual, quantitative data from experiment. Data for each of the groups are then averaged and compared statistically. To draw conclusion, biologist also uses statistical analysis.

1. **Reporting the results:**

Biologist publish their findings in scientific Journals and books, in talks at national and international meetings and in seminars at colleges and universities. Publishing of results is an essential part of scientific method; it allows other people to verify the results or apply the knowledge to solve their problems.

1. How the scientist contrasts an “Experimental group” with a “Control group”?

In science when doing the experiment it must be a controlled experiment. A scientist must contrast an “Experimental group” with a “Control group”. The two groups are treated exactly alike except for the one variable being tested. For example, in an experiment to test the necessity of carbon dioxide for photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide available) with an experimental group (a plant with no carbon dioxide).The necessity of carbon dioxide would be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

**WORKSHEET**

**Activity: The Scientific Process**

1. **How many steps are there in the Biological Method?**
2. **What is the Biological Method?**
3. **In what step of the Biological Method do you collect data?**
4. **What is the first step of the Biological Method?**
5. **In which step do you list all the materials you need for the investigation?**
6. **What is the last step of the Biological Method?**





