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**LIFE SCIENCES GRADE 10 - 12**

**SCIENTIFIC INVESTIGATION SKILLS**

**How to identify variables**

**Look for a "hypothesis", a "scientific question" or an "aim" given at the beginning of the investigation**

**TWO clear "FACTORS" OR "VARIABLES" will stand out - ONE THAT INFLUENCES THE OTHER ONE IN THE PARTICULAR INVESTIGATION.**

These TWO factors are the **independent and dependent** variables

* **Independent variable:** The factor/variable that the investigator choose to change or manipulate and that normally influences the other factor/variable
* **Dependent variable:** The factor/variable that is influenced by the independent variable and the one where the investigator measured or observed any change or influence
* **Control/fixed variable(s):** Sometimes mentioned as part of the method OR planning steps. These factors/variables MUST be controlled OR kept constant in order for the investigator to manipulate the independent variable

**How to write a hypothesis.**

A hypothesis is a **testable statement about a relationship involving two variables**. When a hypothesis is formulated the following is a guideline that should be used:

* There need to be two variables that must be mentioned in the hypothesis (dependent and independent)
* A hypothesis should state the relationship between the two variables and a hypothesis is NOT a question
* The hypothesis must be testable
* Mark allocation is 2 marks for the complete and correct hypothesis and NOT 1 per variable

 **What is reliability?**

The idea behind reliability is that any significant **results of an investigation** must be more than a once-off finding and be **repeatable**. Other researchers must be able to perform exactly the same experiment, under the same conditions and generate the same results. This will reinforce the findings of the experiment and ensure that the wider scientific community accepts the hypothesis. In questions which ask learners to state how the reliability of the investigation could have been improved, the correct answers could generally be the following:

* Repeat the experiment/investigation (use the information given in the question e.g. "Repeat the experiment by recording the temperature 5 times at each site and then calculate the average temperature")
* Increase the sample size e.g. "Measure the pupil diameter of 100 women"

 **What is validity?**

Validity questions **how** the experiment/investigation was carried out. Have all the factors/variables been controlled/fixed except the variable/factor being tested? Have the samples been chosen randomly? Is the design for the investigation appropriate? **Validity therefore speaks to whether the scientific research method was done with the appropriate care and diligence**. In questions which ask learners to suggest some factors that might have decreased the validity of an investigation, the answers should centre on criticism of the scientific process, for example some factors/variables that were not fixed/controlled when carrying out the investigation.

 **Planning for a scientific investigation involves the following:**

* **Ethical issues** around the investigation, e.g. by getting permission from the appropriate authorities before the investigation is conducted
* Making all the **logistical arrangements**, e.g. by identifying and getting all the materials to be used in the investigation
* Deciding on the **method/procedure** that is going to be used or followed e.g. how to catch the fish for the investigation
* Dealing with how the **data** will be collected, recorded, analysed and presented.

**NB: Use hints from the given scenario/investigation to determine PLANNING STEPS applicable to the particular investigation**

**How to draw a conclusion**

The conclusion should:

* Answer the scientific question asked at the start of the investigation
* State the effect that the independent variable had on the dependent variable
* Indicate if the hypothesis can be accepted or be rejected

**LEARNERS MUST BE GIVEN VARIOUS QUESTIONS FROM ARTICLES AND PAST PAPERS TO EXERCISE THE PRINCIPLES OF THE SCIENTIFIC METHOD**