25SCHOOLS
FREE LEARNING NOTES FOR ZAMBIA

FORM 2

Biology

Scientific research and scientific ethics

Lesson notes for learners · Competence-Based Curriculum

INSIDE

1. What is scientific research
2. Scientific ethics and its principles
3. Ethical or unethical: judging a research story
4. The limits of science
5. Check yourself

Scientists find answers by asking clear questions, collecting evidence and drawing conclusions. When a learner tests how sunlight affects plant growth in the school garden, that is scientific research. Scientific ethics are the moral rules that make sure such work is honest, safe and fair to people, animals and the environment.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Say what scientific research is and give an example
- Tell scientific research apart from guessing
- Explain the main principles of scientific ethics
- Judge whether a research story is ethical or unethical and give reasons
- Say why science cannot answer every question about life

KEY WORDS

scientific research	an investigation carried out to discover new knowledge or to check existing knowledge
scientific ethics	the moral principles that guide how research and experiments should be done responsibly
honesty	being truthful when collecting, recording and reporting data, without falsifying it
integrity	keeping strong moral principles and doing the right thing even when nobody is watching
objectivity	making decisions from evidence rather than from personal feelings or bias
bias	an unfair influence that affects research results or conclusions
informed consent	permission given by participants after they have been fully told about the research
confidentiality	protecting the personal information of participants from being shared without permission

1 What is scientific research

Scientific research is an investigation carried out to discover new knowledge or to verify existing knowledge. A researcher asks a clear question, collects evidence by observing and experimenting, and then draws a conclusion from that evidence. For example, you can investigate how sunlight affects plant growth.

Not every activity is scientific research. Observing plants growing in different soils and recording the number of insects in a garden each day are scientific, because evidence is collected. Guessing which plant will grow faster without testing, or saying plants grow better in rain without collecting any data, is not scientific research.

Activity	Scientific research
Observing plants growing in different soils	Yes, evidence is collected
Recording the number of insects in a garden each day	Yes, data is recorded
Guessing which plant will grow faster without testing	No, nothing is tested
Saying plants grow better in rain without collecting data	No, there is no evidence

Figure 1. Scientific research or not

2 Scientific ethics and its principles

Ethics are rules or standards that help us tell right behaviour from wrong behaviour. Scientific ethics are the moral principles and rules that guide how scientific work should be done. They help make sure that experiments and observations are carried out honestly, responsibly and safely. They protect people, animals and the environment, and they keep scientific information accurate and trustworthy.

The main principles are these. Honesty means reporting data as it truly is. Integrity means doing the right thing even when no one is watching. Objectivity means using evidence, not personal feelings, so that bias does not spoil the results. Responsibility means thinking about how the work affects people, animals and the environment. Informed consent means participants agree only after they are fully informed, and confidentiality means their personal information is protected.

Other principles are justice, which means fair selection and treatment of participants; beneficence, which means acting to benefit others; and non-maleficence, which means avoiding harm. Animal welfare means treating animals used in research well. Before research begins, scientists use a risk-benefit analysis to compare the possible risks with the expected benefits. Researchers must also avoid plagiarism and acknowledge the work of other people.

3 Ethical or unethical: judging a research story

To judge a research story, ask which principle is being kept or broken. Take this case: a learner investigates plant growth but changes the results to make the experiment look successful. That breaks honesty, because the data is falsified. It also misleads anyone who later uses the results. So it is unethical.

A safe and honest investigation does the opposite: it records what truly happens, even when the result is not what was expected, and it protects everyone taking part.

WORKED EXAMPLE

A learner asks classmates about their health for a project and then reads the names and answers aloud to the whole school. Which principles are broken?

The learner shared personal information without permission

This breaks confidentiality

If the classmates were not told how their answers would be used, informed consent was also missing

So the project is unethical

4 The limits of science

Science is a powerful tool for understanding the natural world, and it can be applied to solve practical problems in daily life. However, it does not answer every question about life. Other perspectives may also be important, and other sources of knowledge, such as culture, experience and personal values, matter too. Recognising the limits of science helps us respect these other sources.

TRY THIS

Work in pairs. Read the four activities in the table of this note and, without looking at the answers, sort each into scientific research or not scientific research and give a reason. Then write your own short research story about a school garden: first an ethical version, then an unethical version, and swap with your partner to name the principle broken.

REMEMBER

- Scientific research asks clear questions, collects evidence by observing and experimenting, and draws conclusions
- Guessing or claiming without data is not scientific research
- Scientific ethics are moral principles that make research honest, responsible and safe
- Honesty, integrity, objectivity, responsibility, informed consent and confidentiality are key principles
- Justice, beneficence and non-maleficence are also principles
- Changing results to look successful is unethical

? Check yourself

1. What is scientific research?
2. What does informed consent mean?
3. What is bias?
4. Why is guessing which plant will grow faster, without testing, not scientific research?
5. Name two principles of scientific ethics and say what each one means.
6. You are a learner at a school in Luangwa. You grow beans for a class project and, to get a better mark, you write down that all your plants grew tall although two plants died. (a) Which principle of scientific ethics have you broken? (b) Explain why this makes the project unethical. (c) Say what you
7. A group of learners wants to ask pupils in other classes about their eating habits for a project. They plan to write each pupil's name next to their answers and put the list on the notice board. (a) Which two principles are at risk? (b) Say what the group should do before they start. (c) Explain why

ANSWERS

1. An investigation carried out to discover new knowledge or to verify existing knowledge, using evidence.
2. Permission given by participants after they have been fully told about the research.
3. An unfair influence that affects the results or conclusions of research.
4. Nothing is tested and no evidence is collected.
5. For example honesty (reporting data truthfully without falsifying it) and confidentiality (protecting participants' personal information).
6. (a) Honesty, because the data was falsified. (b) The results no longer show what truly happened, so they cannot be trusted. (c) Record all the results truthfully, including the dead plants, and report them.
7. (a) Confidentiality and informed consent. (b) Explain the project to the pupils, ask for their permission, and keep names private. (c) It stops personal information from being shared and respects each pupil's choice.

Written by 25Schools to follow the Form 2 Biology syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.