Lesson One

Biotechnology – an introductory lesson to the study of the structure and manipulation of DNA

Outcomes

All states and territories expect that as a result of their school studies in Science, students should appreciate the relevance of scientific knowledge to their future career (whether the job is in a scientific field or not). Such outcomes are stated most specifically in the New South Wales Science syllabus:

- 4.5 – A student describes areas of current scientific research
- 5.5 – A student analyses how current research might affect people's lives.

In working toward these outcomes students learn *(among other things)* to:

- identify scientific skills that can be useful in a broad range of careers
- identify possible career paths in science.

Aim of this lesson

Students will see that the study of DNA – its structure, how it works and how it can be changed – will provide them with knowledge that will be useful in their daily life, as well as constituting the basic knowledge required in a number of potential scientific careers.

Materials Required:

- *Careers in Science* booklet (class sets are available by emailing enquiries@ansto.gov.au or calling 02 9717 3168. It is also online at www.careersinscience.gov.au).

Activities

1. Introduce the topic to the class

Read aloud, or ask class members to read, the following excerpts:

- Ecologist (page two)
- Agricultural officer (page four)
- Sir Gustav Nossal (page six)
- An Australian Nobel prize winner (page seven).

Point out that all of these people employ an understanding of biotechnology.

2. Biotechnology in daily life

Ask students to work in pairs to look at the cartoon.

Direct them to find the aspects of their daily lives in which biotechnology can be applied.

Possible responses:

- DNA fingerprinting
- Animal welfare
- Conservation
- Environmental improvement
- Medicine.

3. Biotechnology at work

Look at the list of jobs on page ten.

Ask students, 'How might any of these jobs use biotechnology?'

Possible responses:

- Biomedical scientist (many diseases are genetic and the number of vaccines and other medicines that come from genetically engineered organisms is growing)
- Scientific journalist (many of the 'hot' issues today are to do with genetic engineering brought about as a result of applied biotechnology)

- Dietician (a number of the problems that dieticians treat are genetic in origin)
- Geneticist (by definition they deal with DNA)
- Forensic scientist (genetic evidence is processed using biotechnology).

4. Developing a definition of biotechnology

This should initially be a class discussion or large group discussion. Students should then move into pairs or small groups to develop a definition of biotechnology. This will be based on the class discussions, as well as knowledge they have gained from their everyday contact with news, family and friends.

Hints to help the students develop their group definition:

- Look at the cartoon on pages 6-7.
- What chemical is biotechnology concerned with?
- What sort of things does this control in humans?
- What sort of things might it control in other animals and plants? Look back at the list you made for Activity 2. If we could adjust the DNA that controls some features of the plants or animals involved, what might help solve some of these problems?

5. The class definition

Ask each pair or group to write their definition of biotechnology in large writing on a piece of paper. Display all definitions.

As a class activity, identify common aspects of the definitions and come to an agreed class definition. This class definition should stay on display for all of the lessons in the series. At the end of the lesson series, the class should decide whether it is accurate or if it needs some modification. It could also undergo regular modification throughout the duration of the lesson series.

REMEMBER: Up to this point in the lesson, class answers should be treated as contributions to the discussion rather than definitive answers that are right or wrong. At this point the students are still in the stage of engagement and exploration of the topic. It is not until you begin to deal with the specifics of the content that you will want to deal with any misconceptions, or errors of fact or procedure.

6. The structure of DNA

When beginning work on DNA structure, ensure the students possess the appropriate background knowledge from previous work. If they do not, you may need to insert an extra short information session at this point.

They should know:

- what a gene is (that is, a determiner of some characteristic of the organism)
- where it is (that is, identical copies of sets of DNA molecules in all the cells of the body).

Use the diagram on page six as a starting point for the study of DNA structure. Find out how much students already know about DNA structure by asking for volunteers to explain the nature of the components of the diagram.

As a result of their answers, or your elaboration of their answers, draw the structure labelling the deoxyribose sugar side arms and the nucleic acid base pair rungs in correctly paired arrangements.