CPD 1 A road map for SNAB: Building knowledge and principles through the course

Module introduction

This module consists of three activities. It is intended for use with teachers to develop ideas about building knowledge, principles and skills through the course. It also has an introduction and associated tasks. The whole introduction could be viewed at once and the activities combined. Alternatively, the activities could be used on separate occasions. The whole module could probably take two 45-minute sessions to complete. Session 1 could consist of the first part of the Introduction and Activity 1, and Session 2 could consist of the second and third parts of the Introduction plus Activities 2 and 3.

The structure of this module

Introduction

This module has an interactive introductory presentation together with a commentary. This could be looked at by teachers individually before the session, or in a group at the start of the staff development session.

A more detailed introduction to the CPD is provided in these Facilitator notes to give you further background.

Participants will need a copy of the Salters-Nuffield Advanced Biology specification for all the Activities.

Activity 1 Building knowledge and principles through the course

Facilitator notes and Activity sheet are provided. See pp. 4–5 of the Facilitator notes for more details.

Estimated delivery time: 45 minutes

Activity 2 Building knowledge and principles through activities

Facilitator notes and Activity sheet are provided. See pp. 5–6 of the Facilitator notes for more details.

Estimated delivery time: 25 minutes

Activity 3 Using knowledge to reach well-informed decisions

Facilitator notes and Activity sheet are provided. See p. 7 of the Facilitator notes for more details.

Estimated delivery time: 20 minutes

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Introducing the activities

Activity 1 Building knowledge and principles through the course

This course is about turning students into good thoughtful biologists. Being a good biologist is more than just learning facts: although acquiring accurate knowledge and understanding *is* an essential part of SNAB, it also involves developing skills, asking questions and making links. The teacher's role is to help students achieve this and see the bigger picture.

SNAB doesn't present the content in large blocks with neat corners. There is not, for example, a topic labelled 'biochemistry' containing everything on carbohydrates, fats, proteins and nucleic acids. Instead, these building blocks are broken up into a number of smaller ones spread throughout the course and used to build understanding. The session by session grid found in the Teaching scheme for each topic provides a road map showing where these blocks can be found in the course.

Presenting all the biochemistry, for example, early in the course can be very demanding for students, in terms of both the difficulty of the content and maintaining motivation. In SNAB, this content is presented only when relevant to the context. For example, carbohydrates and lipids are introduced in Topic 1 in the context of diet and cardiovascular disease. Proteins are introduced in Topic 2 in the context of transport across membranes. Glycolipids and glycoproteins appear in Topic 2. Topic 4 returns to carbohydrates, and the structure and functions of cellulose are compared with that of starch, featured in Topic 1. In this way, information is presented in manageable chunks and grafted onto existing knowledge using stimulating contexts where the relevance of learning is immediately obvious to students. This leads to better understanding.

Students need their teachers to help them adjust to the SNAB approach. It may be necessary, later in the course, to draw students' attention to earlier material so they develop the skill of making links between the different areas. The ability to make connections in this way is a valuable skill which will equip students for further study. It will also help them in the SNAB exams when there are thematic questions in which they have to combine their knowledge and understanding in unfamiliar ways.

The context-led approach of the course also encourages the student to recognise the links between the traditional themes of biology. For example, the structures of lipids and proteins are linked to membranes, and membranes are linked to transport into and out of cells. Problems with membrane transport in cystic fibrosis then link to DNA, the genetic code and protein synthesis.

Don't teach what isn't there

There are lots of topics that *could* appear in an Advanced Level specification. Putting together the SNAB specification involved selection in order to avoid a course that was overloaded with content and lacked depth. This means that there is no point in teaching material that is not on the specification unless you feel it will add significantly to your students' understanding of other material. If spare time *is* available during the course, it would be well spent on *activities* to deepen understanding.

Identifying the underlying ideas to learn

The SNAB student books not only contain information that meets the learning outcomes of the specification, they also contain relevant examples and case studies. These are provided to help students develop a better understanding of the underlying ideas. For example, the case study on FOP (fibrodysplasia ossificans progressiva) in Topic 3 is provided to illustrate the idea that some genes are always switched off within cells. Students are not meant to remember details about FOP. The case studies contain a lot of detail that students don't need to memorise. Referring to these case studies will help students prepare for exam questions that are *set* in the context of unfamiliar examples but are *looking* for the fundamental knowledge and understanding required by the specification. Some students will need your help to differentiate essential content from material included to provide context.

Learning with understanding

Question 6, Unit 1, January 2003 was about genetics. In the question an unfamiliar condition, achondroplasia, resulting from a *dominant* abnormal allele was used. Many candidates gained marks for a calculation of probability based on a set-piece Punnet square in a way that

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suggested that they understood simple Mendelian genetics. Part (c), which asked why most cases of achrondroplasia are born to parents neither of whom suffered from the condition, required the simple response 'mutation'. Yet many candidates wrote about 'recessive alleles' in a way which suggested that in spite of *looking as though* they understood genetic probability their understanding had not, in fact, progressed beyond grade C at GCSE.

Students can find out what's in the specification for themselves and can prepare for exams by using the 'check your notes' activity that appears at the end of each topic. But they need your help to *understand* what they need to know. This CPD module will help with this guidance.

Activity 2 Building knowledge and principles through activities

Activities are an important feature of SNAB. These activities are not bolt on extras – they're an integral part of building knowledge and understanding, and of developing skills. Each topic contains a range of activities. Students are not expected do all of these. Schools and colleges need to select activities depending on the time and resources available.

Activities use a range of different learning approaches. They provide the opportunity to develop experimental and investigative skills, as well as to develop study skills including: communication skills; data analysis; finding and evaluating information; effective note taking; and the ability to draw on existing knowledge and apply it to new situations.

Independent learning is an important skill that it is hoped students will develop as a result of doing the activities. This does not mean that students should be left to get on with things on their own. Rather they should take responsibility for their own learning. They should be encouraged to identify areas of difficulty and take steps to address any lack of knowledge or any confusion.

Independent learning also means that students are given the opportunity to use the material in such a way that they have to think through ideas. In this way they can build a better understanding with the ability to recall knowledge more effectively and apply their learning in new situations.

Some activities can also be used to check learning. For example, after teaching muscle contraction in Topic 7, the model-building activity that follows can be used to check understanding.

Core activities contain techniques that appear in the specification in italics. It is particularly important that students are familiar with these techniques as they may be examined directly on the written paper.

Activity 3 Using knowledge to reach well-informed decisions

Some SNAB exam questions deal with weighing risks and reaching social and ethical decisions. Candidates need to make a decision and then justify it using knowledge and understanding. In such questions, the mark schemes have a generous range of alternative responses, but sitting on the fence is unlikely to gain full marks. SNAB is trying to move students away from providing responses which *look like* application of knowledge but which are little more than recall. Instead, candidates may be presented with a specific and usually unfamiliar context, often including an element of dilemma, and are required to apply knowledge. Students can acquire the skills needed to tackle such questions through sound understanding of the scientific issues, and class discussion. Role plays can help students think about lifestyle decisions.

Scientific arguments, perceptions of risks and ethical and social issues are in a constant state of change. The aim of the SNAB approach is not to teach the 'right answer' but to equip citizens with a tool kit that enables them to update their knowledge and re-evaluate where they stand throughout the rest of their lives.

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Delivering the activities

Activity 1 Building knowledge and principles through the course

An awareness of the gradual building of knowledge through the course is useful for planning and teaching the course. This activity focuses on enzymes to illustrate how some biological ideas are introduced gradually in small blocks in different topics.

Suggested delivery method

The activity can take place individually, in pairs, or as a small group. There could be a session at the end to discuss the ideas as a group. Guidance notes on outcomes for each task are provided below.

Estimated delivery time: 45 minutes

Enzyme building blocks: a case study

Task 1

Immobilised enzymes appear in Topic 1 as an activity. The aim is to reinforce the idea of hydrolysis but the task also revises GCSE level enzyme theory. Weak students with a shaky GCSE base might need to be taught the basics quite directly; other students may merely need directing to the appropriate places in the SNAB support material and encouraged to review the ideas themselves. They can be directed to the GCSE review on enzymes in Topic 2.

Topic 2 develops an understanding of enzymes in the context of protein structure and synthesis. Enzyme structure and mechanism of action are examined as are the effects of substrate and enzyme concentrations. The effect of temperature on enzyme activity appears in Topic 4 in the context of recycling and climate change.

Encourage students to spot enzymes whenever they crop up and relate new knowledge to what they know already.

Don't teach anything about enzymes that is not on the specification – unless you think that it will deepen (rather than confuse) an individual student's understanding.

Task 2

Answers should be: effect of pH and inhibitors.

Task 3

Answers should include: any investigation that looked at the effect of one or more of these factors on enzyme action.

SNAB thematic web-weaving

Task 4

Genetic inheritance is found in the specifications as follows:

- **Topic 1** Monohybrid inheritance introduced along with multifactoral nature of many diseases
- **Topic 2** More detail on monohybrid inheritance; DNA replication and mutations; gene therapy
- **Topic 3** How characteristics may be affected by both genotype and the environment
- **Topic 4** Genetic modification.

Dihybrid inheritance appears in A2 Topic 5 and polygenic inheritance is in A2 Topic 8.

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Task 5

Answers should include:

Q1 Learning outcomes:

(a) 2.4.3 Compare the structure and function of the polysaccharides starch and cellulose including the role of hydrogen bonds between β glucose molecules in the formulation of cellulose microfibrils

(b) (i) 1.2.10 Explain the mechanism of action and specificity of enzymes in terms of their three-dimensional structure and explain that enzymes are biological catalysts that reduce activation energy

(ii) 2.4.10 Relate the structure of seeds to their role in the dispersal and survival of the plant (adaptations for dispersal, protection and nutrition of the embryo)

(iii) 2.4.12 Explain how the genetic modification of plants is similar to but distinct from conventional breeding; 2.4.13 Discuss the scientific arguments for and against the use of genetically engineered plants (improved plant quality, enhanced yield and consequences for the environment and health).

Q2 Some students would find this style of question difficult because it draws on material from across two topics and it requires students to apply their knowledge.

Q3 Teaching strategies most appropriate for preparing candidates for thematic questions include:

- getting students to think about the principles behind key ideas rather than rely on rote learning
- getting students to draw concept diagrams and/or mind maps to organise and consolidate their learning and identify links
- helping students to distinguish between contexts and underlying biology
- using activities and past questions that use this style of questioning.

What's been left out?

Task 6

Answers to include: Digestion; Function of the liver and kidney; Aspects of reproduction; Nitrogen cycle.

But also be aware that there are some areas included in SNAB that are not dealt with in the same depth as in traditional courses. In some cases, the content is more focused on one particular aspect. For example, details of the stages in meiosis are not required but the role of meiosis in the halving of chromosome numbers and the introduction of variation through random assortment are. There are also areas that are dealt with in greater detail in SNAB than is the case in other Advanced Level biology specifications, for example, how genes can be switched on and off by DNA transcription factors.

A grid showing where ideas are introduced and revisited can be found in the Teaching scheme.

Activity 2 Building knowledge and principles through activities

The use of activities can support the learning of theory and development of skills. Guidance notes on outcomes for each task are provided below.

Suggested delivery method

The activity can be completed individually, in pairs, or in small groups.

Estimated delivery time: 25 minutes

Task 1

Some of the skills that are developed by the Topic 1 activities are outlined in the table on p.6. The development of independence will depend on how activities are used and whether students are encouraged to be reflective about their learning progress.

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Table 1.1 Skills development through Topic 1 activities

Activity number and title	Content learning outcomes addressed from SNAB specification	Some skills that could be developed by the activity
Activity 1.5 Investigating arteries and veins	1.1.2 Explain how the structures of blood capillaries, arteries and veins relate to their functions	• Experimental skills, e.g. identification of variables, producing valid results, presenting data, drawing conclusions and safety • Practical techniques – use of microscope • Calculating percentage change
Activity 1.12 Sudden death in athletes	1.1.6 Describe the symptoms of cardio-vascular disease, i.e. coronary heart disease (CHD) and stroke, and the factors which increase the risk of cardiovascular disease (genetic, diet, age, gender, high blood pressure, smoking and inactivity)	• Reading extended prose • Applying knowledge
Activity 1.23 Functional foods and CHD	1.1.18 Discuss how individuals, by changing their diet, taking exercise and not smoking, can reduce their risk of coronary heart disease	• Data analysis

Task 2

The DNA model-building activity in Topic 2 is designed so that as students follow the instructions to construct the model, they work out the base pairing rule for themselves. Get them to do the activity at home but check their learning at the start of the next lesson.

Task 3

Q1 Activity 4.7 Why do they put mint in toothpaste? Would garlic be better?.

Q2 Bacteria grow on agar plates and appear as a white mat; safety in using bacteria and knowledge of aseptic techniques.

Q3 The plant extract kills or stops the growth of the bacteria leading to the conclusion that plants produce chemicals with antibacterial properties as a defence mechanism against predators.

Q4 Microbiological techniques including aseptic techniques. Experimental skills including safety; producing valid results; recording and interpreting results; and drawing valid conclusions from results.

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Activity 3 Using knowledge to reach well-informed decisions

Discussion of ethical issues can help students recognise the different sides of the argument and then use this experience when it comes to answering exam questions.

Suggested delivery method

The questions can be discussed in small groups before ideas are shared in a whole group session. Guidance notes on outcomes for each task are provided below.

Estimated delivery time: 20 minutes

Task 1

2.3.10 Explain what is meant by stem cells, pluripotency and totipotency
2.3.11 Discuss the moral, ethical and spiritual implications of stem cell research

Task 2

The use of human embryos versus the possibility of research leading to the recovery of people suffering from spinal injuries.

Task 3

Students have to put themselves into another person's shoes because to gain five marks in part (b) of the question the student would need to put both sides of the argument, even if they strongly disagree with one side of the argument.

Task 4

The mark scheme for part (b) is given below.

1 The embryonic stem cells come from human embryos;

2 The most likely source would be 'spare' embryos from {*in vitro* fertilisation/IVF};

3 Parents of 'spare' embryos may object to them being used;

4 Some people regard embryos as {unborn/people};

5 To kill them constitutes murder/have {ethical/religious} objections to killing (human) embryos;

6A (Others consider that) embryos can be used to alleviate (human) suffering;

6B Some people (on the other hand) would consider that this type of research offers so much potential to alleviate human suffering that it would be (ethically) wrong not to attempt it;

7 Correct reference to animal rights issue in appropriate context.

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question 7 mark scheme

To achieve full marks it often helps to conclude the discussion with one or more 'weighing up' statements.

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