

Week 3 Lesson 1

Spiny-headed worms and skin grafts

Aim: To look at a product based on the principles of biomimicry, which is ready to be taken up by a production company and manufactured.

Keywords: host, infection, parasite, skin graft

Starter activity

1. Demonstration

- Take a balloon and a piece of rigid cardboard.
- Puncture a small hole in the centre of the card.
- Push one end of the balloon through the hole.
- Partially inflate the balloon.
- Pinch the end so no air escapes and show that you can't pull the balloon through the hole.

Ask for suggestions for how this is modelling an example of biomimicry. It relates to the spiny-headed worm but students might suggest other parasites that attach themselves to their hosts, e.g. tape worms or leeches.

Main activities

1. What is a skin graft?

Show and read the article below (This is an example of a skin graft which isn't too graphic or shocking.):

www.bbc.co.uk/news/uk-england-manchester-17989713

Discuss the need for skin grafts.

2. Interviewing the professor

Students match up interview questions with the correct answers, see the resource 'Interviewing the professor'.

Differentiation

There are two sets of answers, choose the most appropriate for each group of students.

3.1: Spiny-headed worms and skin grafts

Extension

Students identify keywords and use them as prompts when acting out the interview.

3. Skin graft material

The links below show images of the skin graft material inspired by the way the spiny-headed worm attaches itself to its host:

- directorsblog.nih.gov/2013/05/02/spiny-worm-inspires-next-gen-band-aid/
- www.the-scientist.com/?articles.view/articleNo/36093/title/Sticking-Power/

Ask students to draw a diagram to show how they imagine the micro needles work.

Plenary activity

1. Pictionary

Students work in pairs. One sits with their back to the screen/board; the other faces the board so they can see the word they have to draw.

The first to guess the word are out (and maybe all pairs on their table, depending on time). The game continues until everyone is 'out'.

Suggested word list:

skin	plaster	scalpel	micro needle	sheep
professor	infection	parasite	stitches	cut
intestine	staple	skin graft	transplant	surgeon
cattle	microscope	image	surgery	host
burn	spiny-headed worm			

Week 3 homework activity

The homework is in preparation for Week 4, lesson 3 ‘Tardigrades’ sometimes known as water bears. The students are asked to research Tardigrades. There are handout sheets with the differentiated questions.

Differentiation

There are 3 differentiated tasks. Students could choose their own or be assigned an appropriate task by the teacher.

Main 2

Interviewing the professor – Teaching notes

Before the lesson copy and cut up the questions and answers and give each group a set of each. There is also a differentiated set of answers.

Explain to the students the following:

During work on a series of articles about the research projects of prominent professors, the interview questions and the answers became separated.

The editor of *Science News* has told you as sub-editor, to 'sort the problem out'.

- Can you reunite the questions and answers?
- Can you organise them into a sensible order?

Once the questions and answers have been matched-up, students can act out the interview.

Differentiation

There are two sets of answers, choose the most appropriate for each group of students.

Give students who need more support the question sheet complete and not cut up.

Extension

Ask students to note down the most important keywords from each answer. Then challenge them to act out parts of the interview with just the keywords as prompts.

Interviewing the professor – Set of questions

Good morning Professor, please take a seat. How was your journey here today?

Many research projects have taken inspiration from nature. Why is it so popular at present?

How does your team of scientists find inspiration for new innovations?

Can you tell our readers what you are working on at the moment?

That sounds interesting! Tell us about it.

Why is it important to work with others during the development of your ideas?

What is the main challenge facing your team as you develop your ideas into something that can be used in the real world?

What else do you need to know?

Can you explain how the new material your team developed is different?

Have you had any failures during your career?

What, to you Professor, is the most inspiring thing about the natural world?

Interviewing the professor – Set of answers

Very pleasant, thank you.

Biomimicry has been around for a long time. However, recent developments in technology such as microscopy have made it possible to see right into a cell, right into the tiny organelles within a cell, right down to the interactions of individual molecules. It's fascinating.

With advances in computer technology, producing sophisticated images and models, we now have a much better understanding of what is going on during processes such as respiration.

And nanoscience is enabling us to manipulate atoms and build structures which mimic those found in the natural world.

Also, products have been manufactured; real products such as paints, which can repel water and dirt. That's a great incentive for businesses to fund research.

Would you believe, we search the web? Just like everyone else! When we were looking for new ways to attach skin grafts we decided to investigate how parasites attach themselves to their hosts. We searched images of parasites looking for something we could copy.

Then there are zoos and botanical gardens.

Local knowledge is important too. Many people who live close to habitats such as rainforests, have an intimate knowledge of the forest creatures and still use wild plants as medicines.

My team are looking for new ways to attach skin grafts to areas of the body that have been badly burnt. We were inspired by the spiny-headed worm!

Well, the spiny-headed worm is a tiny creature - a parasite. It lives in the intestines of its host, cattle and sheep, absorbing nutrients from the contents of the gut. The worm attaches itself by piercing the gut wall with its 'nose' and when through, inflating its 'nose' to hold the worm in place. Isn't that ingenious?

People are beginning to realise that much more can be achieved when scientists, engineers, mathematicians even architects get together to talk about their work. Each has a unique insight and unique solutions. Collaboration can make our research move forward in leaps and bounds.

3.1: Spiny-headed worms and skin grafts

You have to really understand the problem. That's the main challenge. Take skin grafts for example. Our research team needed to understand exactly why skin grafts can fail. It turns out that there are three main reasons; firstly the graft can shift sideways and fail to stick to the tissues underneath; secondly, pools of fluid build up underneath the new skin and finally, infection can enter the wounds especially where the graft is stapled to the healthy skin nearby.

Well, you also need to know the advantages, disadvantages and limitations of the methods currently used to tackle the problem. At the present time, skin grafts are attached around the edges, like the patches in a patchwork quilt. Body fluid builds up underneath and will form a giant blister if it is not drained away.

Think of a strip of sticking plaster. This sticking plaster is covered in tiny needles. It is laid all over the skin graft. Each needle penetrates the skin and the tip swells up, gripping the soft tissues beneath the graft and holding the graft in place. Body fluid does not form pools because the graft is firmly attached right the way across. Bacteria cannot enter very easily because the puncture wounds are very small and neat.

Oh yes, ninety percent of our experiments fail. This is normal. The thing is, success and failure both point in the same direction. If we remember to keep an open mind we can learn so much from our failures. It's just like being at school, we're learning all the time.

The elegance of nature's solutions to problems. Just look at the relationship between photosynthesis and respiration for example.

Interviewing the professor – Set of differentiated answers

Very pleasant, thank you.

Biomimicry has been around for a long time. Now, microscopes have made it possible to see right into a cell, right down to the movements of individual molecules. It's fascinating.

Today's computers produce detailed images and models, so we can now understand what is going on during processes such as respiration.

And nanoscience is enabling us to move atoms and build structures which mimic those found in nature.

Would you believe, we search the web? Just like everyone else!

Then there are zoos and botanical gardens.

Local knowledge is important too. Many people who live close to habitats such as rainforests, know about the forest creatures and still use wild plants as medicines.

My team are looking for new ways to attach skin grafts to areas of the body that have been badly burnt. We found the spiny-headed worm!

Well, the spiny-headed worm is a parasite. It feeds and lives in the intestines of cattle and sheep.

The worm attaches itself by piercing the gut wall with its 'nose' and when through, inflating its 'nose' to hold the worm in place. Isn't that ingenious?

People are beginning to realise that much more can be achieved when scientists, engineers, mathematicians even architects get together to talk about their work.

You have to really understand the problem. Take skin grafts for example.

There are three main reasons why a skin graft doesn't work; firstly the graft can shift sideways and fail to stick to the tissues underneath; secondly, pools of fluid build up underneath the new skin and finally, infection can enter the wounds especially where the graft is stapled to the healthy skin nearby.

Well, you also need to know the advantages, disadvantages and limitations of the methods currently used to tackle the problem. At the present time, skin grafts are attached around the edges, like the patches in a patchwork quilt. Body fluid builds up underneath and will form a giant blister if it is not drained away.

3.1: Spiny-headed worms and skin grafts

Well, you also need to know the advantages and disadvantages of the methods currently used to tackle the problem.

Oh yes, ninety percent of our experiments fail. This is normal. The thing is, success and failure both point in the same direction. It's just like being at school, we're learning all the time.

The elegance of nature's solutions to problems. Just look at the relationships between plants and animals for example.

Week 3 homework a

What is very unusual about creatures known as Tardigrades?

Carry out some research and write one short paragraph in your own words, about their unusual powers.

X

Week 3 homework b

What unusual characteristic do these three organisms have in common: the cysts of brine shrimps, the resurrection fern and Tardigrades?

Carry out some research and write three short paragraphs in your own words, about their unusual powers.

X

Week 3 homework c

Carry out research to find out what unusual characteristic these three organisms have in common: the cysts of brine shrimps, the resurrection fern and Tardigrades. What adaptations do they have which enable them to survive when other organisms would die?

Write three to five paragraphs about what you have found out, in your own words.