

WHAT'S NEW?

Communication Objectives: Ss will be able to:

- use expressions for developing an argument and expressions used to introduce assertions.
- use vocabulary, phrases and idioms related to scientific developments.

Educational Objectives: Ss will address recent and future concerns in the different fields of science.

Connected Topics:

- History of the Earth compared to the history of humans
- Recent scientific discoveries
- Ethics in science
- Patents and innovation
- Bionics and robotics
- Genetic engineering
- Mission to Mars
- Future devices
- Human cloning
- Use of chemicals in everyday life
- Nanotechnology
- Biometric scanning
- Large engineering projects
- Non-lethal weapons
- Cold fusion

Key Vocabulary:

AI (artificial intelligence)	genetically modified (GM)	non-lethal
alternative energy	greater good	pave the way
amino acid	herd	pouch
applied science / engineering	holy grail	power-assist v
biodegradable	housings	prototype
bioelectric	human genome	purification
bionics	hybrid	purify
body armour	hydrogen fuel cell	retina
building block	ignite	robotics
bulky	integrate	shrunk
cloning	iris	sought-after
compensate	levitation	submerge
cybernetics	limb	superconductor
detectable	macro	suture
displace	mass-produce	tendon
embryonic	material science	unclog
exoskeleton	micro	unveil
fibre	mimic	vapour
forensic science	nano	
genetically altered	nurture	

1 The BIG question: IS SCIENCE MAKING LIFE BETTER?**VIEWPOINT**

Fact: The age of the universe can be measured by measuring the furthest point of the universe and multiplying this by the rate of expansion from the centre. The age of the Earth can be measured several ways. The most common is the measurement of radioactive decay. Uranium (U) is known to

decompose into lead (Pb) isotopes at a given rate. By measuring the amount of lead isotopes, we know how much the uranium has decomposed over time and the age of the Earth. *Homo sapiens sapiens* (modern humans) can be dated by carbon dating of the oldest skulls and by studying the rate of mitochondrial DNA mutations.

Sources:

http://imagine.gsfc.nasa.gov/docs/science/mysteries_11/age.html
www.nasa.gov/worldbook/earth_worldbook.html
www.mnh.si.edu/anthro/humanorigins

EQ: *What do you think this comparison says about humans? About the Earth? About the universe? How does this compare to the age of human inventions: Gutenberg's printing press (1452), the first telescope (1608), the first telephone (1870), the first computer (1936)?*

Quote: Dr. Magnus Pyke (1881–1958) was a British scientist known for trying to make science understandable to ordinary people.

EQ: *How accurate do you think this description is? How well does the average person understand the different areas of science today? Is it important for average people to understand science? Why / Why not?*

1 WORD POWER

A 1 gets students to consider some scientific developments that have attracted public interest.

1 WORD POWER A1, A2 **Answers**

1 c 2 b 3 e 4 a 5 d

2 (Sample answers) **As you are probably aware**, magnetic levitation trains can greatly improve the flow of traffic in cities. **As a matter of fact**, bionics might lead to technology that would allow paralysed people to walk. **The simple fact is that** hydrogen fuel cells might be the answer to global warming.

B gets students to practise the phrases for developing an argument in **Language Bank 17**.

1 WORD POWER B, C **Sample answers**

B 1 **Consequently, this means that** we could cure many types of spinal injuries.

2 **It follows logically then that** we should be careful about how much of it we eat.

3 **From here, we can conclude that** we should train more people as engineers than scientists.

C 1 The project for mapping the human genome promises many great benefits from genetically customised drugs to identifying the genes responsible for different diseases.

2 This is the classic debate in psychology. What is the greatest influence: our parents and the way they raise us or the genes passed onto us by our parents? The 1990 Minnesota Study on Twins Reared Apart (*Science*. Bouchard et al) found little difference between identical twins brought up together and brought up apart in terms of temperament, career and leisure interests and social attitudes.

ARTICLES**Bionic Suit Offers Wearers Super Strength**

This article discusses Yoshiyuki Sankai's invention of the cybernetic exoskeleton. While his design is quite innovative, the premise behind Sankai's invention has a long history in technologies like deep-sea pressure suits as well as in science fiction. Many have also drawn the comparison between Sankai's cybernetic exoskeleton and the one that appears in the 1986 movie *Aliens*, which features an industrial-sized exoskeleton machine for moving cargo. Although the first commercial suits of Sankai's exoskeleton are expected to cost 11,000 to 15,000 euros, they do seem to be out of the price range of many potential users such as the elderly and disabled.

EQ: *How do humans have artificial components already? Do you see the exoskeleton as an extension of artificial limbs (legs, hands)? Do you think using cybernetic parts will be more common in the future?*

'Spider-Goats' Start Work on Wonder Web

This article discusses the issue of transgenics, the movement of genetic sequences from one organism to another, and bioethics. This particular case is interesting in that the new organism's vast potential to benefit humans has made many people overlook transgenic concerns. Firstly, is this manipulation a violation of that organism's rights? Secondly, it raises the issue of transgenic humans. Scientists have already produced

transgenic pigs that can be harvested for organ donations. It only seems a matter of time before humans begin to experiment on human DNA to produce more useful models: better immune systems (like rice needing no pesticide), faster development (like salmon which grow six times faster), or increased muscle mass for athletes (like a mouse with double the muscles).

Some scientists believe that we may soon see organisms that may have the ability to talk and reason like humans, which would cause a serious rethink about the rights of animals and humans. In 1998, Jeremy Rifkin and Stuart Newman applied for a patent in the US for a Humanzee (part human, part chimpanzee) to bring attention to this issue. The patent was denied, but the debate was left unresolved.

EQ: *Do you see transgenic animals as monsters, miracles of science or something else? Are we blurring the lines between species?*

The success of the transgenic spider-goats has led to using the milk of different animals to deliver things like drugs and vaccines. Do you think this is a good thing? What might be the effects if transgenic animals escaped into the wild?

2 READING

A is a skimming activity that will help students with the Use of English section of the CAE exam and the reading section in IGCSE.

2 READING A

Answers

1 both 2 spider-goat 3 HAL 3 4 spider-goat

B reflects the on-the-spot discussions that appear in the Trinity Spoken exam. You should encourage the students to use vocabulary from the text and try to be concrete in their visual descriptions.

C 1 This question relates to a type of question in the Trinity exam which requires students to speculate on issues that are not explicitly stated. You may want to help the students by pointing out examples of industry or areas of government which might need this technology: oil, logistics, tourism, agriculture, forestry, aerospace, firefighting, police or military use.

EQ: *Why might business be interested in cybernetic exoskeletons?*

2 This question requires students to speculate on the ethics of transgenic spider-goats. You can give students some help by asking students to give the positive (easy to produce, can be mass produced, can be used to help police, industry) and negative (long-term, unknown health effects to goats and offspring, creating organisms for profit and human benefit) aspects.

EQ: *Do the positive aspects outweigh the negative?*

3 SPEAK YOUR MIND

This section covers the topics of benefits and drawbacks to science, important discoveries (past and future), the ethics of science, and medicine and patenting scientific discoveries.

A EQ: *Give five examples of each. How do you think the public sees scientists (caring / uncaring, analytical / illogical, emotional / unemotional, funny / boring)? Do you think the public generally trusts scientists? Think about the different fields: biologist, nuclear physicist, geneticist or chemist?*

B EQ: *How would your life be different without these inventions? What do you think it takes to make these discoveries? Do you think there are too many technological or scientific discoveries for people to keep up with? Is it possible to learn everything about the world?*

C EQ: *What are the positive and negative aspects of genetic engineering? What are some 'wonders of nature' – unique abilities among plants and animals? Give some examples. How might these special genes help other plants, animals or even humans? Why / Why not?*

Why is it alright to do transgenic work on animals and not on humans? Will we see transgenic humans in our lifetime? Will we need to reconsider what we think of as normal? What would happen if scientists developed animals with human-like intellect, ability to talk or to think?

D EQ: *Some patented medicines (AIDS medicines) could save countless lives in the developing world, but*

are too expensive. Should countries be allowed to override patent law in these cases?

Is it right to patent parts of the human gene? Do patents help or harm innovation? Do you think patent holders (medicine or software) are viewed as innovators who should be rewarded, exploiters of a common good, or something else?



4 WATCH AND LISTEN

DVD

This video clip is from the European Space Agency, which provides public access to media coverage of its space and technology programmes. The video contains an interview with Heiner Klinkrad, an ESA expert on space debris. He explains the problems posed by space debris, which looks set to be an increasing problem for future space exploration. The implications of this problem could be very far-reaching, including an end to all space exploration.

Note: ESA is pronounced ['i:sæ].

4 WATCH AND LISTEN B, C

Answers

B Satellites can run out of energy or fall out of orbit. Fuel tanks are explosive and don't always fall back to Earth. Astronauts could easily be killed in space by this debris, and can create it if they are not careful.

C 1 9,500 2 almost 200 3 hit by a sphere 1.2 cm in diameter, caused a lot of damage

D You can encourage students to speculate on the impact an end to space exploration would have on a space scientist.

E EQ: *Would you like to travel in space? Why / Why not? Have we really learnt anything valuable from sending people into space?*

5 TEAMWORK

This activity is designed to get students thinking about how scientists, inventors and businesses might approach developing new technology or conducting research. Students should be encouraged to explore any ideas, even wacky ones. Some of the most

innovative products were not understood for their potential before they became better known.

To expand the discussion, you can also brainstorm alternative energies before the students address the subject: wind power, tidal power, biomass (agricultural waste, peat), hydroelectric energy, biodiesel. And ask the questions: *Which of these are used to power consumer products today? Which could be used in the future?*

Sources:

Why didn't I think of that?: Bizarre Origins of Ingenious Inventions We Couldn't Live Without, Allyan Freeman

Renewable Energy, Godfrey Boyle

<http://inventors.about.com/library/bl/bl12.htm>

6 CONTROVERSY

The public have been aware of the prospect of human cloning since scientists announced the birth of Dolly the sheep in 1996. One important downside to cloning is that all cells have telomeres, a sequence of DNA that limits the number of cell divisions. It is widely believed that the length of telomeres indicates the age of a cell, and therefore the organism. Telomeres tend to shrink over time so the number of cell divisions remaining, and therefore the years remaining, continues to grow smaller. Some scientists believe that Dolly's much shorter telomeres indicated that she might have been physically much older than her six-year lifespan. Although it cannot be proved conclusively, her arthritis and early death from a lung infection fit the pattern for much older sheep. Theoretically, a baby born from the DNA of a 70 year-old man may share the life expectancy of a 70-year old.

Sources:

A Clone of Your Own?: The Science and Ethics of Cloning, Arlene Judith Klotzko

Whose View of Life?: Embryos, Cloning and Stem Cells, Jane Maienschein

www.sciencemuseum.org.uk/antenna/dolly/index.asp

www.globalchange.com/sciencetop.html

EQ: *What do you think of human cloning? Would you want to be cloned? Why do you think people are horrified by human cloning, but not animal*

cloning? How does religion affect the debate over cloning?

7 PORTFOLIO WRITING

See the Introduction to the Teacher's Guide.

A Sources:

The Elements: A Very Short Introduction, Philip Ball
www.chm.bris.ac.uk/webprojects2002/dean/u.htm
<http://c3.org/>
<http://en.wikipedia.org/wiki/Nitrogen>

B Sources:

Some sites have ideas about scientific developments that students can then research further:

www.sciencemap.org
www.newscientist.org
www.seedmagazine.com
<http://web.mit.edu/newsoffice/research>
<http://news-service.stanford.edu>
<http://news.bbc.co.uk>

8 ENGINEERING in English [CLIL]

While some fields of engineering, such as software engineering, have existed for relatively short periods, humans have used the principles of nature in practical applications since ancient times.

From at least 3000 BC, early humans were already using levers and smelting metals and developing large-scale projects like open-pit mining. The Greeks developed the ratchet and the water wheel. The Romans built roads, aqueducts and sewage systems. They also concentrated a lot of their engineering skills on military uses, such as building fortresses and weapons. These ties between the military and engineering continue to this day.

While this activity includes one example relating to military use, there are thousands of examples of everyday technology that originally had military or aerospace applications. These include GPS, smoke detectors, satellite dishes and zips. The largest advances of engineering, however, came as a result of the scientific revolution and the Industrial Revolution. Many of the engineering work done today follows in this line. Large-scale projects like the Three Gorges Dam are designed to benefit the needs of industry.

In many cases, it does seem that modern engineering attempts to do what people often thought was impossible. Both nanobots and the Three Gorges Dam would have been considered impossible only a few decades ago.

EQ: *Can you see any dangers of using nanobots for medical purposes?*

Do these security measures or any others affect personal freedom?

New evidence suggests that hydroelectric dams are as polluting as coal-burning electricity power stations. Given this and the effect on fish and people along the dam, should we still use hydroelectricity? Why do you think countries are always interested in building the 'biggest ___ in the world'?

Should microwave guns be used on people?

Sources:

www.crnano.org
www.biometrics.org
www.wcsscience.com/giant/dam.html
www.au.af.mil/au/awc/awcgate/cst/csatl11.pdf

9 FURTHER DISCUSSION

This section covers types of engineering, similarities between animals and humans, forensic science, and how things work.

A Try to get students to think about how different research is from practical applications.

EQ: *What large engineering projects have there been in your country? How important has engineering been to your country's development? Do you have enough engineers in your country?*

B EQ: *Koko the gorilla can use over a thousand signs and understands 2,000 words of spoken English. She has a tested IQ of 75–95 (100 is normal human intelligence). (See: www.koko.org) Does this change your view of animal intelligence? Why do humans place ourselves as superior to animals? Are we? Think about compassion / intolerance, intelligence, ability to create / destroy, or use of resources. If animals are intelligent and can feel emotion and pain, is it right to do experiments on them?*

C Try to get students to think about the popularity of criminal investigations on television and in movies.

EQ: Name some high profile crimes or unsolved crimes in your country. What do you think really happened? How would a forensic scientist try to solve the crime? Do you see forensic science as true science?

D Try to get students to think about the complexities of things we often take for granted.

EQ: If you had to make these products yourself, could you? Imagine what your life would be like if you had to produce everything: food, shelter, fuel or soap.

10 **Your answer:** IS SCIENCE MAKING LIFE BETTER?

This question tries to get students to address the utility of science. The way that science and scientists focus on the rational is often seen by the public as being more focused on the process than on people. It may be worth asking whether this is a fair criticism given the difference between large engineering projects and cures for diseases compared to some genetic engineering and nuclear weapons.

EG: Do you think scientists are looking at the bigger picture or at the wrong picture? Do the benefits of advances in science outweigh the drawbacks?

WORKBOOK

1 WORD POWER

This activity will get students practising the phrases for developing an argument from **Language Bank 17**. The phrases are interchangeable, so students could use any of them.

1 WORD POWER

Answers

- 0 It follows logically then that...** (e)
1 Consequently, this means that... (c)
2 From here we can conclude that... (a)
3 Clearly then, this indicates that... (b)
4 It follows logically then that... (d)

2 WRITING

A Sources:

A Short History of Nearly Everything, Bill Bryson
www.newscientist.com
www.sciencemuseum.org.uk
www.sciencedaily.com

B Sources:

<http://ghr.nlm.nih.gov/ghr/page/Home>
www.foodfuture.org.uk
www.who.int/foodsafety/biotech/enstemcells.nih.gov/index.asp
www.genengnews.com

3 SPEAKING STRATEGIES: Key words

This activity is the one of the basic techniques that students should learn to give better presentations. In trying to summarise arguments in two to three words, they will learn to memorise their presentations and produce better visuals. The following are suggested answers, but other answers may be as acceptable.

3 SPEAKING STRATEGIES

Sample answers

- 1** The initial experiment. **2** What went wrong.
3 The research continues. **4** 300 scientific papers.
5 Evidence of nuclear reactions. **6** Problems remain.

4 IDIOMS

See the Introduction to the Teacher's Guide.

4 IDIOMS

Answers

- 1** c **2** a **3** d **4** e **5** b

1 to break new ground = to do something other people have not done before **2** to pick your brains = to get information from someone and use it to your own advantage **3** to hit the headlines = to be in the news (literally on the front page of the newspapers) **4** to loom large on the horizon = to appear imminent, likely **5** to be a cornerstone = to be the basis of, be an essential part of

Ask students to use the idioms when answering these questions orally. This can be done as pair work or as a class.

- *Why do you think people know so little about cutting edge research?*
 - I think most research doesn't *hit the headlines* unless it is something that will affect a large number of people.
 - Ordinary, everyday research is *the cornerstone* of science. It just doesn't get reported.
 - I think the mainstream press is not interested in *picking* scientists' *brains* unless it is about genetics or weapons.
- *Should scientific research only be done for profit?*
 - I think you are more likely to *break new ground* when people are motivated by profit.
 - I can't see why we can't *pick* the scientists' *brains* about this.
- *Will humans travel to Mars in your lifetime?*
 - It is definitely *looming on the horizon*.
 - Politicians like to talk about travelling to Mars to *hit the headlines*, but I don't think it will happen.
 - I think Mars Express is intended *to be the cornerstone* of a future European mission to Mars.