



Year 8 LP1 Homework

Name:

1. Edges of science
2. Digital age
3. Modern scientists
4. Frankenstein monkeys
5. Bionic man
6. Pigs back from dead
7. Body transplants
8. Labradoodles
9. First 'edited' embryo
10. The living robot

Homework 1

Frankenstein: Exploring the edges of science

Mary Shelley's Frankenstein is perhaps society's most famous story about overreaching human knowledge. As the science of artificial intelligence advances, has humanity ignored its warning?

'How dangerous is the acquirement of knowledge, and how much happier that man is who believes his native town to be his world, than he who aspires to become greater than his nature will allow.'

When Victor first began to seek out the secret of life in Mary Shelley's novel, Frankenstein, he was consumed with passion for the project. He was desperate to bring the 'man' he had created to life. The novel was written in 1818, at a time when scientists were experimenting with **electricity**. Many believed that the power to reanimate a lifeless body was within humanity's grasp. But the moment Victor succeeded, 'breathless horror and disgust filled my heart.' So begins the terrifying chain of murder and abandonment which finally leads him to chase his creature through the Arctic and towards the **North Pole**. At its core, Frankenstein is a story about humanity grappling with the edges of science. 200 years later, scientists are no longer confused about how electricity works, but they are still debating whether it can ever produce life.

The '**Turing Test**' of artificial intelligence (AI) has already been passed. So when does that intelligence become consciousness? Some scientists have argued that it depends on an awareness of self and identity. After all, this is what makes Frankenstein's creature so compelling — entire chapters are written from his point of view, so we see him develop, learn language, and experience emotions. We also see that humanity's treatment of him turns his kind heart cruel. In July this year, scientists in New York recorded what they believe to be the first sign of **self-awareness** in humanoid robots. If they are right, they must begin to face the question of when their creations become 'alive', and what responsibilities humanity has towards them.

'Miserable Monster'

Frankenstein shows us the darkest consequences of human knowledge, often using religion and nature as a counterpoint; by creating life, Victor tried to elevate himself to a God and suffered the terrible consequences. Since then, similar stories of man-made creations with disastrous results have often been told. We should heed these warnings, many say; just because we can do something, does not mean that we should. Others argue that the benefits of scientific invention far outweigh the risks. Of course we should proceed with caution, but AI is being developed to solve problems, not create them. Computers can already find the quickest route to an airport in under a second — what if they could also find the best cure for a disease, or an answer to the world's energy crisis? Stories depend on exaggerated risk and dramatic effects: but that is no reason to hold back in real life.

WORD WATCH

Electricity

In 1803, Giovanni Aldini used electricity to induce movement in the muscles of a recently executed murderer's corpse. With such dramatic experiments firmly in the public consciousness, Frankenstein's monster did not seem so far-fetched.

North Pole

While scientists studied electricity, explorers were beginning to travel to the Arctic. They would not reach the North Pole until 1908 or 1909, when Frederick Cook and Robert Peary both claimed to be the first.

Turing Test

A test of computer intelligence, proposed by the computer scientist Alan Turing. He argued that if a human studying a five-minute written conversation between two parties cannot tell that one of them is a machine, the machine is 'thinking'. It is claimed that 'Eugene Goostman', a programme posing as a 13-year-old Ukrainian boy, passed it last year.

Self-awareness

Asked whether it had been given a 'dumbing pill' which would mute its voice, a Nao robot stood and said 'I don't know'. On hearing its own voice, however, it apologised. 'Sorry. I know now. I was able to prove that I was not given a dumbing pill'.

ACTIVITIES

- 1) Is Frankenstein responsible for the crimes of his creation? Why or why not?
- 2) Should humanity set limits on its own pursuit of knowledge? Explain your answer.
- 3) Write a short story about artificial intelligence. Will the outcome be good or bad for humanity?

Homework 2

App resurrects 'Frankenstein' for the digital age

Mary Shelley's gothic tale of Frankenstein and his monster has been rewritten as an interactive app for iPads. Is this the triumph of human ingenuity, or a hideous mockery of a great book?

Terrified spectators cower in a corner while lightning rages about a hatch in the roof. A scientist hits a button and a metal table descends. It is covered by canvas, but a hand protrudes, unnaturally large and disfigured. Suddenly, the hand twitches. The scientist is gripped by frenzy. 'It's alive!' he rants. 'Now I know what it feels like to be God!' The scene is the birth of **Frankenstein's monster**, as imagined in the classic 1931 film. But the monster's first twitchings, in **Mary Shelley's** 1818 novel, were quite different. The scientist is a troubled intellectual, not evil lunatic; his fateful creation begins its life in an atmosphere not of manic triumph, but secrecy and shame.

The story of Frankenstein has been subject to countless adaptations. Like the monster, the tale has been twisted and reassembled in new forms, some barely recognisable. Now it is at the forefront of a whole new genre, which some predict could change literature forever: the interactive e-book. No trees will be harmed in this version: it is only available as an app. That is not new – digitally enhanced books have been around for years, animated with videos or soundtracked by effects and mood music. *Sherlock Holmes* and Bram Stoker's *Dracula*, for instance, have both been given electronic makeovers.

This time, though, the novel is not simply enhanced – it is rewritten. Dave Morris, previously a writer for video games and comics, has adapted the original text into a format in which the reader interacts with the story's main characters. The basic plot remains the same. The monster will always be rejected from human society; tragedy will ensue. But the tone and detail mutates depending on the avenues you choose. Such a radical rewriting of a classic might be expected to cause outrage. But the e-book is more faithful than any film has been, and experts have largely reacted with excitement. It is, says one professor 'a thoroughly literary experience... done with enormous sensitivity.'

A novel approach

Is this a new stage in the evolution of the novel? Plots you can navigate and explore; videos and music worked into the text; interaction with other readers, and even the authors themselves! These, say fans, are only a few possibilities in this brave new literary world. We are experiencing of the birth of a whole new art form. Stop, the purists beg. You have created a monster! Part of what makes novels wonderful is that they force us to use our imagination. We should not need earphones, they say, to hear the fire crackle; nor do we need to digitally 'interact' with characters in order to care

about their fate. Far from enriching books, these developments only make them more superficial.

WORD WATCH

Frankenstein's monster

It's a common misconception that Frankenstein *is* the monster. In fact, the novel is named after the scientist – his creation has no name. Interestingly, though, some critics interpret Frankenstein's monster as a symbol of the dark parts of his own subconscious. In a way, then, the misconception might not be so far off after all!

Mary Shelley

Mary Shelley was the daughter of Mary Wollstonecraft, a famous writer on the rights of women who some claim was the first feminist. She began writing *Frankenstein* when she was just 19, and was probably assisted by her husband, the poet Percy Bysshe Shelley, and their illustrious friend Lord Byron.

Dracula

It is often said that modern vampires and Frankenstein were created on the same holiday in Geneva. The Shelleys, Lord Byron and a friend called John Polidori entertained one another by telling ghost stories late into the night. Mary invented her tortured monster, Polidori created a bloodsucking aristocrat. This new idea of the 'vampire' (previously little more than a wild animal) did not become famous until *Dracula* was published 70 years later.

ACTIVITIES

1. Research another important technological development in the arts – such as the printing press or talking movies – and write a paragraph about its effects
2. Is it wrong for authors to rewrite classic novels? Why or why not?
3. Is modern technology damaging our ability to imagine and think about things for ourselves? Why or why not?

Homework 3

How Frankenstein could save the modern world

What can Frankenstein teach modern scientists? For 200 years, the tale has gripped readers. As humans gain greater powers to control life, many say the book still contains a vital message.

Two hundred years ago, Mary Shelley's classic story Frankenstein was first published. It became a sensation, inspiring countless films and plays — not to mention plenty of dodgy Halloween costumes. But one thing that lies at the heart of the tale is a deep anxiety about the dangers of science. In the book the brilliant Victor Frankenstein dreams of unlocking the “mysteries of creation” by single-handedly bringing a person to life. He scavenges some body parts and builds a giant hodgepodge humanoid, successfully sparking it into existence. But as his creature wakes, the doctor is overcome by its monstrosity — struck down by “breathless horror”.

The beast soon escapes, setting in motion a tragic tale of murder and revenge. In retelling this story, Victor Frankenstein gives us a warning: “Learn from me... how dangerous is the acquirement of knowledge.” Despite this message being over two centuries old, some think that it is now more vital than ever. Humans are developing ever greater powers to create and edit living things. Take genetic engineering. In recent years the invention of a gene-editing tool called CRISPR has opened up a world of possibilities, as well as dangers.

According to one of its developers Jennifer Doudna, the technique allows scientists to edit or delete genes in “virtually any living plant's or animal's genome”. Many uses have been predicted: from curing cancer, to engineering super intelligent humans. But Doudna concedes that it may also have “unintended consequences”. For example, in a recent test, scientists used CRISPR to cure blindness in mice. However, the procedure also caused over a thousand unforeseen effects on the animals. And it is not just biologists experimenting with life. Computer scientists are creating ever smarter artificial intelligence (AI) which, according to some, could one day become self-aware just like humans. Others may hope this never happens, like Stephen Hawking, who warned that AI could “spell the end of the human race”.

But should we heed Frankenstein's warning about the dangers of science?

Creating chaos

Arrogance is our downfall, some say. Dr Frankenstein was doomed because he tried to play God. In modifying our genes or creating super intelligent AI, we make the same mistake. The difference is that the extinctions and worldwide chaos which could follow will not be confined to books, but will happen for real.

Great ambition leads to great progress, others respond. Sure, genetic engineering and AI are not without hazards. But nothing great was ever achieved that was risk free.

What is more, the potential rewards which scientific progress brings easily outweigh the slim chance that things will go wrong.

WORD WATCH

First published

The book was initially published anonymously, with only 500 copies printed in the first edition. Mary Shelley's name appeared on the second edition published in 1822.

Frankenstein

The name "Frankenstein" refers to the monster's creator rather than the creature itself. In the novel the monster is referred to with words such as "wretch", "monster", "creature", "demon", "devil", "fiend", and "it".

CRISPR

The process works by essentially unzipping and precisely cutting out strands of DNA. This process disables the gene or leaves space for new DNA to be inserted.

Genome

The complete set of genetic information contained within an organism.

Scientists

Research led by Kellie A. Schaefer, with findings published in the paper, Unexpected mutations after CRISPR–Cas9 editing in vivo.

ACTIVITY

1. Now it is your turn to devise a truly modern ghost story. What monster would feature in the tale? What messages would the story have about modern society? Write down an outline for the plot and share with your classmates.

Homework 4

US scientists create 'Frankenstein' monkeys

Scientists have found a way to create one monkey from six different embryos – a baby with twelve parents. The medical possibilities are endless, but a moral row has already erupted.

Scientists in the USA have revealed the results of a ground-breaking experiment in which three monkeys were born – each with twelve parents. Showing the healthy six-month-old monkeys to the press for the first time, project leader Shoukhrat Mitalipov said that 'the possibilities for science are enormous.'

The stem cell research experiment has caused shock and amazement worldwide and involved merging together six fertilised eggs into a single embryo called a chimera, in which cells from all six genetic lines are combined in one body. The technology has been used before on rats and, in 2005, to create a sheep with a partially human brain. The chimera monkeys, named Chemero, Roku and Hex, mark the first time that the experiment has worked with primates. Many scientists believe that it may now be possible with human embryos. Human chimeras can appear naturally. Occasionally, when two different eggs are fertilised in the womb at the same time, the eggs merge and a single baby is formed. Whilst most human chimeras never become aware of their strange condition, they sometimes have tell-tale quirks such as differently coloured eyes – or in one reported case, 'chequerboard' brown and white skin.

In 2003, a 52-year-old American woman was told by doctors that DNA tests showed her to be genetically unrelated to her own sons. Only later was it discovered that the woman was a chimera. Her reproductive system had totally different DNA to other parts of her body; genetically, it was as if she was two different people in one. Although it is strictly illegal, Mitalipov believes that chimera testing using human embryos is the crucial next step. The team's ultimate goal will be to find out if carefully selected cells from one embryo can survive when injected into another. If this works, they say, the same could be done with adult humans, helping to fix parts of the body that are damaged by ageing and disease.

Science Friction

Many people who object to this research believe strongly that all people possess an intrinsic identity or soul – even from the moment of conception, when an egg is first fertilised. Two embryos should then have two separate souls. Combining them into a chimera would leave two souls trapped in one body – surely a moral outrage of the most serious sort. Not so, reply others. A person's identity or soul or whatever you believe in has nothing to do with their DNA. A fertilised egg or an embryo is not a person, and a chimera is not two people, or two souls, joined together, but just one person with two sets of DNA.

WORD WATCH

DNA

DNA, or deoxyribonucleic acid, is the genetic code carried in almost every cell in the bodies of humans and animals. Every person's DNA is individual to them. Only identical twins share the same DNA.

Stem Cell Research

Stem cells taken from embryos are unique because they have the potential to turn into any kind of cell. This means that it could be possible to use stem cells to replace cells in a person's body which have been damaged by age or disease. However, the cells need to be 'harvested' from embryos when they are around five or six-days-old; the embryo itself is then destroyed.

Chimera

In Greek mythology, the Chimera was a fire-breathing creature, usually depicted as having the head of a lion, the body of a goat and a snake for a tail. In medicine, the term refers to an animal, plant or human which is made up of more than one organism.

Primates

The primate family of animals includes monkeys, apes and humans. Primates are our closest animal relatives in the evolutionary tree.

Embryo

Human reproduction starts with a fertilised egg – a single cell – inside the mother's womb. This egg, which has its own unique genetic code, then grows into an embryo: a small cluster of cells which will develop into a foetus and, eventually, a human baby. Whether or not an embryo can or should be thought of as a person and/or granted the same rights as a baby already born is a hotly debated and highly emotional issue.

ACTIVITY

1. What a person is like is partly a result of their genes and partly their environment and experiences as they grow up. Write an essay entitled 'Nature or Nurture?' explaining which of these you think is more important and why.

Homework 5

Scientists build 'complete' bionic man for TV

He may not be much of a looker, but Rex walks, talks and moves much like a human being. Every inch of his 'body' is artificially engineered. Will we soon build humans from scratch?

Mouth by NeoSpeech, hips by Ottobock, arms by Motion Control Inc and eyes by Second Sight Medical Products: Rex is the ultimate designer robot. Each of his parts comes from the cutting edge of prosthetic technology, imported from medical laboratories all over the world. But he is more than just a showcase for eye-catching inventions. This fully-functioning bionic man can navigate environments, manipulate objects and even hold simple conversations, all without the slightest human input.

Rex was built for this week's Channel 4 documentary *How to Build a Bionic Man* by a team whose leader, Bertolt Meyer, has had a prosthetic hand of his own since childhood. Meyer's challenge: to rebuild himself without a centimetre of biological matter. With a thick, seven-foot-high frame, awkward movements, a bellyful of wires and clumsy habits, Rex does not quite match up to the real thing. But he is a spectacular achievement. His eyes are cameras; images are sent to a microchip, which recognises nearby objects and send messages to his limbs. His legs are formed by the Rex Bionics Exoskeleton, equipped with 29 computer processors which allow him to walk, sit and climb – as well as giving him his name.

But perhaps the most impressive parts are on the inside. There is a false pancreas made of gel, which responds to the presence of glucose by liquefying and releasing the insulin within. There is an artificial heart pumping plastic blood, a prototype kidney the size of a coffee cup and even a small language-processing chip. Many of these prosthetic body parts are already used to replace missing or damaged organs and limbs. Those that are not soon will be. But researchers believe these transplant projects are only the beginning: soon, robotics may outstrip biology, making bionic parts more desirable than the originals. 'Nobody will be going out without less than two hearts,' said one. 'Your entire concept of what constitutes humanity is going to change.'

Superhuman

Limbs of steel, invincible hearts, chip-enhanced brains – it all sounds very exciting. But what if an entire human body, brain included, was replaced by artificial parts? Would the resulting creature still be a person? Would it, in fact, be conscious at all? Of course not, some say: we are not just a collection of cells and nerve endings. A person's essential humanity lies somewhere else, somewhere intangible and unreachable by science.

That is simply an illusion, others respond: humans, like everything else in the universe, are nothing more or less than a bundle of chemicals interacting in spectacularly

complicated ways. If a bionic person functioned exactly like us, they say, it would think and feel like us too.

WORD WATCH

Prosthetic technology

Prosthetics is the science and technology of creating artificial devices that replace or fix body parts. Until recently, prosthetic limbs were inactive objects that attached to a joint or bone; but sensors now allow people to control limbs using brain activity, just as you would the real thing.

Bionic man

Bionic technology is technology that mimics life. Rex has been designated a man because he was loosely based on his chief creator Dr Bertolt Meyer, on whom the head was modelled.

Clumsy habits

Rex's coordination is a little imperfect – for instance, he spilled Dr Meyer's beer twice in one outing!

Pancreas

The pancreas produces several vital hormones including insulin, which controls how much glucose organs absorb from the blood. Diabetes causes problems in insulin production, so an artificial pancreas like Rex's could help millions.

Plastic blood

Blood transfusions are effective, but maintaining supplies can be problematic, because natural blood cannot be preserved for more than about 30 days outside the body. Artificial blood could soon provide the solution.

ACTIVITY

1. Write a short science fiction story set in a world where we coexist with bionic men and women. Think about the ethical dilemmas that might be encountered by people living in such a future.

Homework 6

Scientists bring pigs' brains back from dead

The experiment has blurred the line between life and death, and provoked excitement and horror in equal measure. Does this mean we will one day be able to reverse death? Should we want to?

Thirty-two pigs heads were laid on a slab in a laboratory. The pigs had been slaughtered four hours earlier. Then their heads were severed from their bodies. They were, without question, dead. But not for long. When the scientists pumped the heads with artificial blood, some brain cells started functioning again. In fact, certain regions of the brain were behaving as if they had never died. However, the scientists were unable to restore brain-wide electrical firing, which means the brains did not regain consciousness. "They could not think. They could not feel," explains science writer Mark Ritter. "But within them, you could see the signs of activity."

The findings, which have now been published in the journal *Nature*, are forcing doctors to re-think the boundary between life and death. It even raises the possibility that we could reverse death entirely. Until the 1950s, a person was considered dead when their body had lost one of three key functions: their heart stopped beating; they stopped breathing, or their brain showed no signs of activity. But then came CPR and ventilators, which could revive the heart and keep the lungs breathing. That left only brain death as the last concrete, irreversible symptom of death. Until now.

Could we, one day, reverse brain death in humans?

Neuroscientist Nenad Sestan, who led the experiment, believes it would work on the brains of primates, a group which includes humans. He also thinks it could be possible to restore consciousness, perhaps indefinitely. But assuming your body was damaged beyond repair by age, disease or injury, what kind of life would it be? A living hell, according to ethics professor Benjamin Curtis. "You would have to spend the foreseeable future as a disembodied brain in a bucket, locked away inside your own mind without access to the senses that allow us to experience and interact with the world," he argued in a piece for *The Conversation*. Even an new, healthy body might not help. Curtis says that, attached to a new body, the brain would be overwhelmed with unfamiliar chemical and electrical signals.

"It could send [it] mad," writes Curtis.

Rest in peace?

Why are we so concerned with reversing death? Death isn't evil, it's natural. Immortal life would eventually make you despondent and bored, having done and seen everything on offer. Life is precious and poignant because we know it isn't forever.

But if we could preserve our bodies and minds in perfect health, how long would you want to live for? A few hundred years? A few thousand? It would mean more time with our families; time to travel the world; time to write a book or learn a language. Doesn't that sound like heaven?

WORD WATCH

Electrical firing

Your brain works by firing electrical currents through billions of nerve cells, which are arranged in patterns to carry out different functions.

Consciousness

The state of being aware. How consciousness works, and what exactly it is, is the subjects of centuries of philosophical argument.

CPR

Cardiopulmonary resuscitation. When you push down on someone's chest and breathe into their mouth, in the hope of reviving them. It is only successful about 40% of the time when performed in a hospital.

Ventilators

A machine that breathes for a person when they are unable to.

Brain death

When a person has no brain activity at all. It is also called brain-stem death.

Primates

A group of mammals that includes apes, humans, lemurs and bush babies among others.

ACTIVITIES

1. Write down five questions you would like to ask the scientists who carried out the experiment.
2. Write a short story, no more than two A4 pages, from the perspective of a 1,000-year-old person. What have they seen over their long life? How do they feel about the world now?

Homework 7

Body transplants are on the way, say doctors

Surgeons in China say that they will soon be able to graft a new body onto a living head. This should be good news for the disabled. But many are horrified by the ethical implications.

Two centuries after the publication of *Frankenstein*, Mary Shelley's vision of surgical experimentation is inching closer to reality. A Chinese surgeon has confirmed that he is preparing to carry out the world's first human body transplant. Dr Ren Xiaoping claims that the operation, whereby a living head would be attached to the body of a corpse, could give the physically handicapped a new lease of life. Several patients have expressed interest; transplants will take place, says Ren, 'when we are ready'. He is not alone. In Italy, Dr Sergio Canavero argues that the science behind the surgery is more or less in place. Valery Spiridonov, a Russian man with a rare muscle-wasting disorder, has signed up to be his first subject. Canavero is keen to operate on him by December 2017.

Scientists have been experimenting in this area for a while, with mixed results. The Soviets got a head start in 1954, when Vladimir Demikhov produced a bunch of two-headed dogs. None survived for more than a week. Two decades later, American surgeon Robert J White performed a body transplant on a monkey. The resulting creature was conscious, but could not move its body. More recently, Ren has grafted mice's heads onto other mice's bodies, and claims to have done the same with human cadavers. When it comes to live humans, not everyone shares Ren's and Canavero's confidence. Experts question whether the procedure – in particular, the reattachment of nerves in the spinal cord – is possible with today's tools.

More fundamentally, there are ethical concerns. The issue at stake is whether a person with a new body is still the same person. Some worry that by meddling with identity in this way, we – like Dr Frankenstein – will be playing God. Dr Canavero acknowledges this problem. 'If society doesn't want [the procedure],' he says, 'I won't do it.' Yet he suggests that while some countries may be set against it, others will be receptive. So are body transplants inevitable?

The last taboo?

Don't bet on it, say some. Canavero is too optimistic: even if the surgical issues are resolved, the ethical ones never will be. In the current climate, no medical board is likely to approve experiments on primates, let alone humans. For similar reasons, nobody will finance the operation. Body transplants will remain a pipe dream for mad scientists.

Hang on, reply others. Ethics change. In some societies, operations that were once taboo – abortions, heart transplants – are now normalised. People will come to change their mind about body transplants too. As Ren says, if the procedure can improve patients' lives, we should embrace it. 'There is nothing higher than a life, and that's the core of ethics.'

WORD WATCH

Frankenstein

Mary Shelley's novel tells the story of Dr Frankenstein, a young scientist who creates a monster in a mysterious experiment. Although the creature is benign, its grotesque appearance terrifies people. The book was published when Shelley was only 20; it is sometimes considered to be the first sci-fi novel.

Body transplant

Sometimes called a 'head transplant'. Both terms are correct: it comes down to how you interpret what has happened.

Dr Ren Xiaoping

Ren has plenty of experience: in 1999, he participated in the first successful hand transplant, in the USA.

Dr Sergio Canavero

Canavero claims that he could perform the operation in a day, and that it would have a 90% chance of success. When presented at a neurology conference in 2015, his proposals were heavily criticised.

Human cadavers

Ren's team refuses to divulge details or publish pictures of this particular experiment.

Reattachment of nerves

This has never been achieved before. Canavero believes that it can be done with the use of a substance called polyethylene glycol, which functions as a kind of glue.

ACTIVITIES

1. You have been invited to interview Dr Ren and Dr Canavero. Come up with five questions for them.
2. Should surgeons be allowed to perform human body transplants? Why or why not?
3. In science, does the end always justify the means? Explain your answer

Homework 8

'I created Labradoodles and spawned a monster'

Are Labradoodles really a “Frankenstein’s monster”? That’s what their creator, 90-year-old Wally Conron, says. He believes the “unhealthy” dogs set a dangerous trend.

Throughout history, inventors have regretted their creations: the atomic bomb, the AK47, and now the Labradoodle. “I opened a Pandora’s box and released a Frankenstein’s monster,” says 90-year-old Wally Conron. The Labradoodle was born in 1989, when a Hawaiian woman wrote to Conron asking for a guide dog for her husband, who was allergic to fur.

After three years of careful calculations, Conron came up with the idea of “a dog with the working ability of the Labrador and the coat of the Poodle”. The dogs, with their wavy fur and wide brown eyes, won thousands of hearts. Today, polls regularly declare them the public’s favourite dogs, and they are credited with spawning a trend for copy-cat, “designer” dogs. For Conron, this can only be a bad thing.

“People are just breeding for the money,” he warns. “Unscrupulous breeders are crossing poodles with inappropriate dogs simply so they can say they were the first to do it.”

A cross between two of the world’s most intelligent breeds (second only to the border collie), the Labradoodle is a popular family pet thanks to its docile Labrador genes. But they are not without their problems.

“I find that the majority are either crazy, or have a hereditary problem,” explains Conron. Labradoodles are generally prone to epilepsy, food allergies and Addison’s disease, which means their bodies cannot regulate stress.

But other experts have cast doubt on his comments. According to the Labradoodle Association, members of the cross-breed are “generally considered healthy dogs”, unlike many pedigree breeds. As a result of generations of in-breeding, pedigree dogs are more likely to inherit faulty genes from both parents, or to have extreme, unhealthy physical characteristics. For example, large dogs (like the German Shepherd) often suffer hip dysplasia as their bones struggle to support their enormous weight. The King Charles spaniel, one of the most popular dog breeds, is also very sickly. Half of the dogs will have developed a serious heart condition by the age of five, and 70% will be in severe pain from a neurological disorder that damages their spinal cord.

So, is it fair to call Labradoodles a “Frankenstein’s monster”?

Labradon’t

It certainly is, say some. The trend for “designer dogs” has led the cruel mass-production of unhealthy puppies to be sold on to people who want a fashion accessory

rather than a loving pet. Up to two thirds of these dogs suffer from chronic pain and spend their lives struggling for air. It's obscenely cruel.

Don't be so sure, respond others. From bulldogs that can barely breathe to cancer-plagued Basset Hounds, pedigree dogs are far more likely to be unhealthy because of their tiny gene pool. Of course poorly-matched breeds shouldn't be bred together, but a wider gene pool makes for healthier, happier dogs. We should have more cross-bred creations like the Labradoodle, not fewer.

WORD WATCH

Frankenstein's monster

In Mary Shelley's novel, Victor Frankenstein creates a living monster from the dismembered body parts of corpses.

Poodle

Poodles generally do not shed their fur, so they are good pets for people with fur allergies.

Border collie

A dog developed in the Scottish borders to herd sheep.

Docile

Calm, obedient.

Addison's disease

When your adrenal glands produce too little cortisol. Symptoms include pain, weakness and weight loss.

Pedigree

Pure-bred.

Hip dysplasia

When one's hip socket doesn't fit properly.

Neurological disorder

Canine syringomyelia: when the brain is too big for the skull.

Pandora's box

In Greek mythology, Pandora is given a box by the gods containing all the evils in the world and told not to open it. She, of course, does.

ACTIVITIES

1. Research a breed of dog. List its characteristics and any health problems it may be likely to suffer.
2. Write a speech to persuade your audience not to buy Labradoodles.

Homework 9

Fear and celebration at first 'edited' embryo

Chinese scientists have changed the genes of human embryos for the first time. Using the technique could lead to major advances in combating disease — but can it overcome ethical objections?

Scientists have been capable of editing the genetic makeup of an organism for decades. But one species has always remained untouched: human beings. Now, however, that barrier has been broken. A team at the University of Guangzhou in China have made small alterations to the DNA of embryos. Although the embryos used were non-viable — they would not have been able to live — the breakthrough could allow humans to change their offspring in ways which have so far been the sole preserve of nature.

The researchers, who were led by Jinjiu Huang, were able to modify a gene responsible for a potentially fatal blood disorder by injecting an enzyme and another molecule into very recently fertilised embryos. It opens the possibility that scientists could one day edit embryos used in IVF treatment before they are implanted; so one day we might modify people's genes before their birth. This could in turn allow scientists to find ways of preventing genetic disorders which result from mutated DNA, such as cystic fibrosis, haemophilia and sickle cell anaemia.

The technique will not be widely available for a while, since only 28 of the 54 embryos which the scientists tested after the procedure had been successfully changed. But with similar work rumoured to be underway in countries such as the US, it seems likely to be just a matter of time before the human race makes further advances in its understanding of genetic science.

There will be risks — if a procedure goes slightly wrong, it could give babies new diseases or genetic weaknesses. But what is more worrying to many is the possibility that people could go beyond curing illnesses and use the technique to attempt to 'improve' the genetic features of human beings. This practice is known eugenics, and it has featured in many dark fantasies about a dystopian future, such as the classic novels *Brave New World* and *Frankenstein*.

Others go further still. Why not use any means possible to improve ourselves? Making the human race stronger and more resilient would allow people to live longer, healthier, happier lives. That is surely the point of all medical research.

Change your genes

Some are instinctively queasy at the prospect of altering human genes and worry that humans are trying to take the prerogative of God. Who decides which genes are problematic or need changing? That has never been humans' role before. But some will support the research enthusiastically given the chance to curtail human suffering. Though there will be risks, we should not fear investing money, time and resources in

a scientific process which could save, and improve the quality of, countless lives in years to come.

WORD WATCH

Gene

All living organisms have genes, passed on to them by their parent(s). which dictate who and what they are. Genes come together to form DNA. The gene was discovered by Gregor Mendel in 1865, but the significance of his work was unclear until 1909, when the gene was given its name.

IVF treatment

In vitro (literally 'in glass') fertilisation (IVF) is a process whereby a woman can become pregnant by implantation of an egg fertilised outside of her body e.g. in a test tube — hence the glass.

Eugenics

An attempt to use scientific methods to alter human beings' genetic features. It has been used by some racist regimes to try to create races of people which they consider superior — the Nazis being the best-known example.

Brave New World

A novel by Aldous Huxley, published in 1932, in which natural human birth had been abandoned and all people were created for specific purposes. Huxley painted the world which resulted as largely devoid of meaning.

ACTIVITIES

1. Should governments continue to fund medical research into modifying human genes? Why or why not?
2. If you could alter your own genes or those of your children, would you do it? Should you be allowed to do so? Explain your answer

Homework 10

The living robot! Part-frog, part-machine

Is it dangerous to create living robots? Using the cells of a frog and artificial intelligence, scientists have designed an entirely new life form small enough to travel inside a human body.

Imagine Lego bricks that are made out of living cells. You could put them together, however you wanted, and make them carry out whatever task you desired. That is pretty much what scientists in the USA have just achieved. Researchers from UVM and Tufts University worked together to prototype a whole new species, the xenobot. First, the scientists decide on the simple action they want their biological robot to do. This could be reaching a destination, moving a smaller object, or grouping together.

The researchers then use a computer to figure out the perfect arrangement of cells to fulfil that particular function. An algorithm will run through hundreds and thousands of possible shapes. Once they have the ideal design, the scientists use tiny forceps to piece together dozens of cells taken from a frog. They build the creature as best they can in a petri dish. Some of the cells, grown like those from a frog's heart, then contract allowing the new creature to move through liquid. One day, researchers hope that similar creations will be able to carry out medical tasks such as delivering drugs to infected cells or targeting viruses. We could program miniature doctors that could propel themselves around our veins.

The xenobots are given enough food in their cells to survive for a week before they degrade naturally. This means they could carry out tasks inside a human body without causing any damage or leaving any waste. The scientists have also made discoveries that they did not expect. When you cut a xenobot in half, it grows back together again. It is very difficult to say with any certainty whether the xenobots are alive or if they are machines. They are built entirely from organic matter, not from wires and steel. But they cannot eat, grow or reproduce.

The shape they take and the functions they carry out are determined with the help of a machine, but they are still limited by the boundaries of biology. Nonetheless, our culture is filled with warnings about "playing God". Just think of Mary Shelley's Frankenstein. Should we really be creating living robots?

Biobot

Why not? A xenobot is fundamentally no stranger than a mule or a genetically modified crop. Existing parts of nature are simply being recombined. We are not creating anything radically new. If it can help us make breakthroughs in healthcare, then we should not hold back just because it 'feels' wrong. Novelty is always frightening. But it is also something to marvel at and enjoy.

Then again, many say, by using computers to design new life forms, we might accidentally create something unstoppable. A disaster situation is always unlikely but

unless we put limits on what scientists can do, the worst is always possible. Life has a tendency to do whatever it can to survive. And while today we want to use xenobots to fight diseases, tomorrow they could be turned into weapons or worse.

WORD WATCH

Prototype

Original or test version of something.

Algorithm

Set of commands, like a recipe, used to programme machines.

Forceps

Like tweezers with curved ends.

Petri dish

Circular case used to conduct cellular experiments and grow cell cultures.

Degrade

Waste away.

Frankenstein

Novel about a scientist who builds a monster out of different human body parts.

Mule

A cross between a horse and a donkey.

ACTIVITIES

1. Do you think it is wrong for scientists to build new life forms? Do you think it is the same thing as playing God? Why or why not?
2. How would you feel if some of your own cells were used as the building blocks of a biological robot? Would you feel upset? Explain your answer