Long-form writing

Session 4

Writing

What's your **plan** ?

1. A working **title**
2. **Introduction** is important
3. A logical **development**
4. A satisfactory **conclusion**
5. A **title** that works

Revision

Eliminate errors

- in logic
- in language

Eliminate ambiguity

- clear definitions
- clear language

Illustration & layout

Example 1

Sugar triggers a sense of happiness

Sugar releases dopamine, the same substance released by cocaine to 'reward' our cells. But the effect of sugar is less overwhelming, so that the dopamine can more quickly regain its natural level.

Three brain centres at work

1 The brain's mesolimbic dopamine system is responsible for the sensations of happiness that accompany sex, food, and social interaction. The system comprises the ventral tegmental area, nucleus accumbens, and the prefrontal cortex.

Food releases dopamine

2 Food makes nerve cells in the ventral tegmental area release dopamine, passing signals of happiness and reward on through the system. When we stop eating, dopamine starts flowing back into the nerve cells.

Cocaine blocks channels

3 Cocaine prevents dopamine from flowing back by blocking the transport channels that will otherwise reabsorb dopamine. The quantity of dopamine thus becomes highly concentrated, causing euphoria and an exaggerated sense of happiness.

Fat and sugar can reprogram the brain to want them more

Scientists have found that consumption of certain food types can alter links within the brain, teaching us to find them more attractive in future.

METABOLISM Ever wondered why some types of food are highly attractive even when we know that they are not particularly healthy?

That's the question that scientists from the Max Planck Institute for Metabolism Research in Cologne set out to answer, in collaboration with Yale University in the US. They conducted a study in which they measured the brain activity of a series of test subjects over a period of eight weeks. The results show that even a modest daily intake of some specific types of food can cause changes in brain links that cause us to choose the same food again later.

The study was undertaken after the scientists wondered how such preferences for unhealthy and fattening food originate in our brains. They hypothesised that the brain's affection for sugar and fat would develop over time. So they collected two groups of test subjects. One group was served a small pudding loaded with fat and sugar every day for eight weeks in addition to their ordinary diet. Another group of test subjects were served a pudding with the same quantity of calories, but less fat content.

The participants' brain activity was measured both before and after the eight weeks passed. From the data, published in the scientific journal *Cell Metabolism*, the scientists could see that the brain's reaction to sugar and fat in food was more pronounced in the group that consumed pudding with a high content of sugar and fat, and that the changes took place via a special network of signalling pathways associated with the brain's reward centre, where the neurotransmitter dopamine plays a key role.

"Our brain activity data indicates that the brain reprograms itself so that our preference for snacks that include fat and sugar increases," Marc Tittgemeyer, who led the study, tells *Science Illustrated*. "The brain learns to unconsciously prefer food that involves the reward."

In this example, the additional fat did not affect the participants' health to any notable degree. When the scientists compared the two groups of pudding eaters with each other, they could observe neither a difference in the participants' weight nor a change in the level of sugar and cholesterol in their blood after the eight-week trial.

However, the scientists believe that the changes in the brain will remain after the experiment.

"Links in the brain develop, and they don't go away as quickly. The whole point of learning is that when you have learned something, you won't forget it very quickly," says Marc Tittgemeyer.

Illustration & layout

Example 2

CONSERVATION

DARK EARTH: SCIENTISTS UNVEIL A NEW 'SECRET WEAPON' TO COMBAT DEFORESTATION

Ancient soil from the heart of the Amazon could help restore the planet's depleted rainforests

Scientists may be able to protect the future of the world's forests by using remnants from the past, in the form of a thick, black soil buried deep in the Amazon rainforest. It's called 'Dark Earth'.

Transformed from poor-quality soil by centuries of deposits from indigenous peoples, Dark Earth could now be the 'secret weapon' we need to restore forests across the globe, according to a new study from the University of São Paulo, Brazil. The scientists found that tree species grow as much as six times taller in Dark Earth than in normal soil.

Amazonian Dark Earth (or ADE) comprises ancient sediments of day-to-day life, including charcoal from fires for cooking and burning waste, animal bones, broken pottery, compost and manure. These were created by millions of Amerindian people between 450 BC and AD 950.

The charcoal is particularly good for making the soil fertile and nutrient-rich, as well as providing its distinctive black colour. Crucially, the soil also contains an abundant microbial community of helpful bacteria and archaea (another type of single-celled micro-organism).

"Microbes transform chemical soil particles into nutrients that can be taken up by plants," explains the study's joint lead author Anderson Santos de Freitas. Dark Earth's combination of micro-organisms is especially good at unlocking more resources than usual to help plants grow.

Knowing the combination of ingredients that make Dark Earth so fertile will help the researchers share the recipe with reforestation projects across the globe. But the researchers won't be sending out the soil itself: "Amazonian Dark Earth has taken thousands of years to accumulate and would take an equal time to regenerate in nature if used," said senior author Prof Siu Mui Tsai.

"Our recommendations aren't to utilise the Amazonian Dark Earth itself but rather to copy its characteristics, particularly its micro-organisms, for future ecological restoration projects."

The study, published in *Frontiers In Soil Science*, involved conducting micro-reforestation experiments. The scientists used Dark Earth from the Brazilian state of Amazonas, normal agricultural soil from São Paulo, and a mixture containing 20 per cent Amazonian Dark Earth.

They discovered that the plants they grew were up to 6.3 times taller in Dark Earth than in normal soil. One of the species, Ambay pumpwood (an important species in young forests) did not grow at all in the normal or even the combination soil but thrived in the Dark Earth.

Amazon rainforest in numbers

6.7m
The rainforest covers an area of 6.7 million km²

18%
The amount of the Amazon lost since the 1970s

2 million
The Amazon is home to over 2 million indigenous people

150+ bn
The amount of carbon, in tonnes, stored in the Amazon's forests and soils

21

Example 3

Our bodies are getting colder, and gut bacteria may be to blame

Our average body temperature is no longer 37°C. But why? Scientists may have stumbled on the answer, thanks to 100 patients with blood poisoning.

HUMANS In the mid-19th century, a German doctor, Carl Reinhold August Wunderlich, spent years collecting body temperature data from thousands of people. His aim was to find the healthy core temperature of the human body, and he determined the average to be 37°C.

But a few years ago, scientists from Stanford University followed up on that general belief – and discovered that the core of the human body has been cooling consistently every decade for the past 150 years. The average is now 36.4°C. This has been widely accepted, and we have shifted into this cooler reality – without scientists being able to explain exactly why. But University of Michigan doctors have now found a possible explanation – in an unexpected place.

To find the cause of the falling temperature, the scientists investigated 100+ patients hospitalised with blood poisoning, a severe condition in which bacteria enter the bloodstream and could spread to the organs.

The life-threatening infection can inwolve high temperature, and previous studies have demonstrated that the body temperatures of hospital patients with blood poisoning vary greatly. The scientists wondered whether the patients' gut bacteria, the microbiome, play a role.

The scientists tested mice, finding that if mice were ‚genetically-modified to have no microbiome they showed less extreme body temperature variation in case of blood poisoning, compared with mice that had normal gut bacteria. And the variation in ordinary mice also seemed to be linked with the same gut bacteria as in humans.

Even healthy genetically-modified mice without a microbiome generally had a lower body temperature than the ordinary mice, and treatment with bactericidal antibiotics made the body temperature fall even further.

According to the scientists, the results indicate that our gut bacteria could play a key role in relation to our body temperature, and that longterm changes to the tiny inhabitants of our digestive system might also explain why our average body temperature has been falling over the past 150 years.

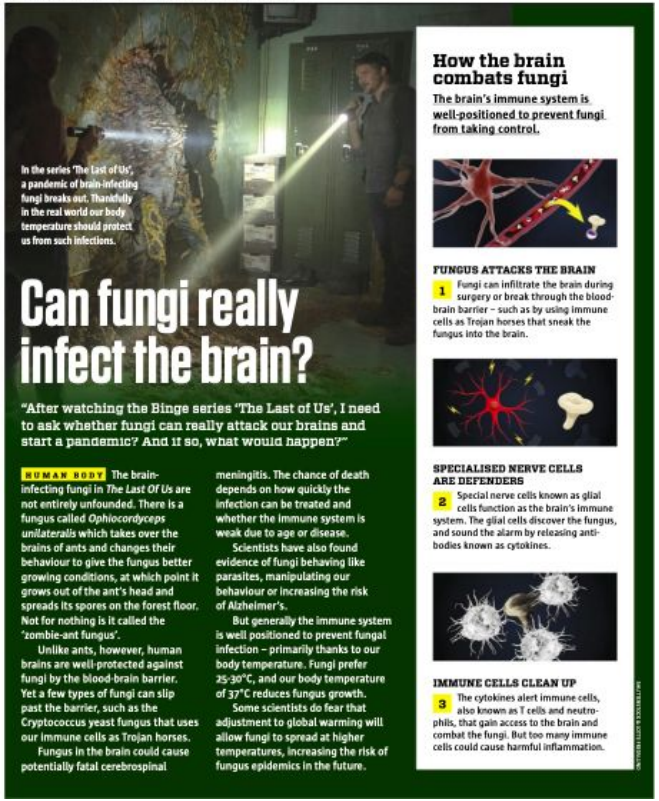
"Our genetics have not changed markedly over the past 150 years, but changes in our food, hygiene, and anti-biotics have a major influence on our gut bacteria," says one of the scientists behind the study, Kale Bongers. He stresses that more studies will be required to confirm the link conclusively, and to explain the mechanism that cools us.

Hypothalamus is a body thermostat

The body's core temperature is regulated in the hypothalamus, in the interbrain. Via sensors in everything from the skin to the spinal cord, the hypothalamus is kept informed of temperature change. If the temperature increases by 1°C, the hypothalamus tells the body's tiniest blood vessels, arterioles, to expand, making the skin slightly reddish and intensifying sweat production. When the sweat reaches the skin surface, it evaporates, causing heat loss.

Illustration & layout

Example 4



In the series 'The Last of Us', a pandemic of brain-infecting fungi breaks out. Thankfully in the real world our body temperature should protect us from such infections.

Can fungi really infect the brain?

"After watching the Binge series 'The Last of Us', I need to ask whether fungi can really attack our brains and start a pandemic? And if so, what would happen?"

HUMAN BODY The brain-infecting fungi in *The Last Of Us* are not entirely unfounded. There is a fungus called *Ophiocordyceps unilateralis* which takes over the brains of ants and changes their behaviour to give the fungus better growing conditions, at which point it grows out of the ant's head and spreads its spores on the forest floor. Not for nothing is it called the 'zombie-ant fungus'.

Unlike ants, however, human brains are well-protected against fungi by the blood-brain barrier. Yet a few types of fungi can slip past the barrier, such as the Cryptococcus yeast fungus that uses our immune cells as Trojan horses.

Fungus in the brain could cause potentially fatal cerebrospinal meningitis. The chance of death depends on how quickly the infection can be treated and whether the immune system is weak due to age or disease.

Scientists have also found evidence of fungi behaving like parasites, manipulating our behaviour or increasing the risk of Alzheimer's.

But generally the immune system is well positioned to prevent fungal infection – primarily thanks to our body temperature. Fungi prefer 25-30°C, and our body temperature of 37°C reduces fungus growth.

Some scientists do fear that adjustment to global warming will allow fungi to spread at higher temperatures, increasing the risk of fungus epidemics in the future.

How the brain combats fungi

The brain's immune system is well-positioned to prevent fungi from taking control.

FUNGUS ATTACKS THE BRAIN

1 Fungi can infiltrate the brain during surgery or break through the blood-brain barrier – such as by using immune cells as Trojan horses that sneak the fungus into the brain.

SPECIALISED NERVE CELLS ARE DEFENDERS

2 Special nerve cells known as glial cells function as the brain's immune system. The glial cells discover the fungus, and sound the alarm by releasing anti-bodies known as cytokines.

IMMUNE CELLS CLEAN UP

3 The cytokines alert immune cells, also known as T cells and neutro-phils, that gain access to the brain and combat the fungi. But too many immune cells could cause harmful inflammation.

Example 5

3 Can't Stop Thinking About

Why IQ Tests Are Bad Math

SOME EXPERTS WHO STUDY INTELLIgence quotient (IQ) tests say these models are mathematically imperfect and can even lead to race and class discrimination. So how do IQ tests work, and what makes their methodology so shaky?

How We Measure IQ // "IQs are computed by percentiles. IQs tend to form a normal distribution.

And so you compute how people compare to each other," explains Robert Sternberg, PhD, a professor of psychology at Cornell University. Most IQ tests have subscores, he says. These could be for verbal performance, math performance, or other skills. The total score is a weighted average of the subscores. On tests like the SAT and the ACT, the subscores are weighted equally.

"A lot of proprietary tests don't go into a lot of detail about their scoring because that's something they've copyrighted," says Elizabeth Dworak, PhD, a research assistant professor of medical social sciences at Northwestern University.

The Problem With IQ Tests // Sternberg says current IQ tests are narrow and should be replaced with more socially responsible measures like emotional maturity and common sense or musical or kinesthetic skills. "You can get people who are very high in IQ, but they never have an original idea. And I see a lot of those in my university experience...people who were promoted by having high test scores."

"What an IQ test measures is whether you're doing what you're told to do," Sternberg continues. "So what you're doing is creating a leadership class that's obedient...and those are not necessarily the people you want to be in leadership roles."

As IQ scores have gone up by 30 points during the last century, people in the U.S. have become more narcissistic and aggressive, which can reinforce social hierarchies, especially in a competitive economic landscape, Sternberg says.

Although it's hereditary to an extent, cultural environment and social class—including learning opportunities at home and at school—greatly influence IQ; some parents may have less money to pay for after-school tutoring, for instance.

"In any society, people who are privileged make it so that people like them can stay privileged," Sternberg says. "The tests turn out to correlate very highly with socioeconomic status, and it's sort of a way of laundering that."—*Kat Friedrich*

3 OF THE MOST POPULAR IQ TESTS TODAY

- ***The Wechsler Adult Intelligence Scale*** analyzes verbal comprehension, perceptual reasoning, working memory, and processing speed.
- ***The Stanford-Binet Intelligence Test*** examines fluid reasoning, knowledge, quantitative reasoning, visual-spatial processing, and working memory.
- ***The Woodcock-Johnson Tests of Cognitive Abilities*** is organized into 18 tests for measuring general intellectual ability, broad and narrow cognitive abilities, academic domain-specific aptitudes, and related aspects of cognitive functioning.

Points to consider

Column size

Text alignment

Text size and style

Font legibility

Illustrations with intent

Blockquotes

Software

Editors : Microsoft Publisher, Swift, Affinity, InDesign, Scribus

Online tools : Canva, Visme, Postermywall

Colour palettes : Coolors, Colormind

Infographics : Venngage, Snappa, Piktochart, Designcap, Mural

Fonts : Fontrepo, Google fonts, Nerdfonts, Fontsrepo, Befonts