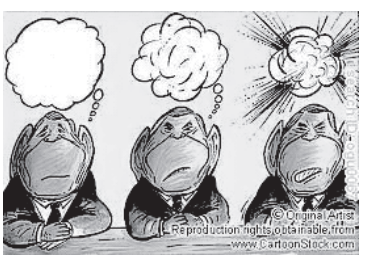
SECTION 1

brain Activating

A In 1937 the great neuroscientist Sir Charles Scott Sherrington of the University of Oxford laid out what would become a classic description of the brain at work. He imagined points of light signaling the activity of nerve cells and their connections. During deep sleep, he proposed, only a few remote parts of the brain would twinkle, giving the organ the appearance of a starry night sky. But at awakening, "it is as if the Milky Way entered upon some cosmic dance," Sherrington reflected. "Swiftly the head-mass becomes an enchanted loom where millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern though never an abiding one; a shifting harmony of subpatterns."

B Although Sherrington probably did not realize it at the time, his poetic metaphor contained an important scientific idea: that of the brain revealing its inner workings optically. Understanding how neurons work together to generate thoughts and behavior remains one of the most difficult open problems in all of biology, largely because scientists generally cannot see whole neural circuits in action. The standard approach of probing one or two neurons with electrodes reveals only tiny fragments of a much bigger puzzle, with too many pieces missing to guess the full picture. But if one could watch neurons communicate, one might be able to deduce how brain circuits are laid out and how they function. This alluring notion has inspired neuroscientists to attempt to realize Sherrington's vision.

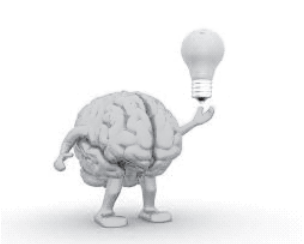


C Their efforts have given rise to a nascent field called optogenetics, which combines genetic engineering with optics to study specific cell types. Already investigators have succeeded in visualizing the functions of various groups of neurons. Furthermore, the approach has enabled them to actually control the neurons remotely—simply by toggling a light switch. These achievements raise the prospect that optogenetics might one day lay open the brain's circuitry to neuroscientists and perhaps even help physicians to treat certain medical disorders.

D Enchanting the Loom Attempts to turn Sherrington's vision into reality began in earnest in the 1970s. Like digital computers, nervous systems run on electricity; neurons encode information in electrical signals, or action potentials. These impulses, which typically involve voltages less than a tenth of those of a single AA battery, induce a nerve cell to release neurotransmitter molecules that then activate or inhibit connected cells in a circuit. In an effort to make these electrical signals visible, Lawrence B. Cohen of Yale University tested a large number of fluorescent dyes for their ability to respond to voltage changes with changes in color or intensity. He found that some dyes indeed had voltage-sensitive optical properties. By staining neurons with these dyes, Cohen could observe their activity under a microscope.

E Dyes can also reveal neural firing by reacting not to voltage changes but to the flow of specific charged atoms, or ions. When a neuron generates an action potential, membrane channels open and admit calcium ions into the cell. This calcium influx stimulates the release of neurotransmitters. In 1980 Roger Y. Tsien, now at the University of California, San Diego, began to synthesize dyes that could indicate shifts in calcium concentration by changing how brightly they fluoresced. These optical reporters have proved extraordinarily valuable, opening new windows on information processing in single neurons and small networks.

F Synthetic dyes suffer from a serious drawback, however. Neural tissue is composed of many different cell types. Estimates suggest that the brain of a mouse, for example, houses many hundreds of types of neurons plus numerous kinds of support cells. Because interactions between specific types of neurons form the basis of neural information processing, someone who wants to understand how a particular circuit works must be able to identify and monitor the individual players and pinpoint when they turn on (fire an action potential) and off. But because synthetic dyes stain all cell types indiscriminately, it is generally impossible to trace the optical signals back to specific types of cells.



G Optogenetics emerged from the realization that genetic manipulation might be the key to solving his problem of indiscriminate staining. An individual's cells all contain the same genes, but hat makes two cells different from each other is that different mixes of genes get turned on or off in them. Neurons that release the neurotransmitter dopamine when they fire, for instance, need the enzymatic machinery for making and packaging dopamine. The genes encoding the protein components of this machinery are thus switched on in dopamine producing (dopaminergic) neurons but stay off in other, non-dopaminergic neurons. In theory, if a biological switch that turned a dopamine-making gene on was linked to a gene encoding a dye and if the switch-and-dye unit were engineered into the cells of an animal, the animal would make the dye only in dopaminergic cells. If

researchers could peer into the brains of these creatures (as is indeed possible), they could see dopaminergic cells functioning in virtual isolation from other cell types. Furthermore, they could observe these cells in the intact, living brain. Synthetic dyes cannot perform this type of magic, because their production is not controlled by genetic switches that flip to on exclusively in certain kinds of cells. The trick works only when a dye is encoded by a gene—that is, when the dye is a protein.

H The first demonstrations that genetically encoded a decade ago, from teams led independently by Tsien, Ehud Y. Isacoff of the University of California, Berkeley with James E. Rothman, now at Yale University. In all cases, the gene for the dye was borrowed from a luminescent marine organism, typically a jellyfish that makes the so-called green fluorescent protein .Scientists tweaked the gene so that its protein product could detect and reveal the changes in voltage or calcium that underlie signaling within a cell, as well as the release of neurotransmitters that enable signaling between cells.

Questions 6-10

The reading Passage has seven paragraphs A-H. Which paragraph contains the following information? Write the correct letter A-H, in boxes 6-10 on your answer sheet.

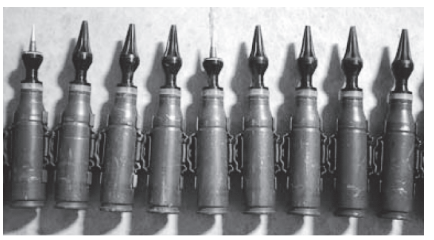
6. a sea creature producing light triggered by certain genes
7.first attempts to make a great idea come true
8. the reason to explain the failure of synthetic dyes
9. difficulty in observing how the whole set of neurons works
10. visual indicators to show how information is handled in and between cells in the Brain

SECTION 2

war debris could cause cancer

A Could the mystery over how depleted uranium might cause genetic damage be closer to being solved? It may be, if a controversial claim by two researchers is right. They say that minute quantities of the material lodged in the body may kick out energetic electrons that mimic the effect of beta radiation. This, they argue, could explain how residues of depleted uranium scattered across former war zones could be increasing the risk of cancers and other problems among soldiers and local people.

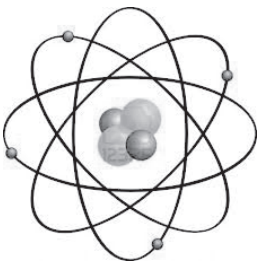
B Depleted uranium is highly valued by the military, who use it in the tips of armour-piercing weapons. The material's high density and self-sharpening properties help it to penetrate the armour of enemy tanks and bunkers. Its use in conflicts has risen sharply in recent years. The UN Environment Programme (UNEP) estimates that shells containing 1700 tonnes of the material were fired during the 2003 Iraq war. Some researchers and campaigners are convinced that depleted uranium left in the environment by spent munitions causes cancer, birth defects and other ill effects in people exposed to it. Governments and the military disagree, and point out that there is no conclusive epidemiological evidence for this. And while they acknowledge that the material is weakly radioactive, they say this effect is too small to explain the genetic damage at the levels seen in war veterans and civilians.



C Organisations such as the UK's Royal Society, the US Department of Veterans Affairs and UNEP have called for more comprehensive epidemiological studies to clarify the link between depleted uranium and any ill effects. Meanwhile, various test-tube and animal studies have suggested that depleted uranium may increase the risk of cancer, according to a review of the scientific literature published in May 2008 by the US National Research Council. The authors of the NRC report argue that more long-term and quantitative research is needed on the effects of uranium's chemical toxicity. They say the science seems to support the theory that genetic damage might be occurring because uranium's chemical toxicity and weak radioactivity could

somehow reinforce each other, though no one knows what the mechanism for this might be.

D Now two researchers, Chris Busby and Ewald Schnug, have a new theory that they say explains how depleted uranium could cause genetic damage. Their theory invokes a well-known process called the photoelectric effect. This is the main mechanism by which gamma photons with energies of about 100 kiloelectronvolts (keV) or less are blocked by matter: the photon transfers its energy to an electron in the atom's electron cloud, which is ejected into the surroundings. An atom's ability to stop photons by this mechanism depends on the fourth power of its atomic number – the number of protons in its nucleus – so heavy elements are far better at intercepting gamma radiation and X-rays than light elements. This means that uranium could be especially effective at capturing photons and kicking out damaging photoelectrons: with an atomic number of 92, uranium blocks low-energy gamma photons over 450 times as effectively as the lighter element calcium, for instance.

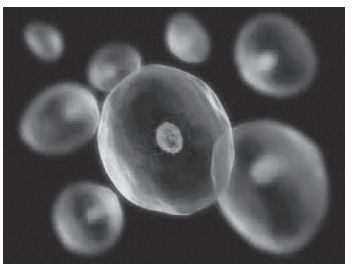


E Busby and Schnug say that previous risk models have ignored this well-established physical effect. They claim that depleted uranium could be kicking out photoelectrons in the body's most vulnerable spots. Various studies have shown that dissolved uranium – ingested in food or water, for example – is liable to attach to DNA strands within cells, because uranium binds strongly to DNA phosphate. "Photoelectrons from uranium are therefore likely to be emitted precisely where they will cause most damage to genetic material," says Busby.

F Busby and Schnug base their claim on calculations of the photoelectrons that would be produced by the interaction between normal background levels of gamma radiation and uranium in the body. "Our detailed calculations indicate that the phantom photoelectrons are the predominant effect by far for uranium genome toxicity, and that uranium could be 1500 times as powerful as an emitter of photoelectrons than as an alpha emitter." Their computer modelling results are described in a peer-reviewed paper to be published in this month by the IPNSS in a book called Loads and Fate of Fertiliser Derived Uranium.

G Hans-Georg Menzel, who chairs the International Commission on Radiological Protection's committee on radiation doses, acknowledges that the theory should be considered, but he doubts that it will prove significant. He suspects that under normal background radiation the effect is too weak to inflict many of the "double hits" of

energy that are known to be most damaging to cells. “It is very unlikely that individual cells would be subject to two or more closely spaced photoelectron impacts under normal background gamma irradiation,” he says. Despite his doubts, Menzel raised the issue last week with his committee in St Petersburg, Russia, and says that several colleagues “intended to collect relevant data and perform calculations to check whether there was any possibility of a real effect in living tissues”. Organisations in the UK, including the Ministry of Defence and the Health Protection Agency, say they have no plans to investigate Busby’s hypothesis.



H Radiation biophysicist Mark Hill of the University of Oxford would like to see a fuller investigation, though he suggests this might show that the photoelectric effect is not as powerful as Busby claims. “We really need more detailed calculations and dose estimates for realistic situations with and without uranium present,” he says. Hill’s doubts centre on an effect called Compton scattering, which he believes needs to be factored into any calculations. With Compton scattering, uranium is only 4.5 times as effective as calcium at stopping gamma photons, so Hill says that taking it into account would reduce the relative importance of uranium as an emitter of secondary electrons. If he is right, this would dilute the mechanism proposed by Busby and Schnug.

I The arguments over depleted uranium are likely to continue, whatever the outcome of these experiments. Whether Busby’s theory holds up or not remains to be seen, but investigating it can only help to clear up some of the doubts about this mysterious substance.

Questions 14-18

The reading Passage has nine paragraphs A-I.
Which paragraph contains the following information?
Write the correct letter A-I, in boxes 14-18 on your answer sheet. NB you may use any letter more than once

14 a famous process is given relating to the new theory.
15 a person who acknowledges but suspects the theory.
16 the explanation of damage to DNA.
17 a debatable and short explanation of the way creating the problems of soldiers.
18 Busby's hypothesis is not in the investigation plans of organizations.

SECTION 3

You should spend about 20 minutes on Questions 28-40, which are based on Reading Passage 3on the following pages.

Facial expression

A A facial expression is one or more motions or positions of the muscles in the skin.These movements convey the emotional state of the individual to observers. Facial expressions are

a form of nonverbal communication. They are a primary means of conveying social information among aliens, but also occur in most other mammals and some other animal species. Facial expressions and their significance in the perceiver can, to some extent, vary between cultures with evidence from descriptions in the works of Charles Darwin.

B Humans can adopt a facial expression to read as a voluntary action. However, because expressions are closely tied to emotion, they are more often involuntary. It can be nearly impossible to avoid expressions for certain emotions, even when it would be strongly desirable to do so; a person who is trying to avoid insulting an individual he or she finds highly unattractive might , nevertheless, show a brief expression of disgust before being able to reassume a neutral expression. Microexpressions are one example of this phenomenon. The close link between emotion and expression can also work in the other direction; it has been observed that voluntarily assuming an expression can actually cause the associated emotion.

C Some expressions can be accurately interpreted even between members of different species- anger and extreme contentment being the primary examples. Others, however, are difficult to interpret even in familiar individuals. For instance, disgust and fear can be tough to tell apart. Because faces have only a limited range of movement, expressions rely upon fairly minuscule differences in the proportion and relative position of facial features, and reading them requires considerable sensitivity to same. Some faces are often falsely read as expressing some emotion, even when they are neutral, because their proportions naturally resemble those another face would temporarily assume when emoting.

D Also, a person's eyes reveal much about how they are feeling, or what they are thinking. Blink rate can reveal how nervous or at ease a person may be. Research by Boston College professor Joe Tecce suggests that stress levels are revealed by blink rates. He supports his data with statistics on the relation between the blink rates of presidential candidates and their success in their races. Tecce claims that the faster blinker in the presidential debates has lost every election since 1980. Though Tecce's data is interesting, it is important to recognize that non-verbal communication is multi-channeled, and focusing on only one aspect is reckless. Nervousness can also be measured by examining each candidates' perspiration, eye contact and stiffness.

E As Charles Darwin noted in his book The Expression of the Emotions in Man and Animals:the young and the old of widely different races, both with man and animals, express the same state of mind by the same movements. Still, up to the mid-20th century most anthropologists believed that facial expressions were entirely learned and could therefore differ among cultures. Studies conducted in the 1960s by Paul Ekman eventually supported Darwin's belief to a large degree.

F Ekman's work on facial expressions had its starting point in

the work of psychologist Silvan Tomkins. Ekman showed that contrary to the belief of some anthropologists including Margaret Mead, facial expressions of emotion are not culturally determined, but universal across human cultures. The South Fore people of New Guinea were chosen as subjects for one such survey. The study consisted of 189 adults and 130 children from among a very isolated population, as well as twenty three members of the culture who lived a less isolated lifestyle as a control group. Participants were told a story that described one particular emotion; they were then shown three pictures (two for children) of facial expressions and asked to match the picture which expressed the story's emotion.

G While the isolated South Fore people could identify emotions with the same accuracy as the non-isolated control group, problems associated with the study include the fact that both fear and surprise were constantly misidentified. The study concluded that certain facial expressions correspond to particular emotions and can not be covered, regardless of cultural background, and regardless of whether or not the culture has been isolated or exposed to the mainstream.

H Expressions Ekman found to be universal included those indicating anger, disgust, fear, joy, sadness, and surprise (note that none of these emotions has a definitive social component, such as shame, pride, or schadenfreude). Findings on contempt (which is social) are less clear, though there is at least some preliminary evidence that this emotion and its expression are universally recognized. This may suggest that the facial expressions are largely related to the mind and each parts on the face can express specific emotion.

Questions 6-11:

The reading Passage has seven paragraphs A-H
Which paragraph contains the following information?
Write the correct letter A-H, in boxes 6-11 on your answer sheet.
NB: You may use any letter more than once

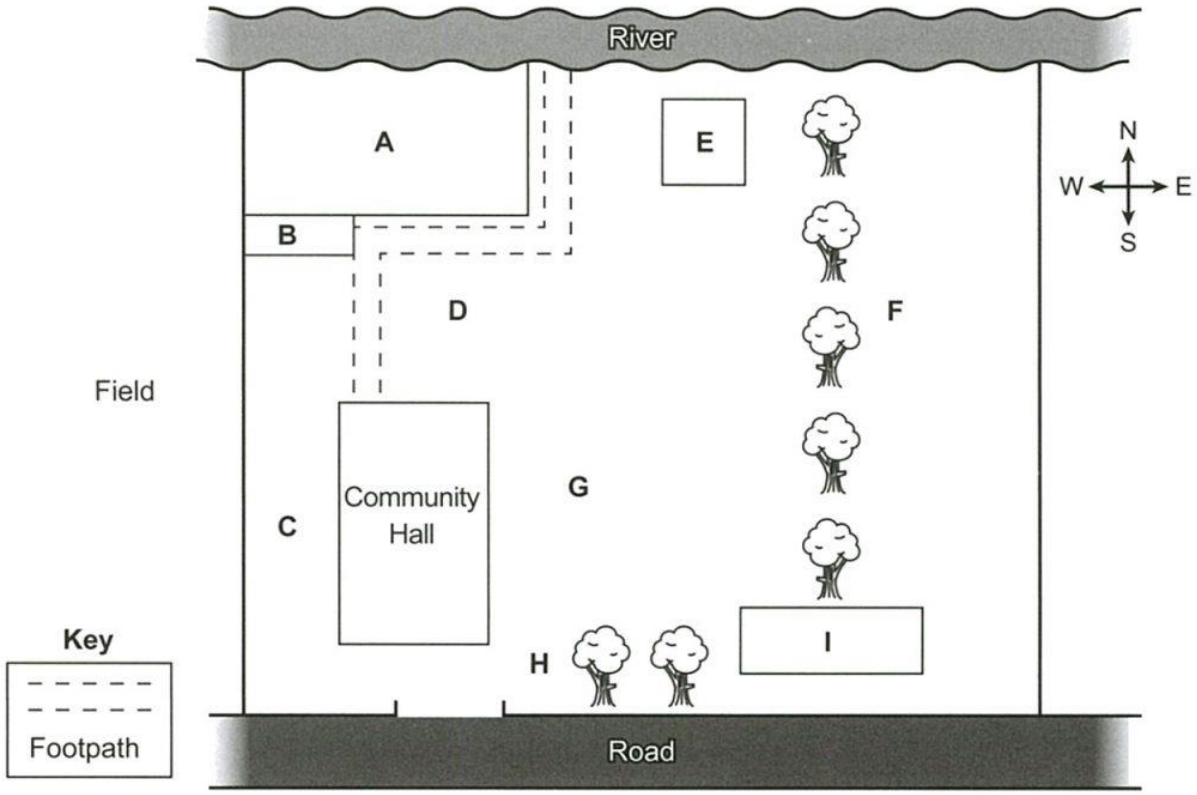
6: the difficulty identifying the actual meaning of facial expressions
7: the importance of culture on facial expressions is initially described
8: collected data for the research on the relation between blink and the success in elections
9: the features on the sociality of several facial expressions
10: an indicator to reflect one's extent of nervousness
11: the relation between emotion and facial expressions

Questions 15-20

Label the map below.

*Write the correct letter, **A-I**, next to Questions 15-20.*

Recreation ground after proposed changes



15 New car park ……

16 New cricket pitch ……

17 Children's playground ……

18 Skateboard ramp ……

19 Pavilion ……

20 Notice board ……

Task – 1

The graph below shows the number of enquiries to tourist information office made by telephone, letter/email, and in person from January 2001 to June 2001.

Summarize the information by selecting and reporting the main features, and make comparisons where relevant.

You should write at least 150 words.