

There are eight assays in this test.

Each assay contains a text (one to few paragraphs) followed by questions.

Please answer these questions according to the text provided to you.

Assay 1 (15%).

If you have ever been to Southeast Asia, you'll probably have visited a street market laden with counterfeit goods. Maybe you even bought a knocked-off 'Rolex' watch or some pirated DVDs. It's all part of the Asian experience. Sure, it's illegal. But many visitors view the counterfeiters as Robin Hood-style outlaws, robbing rich Western companies to bolster the local cash economy.

But there is another side to Asia's culture of counterfeiting, which tourists don't usually get to see. The continent's pharmacies are awash with fake drugs that contain little or none of the labelled active ingredient. Produced mostly in China and India, these bogus products are also exported to Africa and the rest of the developing world. This trade is far from benign. It spawns chronic sickness, and leaves orphans and widows in its wake. It is run by ruthless individuals with scant regard for human life, and flourishes wherever they can induce corrupt officials to turn a blind eye.

Thankfully, awareness of the developing world's problems with fake pharmaceuticals is growing. Scientists and doctors who are trying to improve standards of healthcare in some of the world's poorest countries have helped to raise the alarm. And in recent years, several programmes have been established to address the issue. The International Chamber of Commerce, for instance, launched a Counterfeit Pharmaceuticals Initiative in 2003 that acts as a clearing-house for information about fake drugs.

Multinational drug companies have also begun to get involved. Several have come together to form the Pharmaceutical Security Institute, which gathers information on counterfeiting so that prosecutions can be pursued. Such actions have been driven by a growing Internet trade in counterfeit drugs that is hitting 'big pharma' where it hurts — by targeting their rich, developed-world consumers.

Question 1-1: What is the objective of this assay? (No more than two sentences)

1-2: What are the strategies to solve the problem?

(背面仍有題目,請繼續作答)

Assay 2 (10%).

Feeding fewer calories to rodents—and likely primates too—makes them more stress-resistant and, perhaps because they are more stress-resistant, they live considerably longer. Several other animal model systems have mutation-induced metabolic states that are similar to those produced by calorie restriction and are also designed for withstanding adverse conditions—the dauer phase in the worm *Caenorhabditis elegans*, for example. These mechanisms are probably related to ancient and adaptive types of diapause: time-outs from the business of reproduction while awaiting more favorable conditions. In their Review, Longo and Finch compare these long-lived creatures, ranging from yeast to mice, and point out the commonalties, such as defects in the insulin/insulin-like growth factor 1 signaling pathway. Masoro surveys the history of research on calorie restriction, and Hopkin explores the downside of eating less. It turns out to be more than just hunger pangs.

Question 2-1: What is diapause?

2-2: What is the relationship between aging and insulin/insulin-like growth factor?

Assay 3 (10%).

The term 'RNA world' was first coined to describe a hypothetical stage in the evolution of life some four billion years ago when RNA may have been the genetic material and catalyst for emerging life on Earth^{1,2}. This original RNA world, if it ever existed on Earth, is long gone. But this Insight deals with a process that reflects an RNA world that is alive and thriving within our cells — RNA silencing or RNA interference (RNAi). When exposed to foreign genetic material (RNA or DNA), many organisms mount highly specific counter attacks to silence the invading nucleic-acid sequences before these sequences can integrate into the host genome or subvert cellular processes. At the heart of these sequence directed immunity mechanisms is double-stranded RNA (dsRNA). Interestingly, dsRNA does more than help to defend cells against foreign nucleic acids — it also guides endogenous developmental gene regulation, and can even control the modification of cellular DNA and associated chromatin. In some organisms, RNAi signals are transmitted horizontally between cells and, in certain cases, vertically through the germ line from one generation to the next.

Question 3-1: According to the text provided above, what is RNAi?

3-2: What are the potential functions of dsRNA?

Assay 4 (15%).

Older adults typically perform more poorly than young adults in terms of both response latency and accuracy on tasks as diverse as perceptual speed, working memory, tracking, decision making, explicit memory and multiple task processing. Despite such declines in a multitude of perceptual, cognitive and motor processes during the course of aging, recent findings suggest that a variety of interventions can be used to impede or minimize selective aspects of cognitive decline.

For example, age-related deficits in the ability to concurrently perform multiple tasks or rapidly switch between two different tasks can be reduced through training. Indeed, not only can age-related deficits in multiple task performance be reduced on a set of trained tasks but performance improvements can be retained for several months. Furthermore, older adults who learned to rapidly shift their priorities between concurrently performed tasks were able to apply this processing strategy to an untrained set of tasks, thereby dramatically reducing age-related deficits in dual-task performance as compared to a control group of young and older adults who were trained with a more traditional multiple task method. Another intervention strategy that has been shown to reduce selective aspects of cognitive decline is fitness training. Consistent with the research on the behavioral effects of exercise in aging animals, there is now a substantial body of literature that suggests that a lifetime of exercise can result in enhancements in a number of aspects of cognition. Much of this literature has focused on aerobic exercise such as walking, running, bicycling and swimming.

Question 4-1: What is cognition?

4-2: What are the potential strategies that have been shown effectively to reduce age-related cognitive decline?

4-3: In your opinions why fitness training can enhance cognition?

(背面仍有題目,請繼續作答)

Assay 5 (18%).

Researchers in Wisconsin have come a step closer to developing a culture for human embryonic stem (ES) cells that is free of animal products—a recipe that is essential for growing any cells that would be used for therapy in humans. Human ES cells are tricky to grow, and many regard their culture more as an art than a science. But scientists have found that they need a combination of at least two animal-derived products: fetal bovine serum to nourish the cells and a layer of fetal mouse fibroblasts called feeder layer that inhibit differentiation into a variety of cell types. Because of that, there is a risk of contamination from animal pathogens. Recently a substance, N-glycolylneuraminic acid, taken up from animal products on the surface of ES cells, would probably cause them to be rejected if transplanted into a patient. To circumvent such problems, many groups have been racing to develop stem cell culture media free of animal products. Now a group led by RH Xu at the University of Wisconsin has found that in high doses, a synthetic human molecule FGF2 can do what mouse feeder cells do: sustain stem cells in an undifferentiated-or pluripotent –state. If administered in high quantities in combination with bone morphogenic proteins (BNP) antagonists, FGF2 inhibit BNP activity, preserving the cells in undifferentiated state.

Question 5-1: Please give a title for this report.

5-2: Please define “stem cell”.

5-3: What are the problems in ES cell cultures?

5-4: Why is Xu’s study considered “a major step forward”?

5-5: What is FGF2? Please give a full name and possibly role in cell growth.

Assay 6 (12%).

Almost everything we know about the fundamental properties of living cells—how they growth and divide, how they express their genetic information, and how they use and store energy—has come from the study of model organisms. These simple creatures include *E. coli*, bakers’ yeast, *C. elegans*, fruit fly and the mouse, each a representative of the diversity of life.

Question 6-1: Please give some reasons why we need model organism in biomedical research.

Assay 7 (8%).

Several years ago, a paper showed that among a group of U.S. and European men, the "ideal" body type sported some 13 kg more muscle than the men had. The men also estimated that women would find that more attractive. Pope and his student J Yang decided to find out if this disconnection was a cultural universal event. So they asked 55 young, heterosexual males in Taiwan to choose images that best represented their own bodies and ideal shapes. These men chose an ideal body with only 2 kg more muscle. The author also reported that a survey of ads in U.S. and Taiwanese women's magazines supported the notion that in Asia, muscle doesn't make the man. "Asia men were almost never shown undressed", while 43% of Western men were baring pecs or abs.

**Question 7-1: Are Eastern men more comfortable with their bodies than Caucasians?
Please provide your reasons.**

7-2: Why do Taiwanese men's lack of interest in muscle-building drugs?

Assay 8 (12%).

Vascular endothelial growth factor (VEGF), a powerful trigger of blood vessel growth, is turning up in nerve cells and may function in keeping them healthy and alive. Animal trials suggest that VEGF is a potential weapon against amyotrophic lateral sclerosis (ALS) and incurable disease that attacks nerves and paralyzes its victims. And for those trying to control the growth of blood vessels- either to stop them from supporting cancerous tumors or to help them regrow after illness or injury- the nerve proteins offer a wealth of new targets to manipulate. Normally, VEGF is expressed in response to low oxygen levels- it attracts new blood vessels to tissues that are short of oxygen. Mice carrying a mutation that prevent that oxygen-dependent increase in expression, suggesting that a lack of VEGF leaves nerves vulnerable to hypoxia. In animal models of ALS, Carmeliet *et al.* injected into muscle a rabies virus, which homes in and infects nerve cells, modified to churn out VEGF. The mice that received the virus took longer to develop ALS-like symptoms and survival longer than their untreated counterparts. Working with a rat model of ALS, the researchers injected the VEGF protein directly into the cerebral fluid and documented similar benefits.

Question 8-1: Why does VEGF become the hottest factor in developmental biology-neural guidance and angiogenesis?

8-2: What is ALS? Is it a good idea to treat patients with virus-conjugated VEGF?