Contents

Unit 5
Health risks of space travel

Learning objectives

Upon completion of this unit, you will be able to:

- recognize health problems that space exploration brings about;
- appraise astronauts' efforts to deal with the challenges and dangers;
- identify the elements that contribute to astronauts' survival;
- write an experiment report.

Lead-in

There is no royal road to space exploration. As astronauts are faced with all kinds of challenges and dangers, they have to stand ready physically and mentally so as to ensure successful space missions. What are the possible challenges and dangers they might meet with? Do you think astronauts can serve as your role models when you come across setbacks? Why or why not?

Intensive reading

The challenges astronauts will face on a journey to Mars

1 NASA is trying to bring the various risks down before launching astronauts to Mars in the 2030s. The road to Mars is paved with peril. Astronauts on Red Planet missions will have to deal with deep-space radiation, the effects of microgravity and the stress of confinement and isolation, all at the same time and for a long, continuous period. It currently takes a minimum of six months to get to Mars after all, and just as long to get back. Crewmembers will have to make it through this gauntlet in good nick, both physically and mentally.

2 The spacecraft these astronauts launch aboard "will have to provide them with everything they need for basic survival, but even more than that, because we expect them to be capable of doing a job – a job that has mental demands, a job that has physical demands," said Jennifer Fogarty, the chief scientist with NASA's Human Research Program (HRP), during a presentation with the agency's Future In-Space Operations working group.

Many stressors

3 The HRP is tasked with characterizing the effects of spaceflight on astronauts and developing mitigation strategies. The program recognizes five classes of "stressor" that can significantly affect human health and performance on deep-space missions, Fogarty said. These are altered gravity fields, hostile closed environments, radiation, isolation/confinement, and distance from Earth (which means that help is very far away). HRP scientists and other researchers around the world are trying to get a handle on all of these stressors, by performing experiments here on Earth and carefully monitoring the mental and physical health of astronauts living on the International Space Station (ISS).

4 The long-term goal of such work is to help enable crewed missions to Mars, which NASA wants to pull off before the end of the 2030s. Indeed, a few years ago, NASA astronaut Scott Kelly and cosmonaut Mikhail Korniyenko stayed aboard the ISS for 11 months – about twice as long as the usual time – to help researchers measure the impact of very long space missions, such as the roundtrip journey to Mars.

5 "It's tough to accurately characterize the toll that such a voyage will take on an astronaut, however. That's because the cumulative effect of the spaceflight stressors might be additive or interactive," Fogarty said, "and putting all of the hazards together in an experimental setting is nearly impossible." For example, scientists perform radiation studies on lab animals here on Earth. But microgravity isn't part of that experimental picture, and adding it to the mix isn't feasible at the moment. The ISS cannot provide deep-space radiation data, because it orbits within Earth's protective magnetosphere. And installing radiation-emitting equipment aboard the orbiting lab doesn't seem like a great idea.

Biggest concerns

6 Some of the stressors are more worrying than others. For example, researchers and NASA officials have repeatedly cited radiation as one of the biggest Mars-mission hazards. High radiation exposure increases astronauts' risk of developing cancer later in life, but there are more immediate concerns as well. For instance, a recent study determined that crewmembers on a Red Planet mission will likely receive cumulative doses high enough to damage their central nervous systems. Astronauts' moods, memory and learning ability may be harmed as a result, the study found.

7 Fogarty mentioned another issue that requires focused research attention – spaceflight associated neuro-ocular syndrome (SANS), also known as visual impairment and intracranial pressure (VIIP) syndrome. It describes the potentially significant and long-lasting vision problems that spaceflight can cause in astronauts, likely because of fluid shifts that increase pressure inside the skull. SANS "right now in low Earth orbit is very, very manageable and recoverable, but we don't know

the system well enough to predict whether it will remain that way for something like an exploration mission," Fogarty said. "So, this is one of our highest-priority physiological areas that we're studying right now."

The moon as a proving ground

8 NASA isn't planning to go straight to Mars. The agency aims to land two astronauts near the lunar south pole by 2024, then establish a long-term, sustainable presence on and around the moon shortly after that time.

9 Indeed, the main goal of these activities, which NASA will conduct via a program called Artemis, is to learn the skills and techniques needed to send astronauts to Mars, agency officials have said. One of Artemis' key pieces of infrastructure is a small moon-orbiting space station called the Gateway, which will serve as a hub for surface activities. For example, landers, both robotic and crewed, will descend toward the lunar surface from Gateway, and astronauts aboard the outpost will likely operate rovers from up there as well, NASA officials have said.

10 A great deal of research will be conducted on Gateway as well, and much of it will investigate astronauts' health and performance in a true deep-space environment. Fogarty mentioned one research strategy that may be particularly useful to planners mapping out the path to Mars – studying small samples of human tissue aboard the moon-orbiting outpost. Such work will help researchers get around one of the biggest issues affecting studies that use rodents and other non-human animals as model organisms, Fogarty said – that of "translatability". "How do we bridge the difference between a rat or a mouse and a human? Because it's not directly applicable, and that's plaguing terrestrial medicine and research as well," she said.

11 "But with the invention of, and the continued validation of, organs and tissue on a chip – those are actual human organs and tissue, you can connect them, and essentially you can recapitulate very sophisticated aspects of a human using these chips," Fogarty added, "I think we can make significant progress understanding the complex environment using the chip as a model organism to interpret really where we're going with the human limitation."

New words

crewmember /ˈkruːˌmembə/ *n.* a member of a group of people who work together esp. on a ship 工作人员；（尤指）船员

stressor /ˈstresə/ *n.* an event, experience, etc. that causes stress 导致压力的因素

mitigation /ˌmɪtɪˈgeɪʃən/ *n.* a reduction in the unpleasantness, seriousness, or painfulness of sth. 减轻，缓和

cumulative /ˈkjuːmjʊlətɪv/ *adj.* increasing gradually as more of sth. is added or happens 积累的，渐增的

magnetosphere /mægˈniːtəsfɪə/ *n.* the region surrounding a planet, such as the Earth, in which the behavior of charged particles is controlled by the planet's magnetic field 磁气圈，磁层

recoverable /rɪˈkʌvərəbəl/ *adj.* (of sth. lost) able to be regained or retrieved 可恢复的；可重新获得的

sustainable /səˈsteɪnəbəl/ *adj.* able to continue or be continued for a long time 可持续的

lander /ˈlændə/ *n.* a spacecraft designed to land on the surface of a planet or moon 着陆器

rodent /ˈrəʊdənt/ *n.* a small mammal which has sharp front teeth 啮齿动物

plague /pleɪg/ *v.* to cause worry, pain, or difficulty to someone or something over a period of time 不断困扰

terrestrial /təˈrestriəl/ *adj.* relating to the Earth rather than to the moon or other planets 地球的；与地球有关的

validation /ˌvælɪˈdeɪʃən/ *n.* the act of proving that sth. is true 证实；认可

recapitulate /ˌriːkəˈpɪtʃʊleɪt/ *v.* to repeat or give a summary of what has already been said, decided, etc. 扼要重述；概括

Phrases and expressions

in good nick 状态良好

be tasked with doing sth. 被指派去做某事

get a handle on 开始掌握

pull off 成功完成

take a toll on 对…造成严重损害

conduct research on 对…进行研究

map out 筹划

get around 克服

Proper nouns

Red Planet 火星，红色星球，红色行星

Future In-Space Operations 未来太空行动

Technical terms

deep-space radiation 深空辐射
gravity field 重力场
roundtrip journey 往返行程
cumulative effect 累积效应
experimental setting 实验环境
protective magnetosphere 保护磁层
central nervous system 中枢神经系统
proving ground 试验场所

Background information

Human Research Program (HRP) 人类研究项目

The Human Research Program (HRP) investigates and mitigates the highest risks to human health and performance, providing essential countermeasures and technologies for human space exploration. Risks include physiological and performance effects from hazards such as radiation, altered gravity, and hostile environments, as well as unique challenges in medical support, human factors, and behavioral health support.

spaceflight associated neuro-ocular syndrome (SANS) 太空飞行相关神经视觉综合征

Spaceflight associated neuro-ocular syndrome (SANS), formerly called visual impairment and intracranial pressure (VIIP) syndrome (视力障碍和颅内压综合征), is a constellation of findings and symptoms that have been found in astronauts who have undergone long-duration spaceflight missions in microgravity environments.

Artemis “阿尔忒弥斯”计划

With the Artemis program, NASA will land the first woman and first person of color on the moon by 2024, using innovative technologies to explore more of the lunar surface than ever before. It will collaborate with its commercial and international partners and establish sustainable exploration on the moon. Then, it will use what is learned on and around the moon to take the next giant leap – sending astronauts to Mars.

Gateway “门户”月球轨道空间站

The Gateway, a vital component of NASA's Artemis program, will serve as a multi-purpose outpost orbiting the moon that provides vital support for a sustainable, long-term human

return to the lunar surface and serves as a staging point for deep space exploration. NASA is working with commercial and international partners to establish the Gateway.

Difficult sentences

1 **NASA is trying to bring the various risks down before launching astronauts to Mars in the 2030s. (Para. 1)**

NASA is going to send astronauts to Mars in the 2030s. But before that, it is trying to reduce all kinds of risks that astronauts might face in the future.

2 **Crewmembers will have to make it through this gauntlet in good nick, both physically and mentally. (Para. 1)**

Astronauts will face very direct and hazardous challenges on their journey, as a soldier would face them in a battle. But the hope is that they will finish the task in good physical and mental condition.

3 **The HRP is tasked with characterizing the effects of spaceflight on astronauts and developing mitigation strategies. (Para. 3)**

The HRP has been given a task to study the dangerous influences of spaceflight on astronauts and find solutions to relieve the problems.

4 **The long-term goal of such work is to help enable crewed missions to Mars, which NASA wants to pull off before the end of the 2030s. (Para. 4)**

The ongoing purpose of the work is to finally make manned spaceflight to Mars possible, and NASA wants to succeed in doing so before the end of the 2030s.

5 **Fogarty mentioned one research strategy that may be particularly useful to planners mapping out the path to Mars – studying small samples of human tissue aboard the moon-orbiting outpost. (Para. 10)**

Fogarty said it is a good idea to study small samples from the human body when they are in the moon-orbiting outpost. It may be very helpful to the plan of sending humans to Mars in future.

6 **Such work will help researchers get around one of the biggest issues affecting studies that use rodents and other non-human animals as model organisms, Fogarty said – that of "translatability". (Para. 10)**

One strategy is to use rodents, such as rats and mice, to do experiments in an

environment beyond Earth. However, rodents are not humans. And the results have to be transferred to apply to human organisms, though doing experiments in a moon-orbiting outpost will help.

7 **"How do we bridge the difference between a rat or a mouse and a human? Because it's not directly applicable, and that's plaguing terrestrial medicine and research as well," she said. (Para. 10)**

"While we conduct medical experiments on rodents, such as mice or rats, the results still need to be applied to humans. That's a problem, because humans are not rodents. This is the same challenge facing medical research and medicine here on Earth," she said.

8 **"I think we can make significant progress understanding the complex environment using the chip as a model organism to interpret really where we're going with the human limitation." (Para. 11)**

"In my opinion we can move forward in understanding the complicated environment. With the help of organs and tissue on a chip, the researchers can carry out experiments and understand where the limits of humans are."

Exercises

I Fill in the blanks with the words and expressions given below, and change the forms when necessary.

cumulative	survival	infrastructure	get around	mitigation
sophisticated	recoverable	sustainable	interpret	mission

1 The Long March 9 will not only be used for lunar _____ but also be required for other deep-space exploration projects.
2 I think we should be able to _____ most of these problems with the help of our professor.
3 If the program does not indicate this, a user will _____ it as rudeness at best; at worst, he will assume the program has crashed and that drastic action must be taken.

4 The administration will coordinate with different government departments to include the safety of heritage sites in the national disaster prevention and _____ system.

5 The main reason many amateur photographers upgrade from their handy compact digital cameras to _____ digital SLR versions is because they are tired of dealing with the dreaded lag time.

6 Lack of water and oxygen poses a serious threat to the _____ of astronauts.

7 _____ investment can create jobs and lay the foundation for future economic growth.

8 Removal expenses might be _____ if you have to move to a different area in order to find work.

9 At the summit, a plan was put forward that the government would import commodities with a(n) _____ value of over $170 billion from European countries in the coming five years.

10 According to the scientist, many of the crops grown for ethanol are not done so in a(n) _____ manner, resulting in habitat destruction and loss of valuable food supply resources.

Translation

Part A Translate the following paragraph into Chinese.

The HRP is tasked with characterizing the effects of spaceflight on astronauts and developing mitigation strategies. The program recognizes five classes of "stressor" that can significantly affect human health and performance on deep-space missions, Fogarty said. These are altered gravity fields, hostile closed environments, radiation, isolation/confinement, and distance from Earth (which means that help is very far away). HRP scientists and other researchers around the world are trying to get a handle on all of these stressors, by performing experiments here on Earth and carefully monitoring the mental and physical health of astronauts living on the International Space Station (ISS).

Part B Translate the following paragraph into English.

中国国内研制的宇航服（spacesuit）确保了宇航员在空间站天和核心舱逗留期间以及在空间站外活动时的安全。他们有舱内（intravehicular）宇航服和舱外（extravehicular）宇航服。舱内宇航服保证了正常情况下的通风（ventilation）和散

热（heat dissipation），并在航天器发生泄漏时提供氧气以确保宇航员的安全。舱外宇航服为在航天器外工作的宇航员提供安全有效的环境保护、环境控制和生命保障。

III Write a summary of the text in 120 words.

Directions: A summary should be written in your own words. It should contain only the ideas of the original text. Do not insert any of your own opinions, interpretations, deductions or comments into the summary.

IV Read the passage, select one word for each blank from a list of choices in the bank, and change the form when necessary. You may not use any of the words in the bank more than once.

complete	harmful	prolong	physical	further
spaceflight	impact	astronaut	agency	microgravity

The effects of **1)** _____ on the human body are well known, with **2)** _____ seeing some changes to bone density, muscle strength and other **3)** _____ changes, such as puffy (肿胀的) faces or changes to their eyes. But a new study suggests the changes may go even **4)** _____ – they may cause harm to the immune system and lead to cancer.

The study, which was published in November 2018 in the *Journal of Applied Physiology*, highlights the negative **5)** _____ on natural killer cells for astronauts who have spent approximately six months on the International Space Station.

"What NASA and other space **6)** _____ are concerned about is whether or not the immune system is going to be weakened during very **7)** _____ spaceflight missions," said Richard Simpson, senior author and associate professor of nutritional sciences at the University of Arizona, in a statement. "What clinical risks are there to the astronauts during these missions when they're exposed to things like **8)** _____, radiation and isolation stress? Could it be **9)** _____ to the level that the astronaut wouldn't be able to **10)** _____ the mission?"

V Critical thinking

Work in groups and discuss the following questions.

It is said that there is no royal road to space exploration. Astronauts have to deal with the adverse effects of radiation, microgravity, isolation, boredom on a long mission, etc. Imagine you, as an astronaut, would spend six months on Tiangong space station. One of the problems that you would face on the long mission is boredom. How would you combat boredom in space? What activities would help to keep you fit both physically and mentally?

Further reading

Five hazards of human spaceflight

1 A human journey to Mars, at first glance, offers an inexhaustible amount of complexities. To bring a mission to the Red Planet from fiction to fact, NASA's Human Research Program has organized hazards astronauts will encounter on a continual basis into five classifications. Pooling the challenges into categories allows for an organized effort to overcome the obstacles that lay before such a mission. However, these hazards do not stand alone. They can feed off one another and exacerbate effects on the human body. These hazards are being studied using ground-based analogs, laboratories, and the International Space Station, which serves as a test bed to evaluate human performance and countermeasures required for the exploration of space.

2 Various research platforms give NASA a valuable insight into how the human body and mind might respond during extended forays into space. The resulting data, technology and methods developed serve as valuable knowledge to extrapolate to multi-year interplanetary missions.

Radiation

3 The first hazard of a human mission to Mars, radiation, is also the most difficult to visualize because, space radiation is invisible to the human eye. Radiation is not only stealthy, but considered one of the most menacing of the five hazards. Outside Earth's natural protection, radiation exposure increases cancer risk, damages the central nervous system, and can alter cognitive function, reduce motor function and prompt behavioral changes. To learn what can happen above low Earth orbit, NASA studies how radiation affects biological samples using a ground-based research laboratory. The space station sits just within Earth's protective magnetic field, so while our astronauts are exposed to ten-times higher radiation than on Earth, it's still a smaller dose than what deep space has in store. To mitigate this hazard, deep space vehicles

will have significant protective shielding, dosimetry, and alerts. Research is also being conducted in the field of medical countermeasures such as pharmaceuticals to help defend against radiation.

Isolation

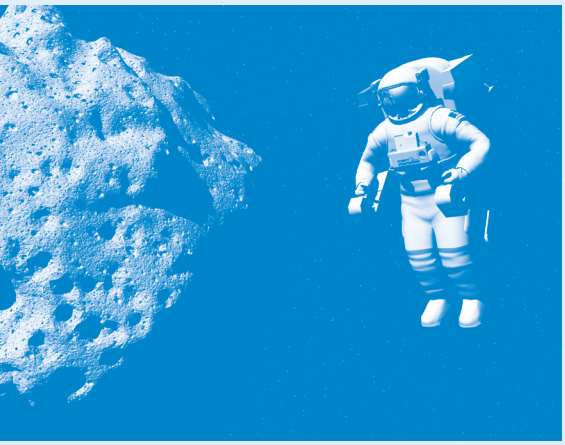
4 Behavioral issues among groups of people crammed in a small space over a long period of time, no matter how well trained they are, are inevitable. Crews will be carefully chosen, trained and supported to ensure they can work effectively as a team for months or years in space.

5 On Earth we have the luxury of picking up our cell phones and instantly being connected with nearly everything and everyone around us. On a trip to Mars, astronauts will be more isolated and confined than we can imagine. Sleep loss, circadian desynchronization, and work overload compound this issue and may lead to performance decrements, adverse health outcomes, and compromised mission objectives.

6 To address this hazard, methods for monitoring behavioral health and adapting/refining various tools and technologies for use in the spaceflight environment are being developed to detect and treat early risk factors. Research is also being conducted in workload and performance, light therapy for circadian alignment, phase shifting and alertness.

Distance

7 The third and perhaps most apparent hazard is, quite simply, the distance. Mars is, on average, 225 million kilometers from Earth. Rather than a three-day lunar trip, astronauts would be leaving our planet for roughly three years. While International Space Station expeditions serve as a rough foundation for the expected impact on planning logistics for such a trip, the data isn't always comparable. If a medical event or emergency happens on the station, the crew can return home within hours. Additionally, cargo vehicles continually resupply the crews with fresh food, medical equipment, and other resources. Once you burn your engines for Mars, there is no turning back and no resupply.



8 Planning and self-sufficiency are essential keys to a successful Martian mission. Facing a communication delay of up to 20 minutes one way and the possibility of equipment failures or a medical emergency, astronauts must be capable of confronting an array of situations without support from their fellow team on the Earth.

Gravity

9 The variance of gravity that astronauts will encounter is the fourth hazard of a human mission. On Mars, astronauts would need to live and work in three-eighths of Earth's gravitational pull for up to two years. Additionally, on the six-month trek between the planets, explorers will experience total weightlessness.

10 Besides Mars and deep space there is a third gravity field that must be considered. When astronauts finally return home they will need to readapt many of the systems in their bodies to Earth's gravity. Bones, muscles, cardiovascular system have all been impacted by years without standard gravity. To further complicate the problem, when astronauts transition from one gravity field to another, it's usually quite an intense experience. Blasting off from the surface of a planet or a hurdling descent through an atmosphere is many times the force of gravity.

11 Research is being conducted to ensure that astronauts stay healthy before, during and after their mission. NASA is identifying how current and future, FDA-approved osteoporosis treatments, and the optimal timing for such therapies could be employed to mitigate the risk for astronauts developing premature osteoporosis. Adaptability training programs and improving the ability to detect relevant sensory input are being investigated to mitigate balance control issues. Research is ongoing to characterize optimal exercise prescriptions for individual astronauts, as well as defining metabolic costs of critical mission tasks they would expect to encounter on a Mars mission.

Closed environments

12 A spacecraft is not only a home; it's also a machine. NASA understands that the ecosystem inside a vehicle plays a big role in everyday astronaut life. Important

habitability factors include temperature, pressure, lighting, noise, and quantity of space. It's essential that astronauts are getting the requisite food, sleep and exercise needed to stay healthy and happy.

13 Technology, as often is the case with out-of-this-world exploration, comes to the rescue in creating a habitable home in a harsh environment. Everything is monitored, from air quality to possible microbial inhabitants. Microorganisms that naturally live on your body are transferred more easily from one person to another in a closed environment. Astronauts, too, contribute data points via urine and blood samples, and can reveal valuable information about possible stressors. The occupants are also asked to provide feedback about their living environment, including physical impressions and sensations so that the evolution of spacecraft can continue addressing the needs of humans in space. Extensive recycling of resources we take for granted is also imperative: oxygen, water, carbon dioxide, even our waste.

Human research essential to space exploration

14 NASA has already gone beyond simply identifying five challenges of human spaceflight to facilitate a focused and organized effort to reach Mars. Within the agency, there are entities dedicated to the evolution of spaceflight in all five of these areas.

15 NASA's Human Research Program (HRP) remains committed to preserving the health and vitality of the crew that will someday touch down upon Mars. It is dedicated to discovering the best methods and technologies to support safe, productive human space travel. HRP enables space exploration by reducing the risks to astronaut health and performance using ground research facilities, the International Space Station, and analog environments. This leads to the development and delivery of an exploration biomedical program focused on: informing human health, performance, and habitability standards; the development of countermeasures and risk mitigation solutions; and advanced habitability and medical support technologies.

16 While these five hazards present significant challenges, they also offer opportunities for growth and innovation in technology, medicine and our understanding of the human body. One human challenge explored, one step closer to Mars.

New words

exacerbate /ɪgˈzæsəbeɪt/ *v.* to make sth. worse, especially a disease or problem 使恶化；使加重

analog /ˈænəlɒg/ *n.* a thing that is similar to another thing 相似物，类似物

extrapolate /ɪkˈstræpəleɪt/ *v.* to estimate sth. or form an opinion about sth., using the facts that you have now and that are relevant to one situation and supposing that they will be relevant to the new one 推断，推知

dosimetry /dəʊˈsɪmətri/ *n.* a method of measuring the dose of radiation emitted by a radioactive source 放射量测定；剂量测定

circadian /sɜːˈkeɪdiən/ *adj.* connected with the changes in the bodies of people or animals over each period of 24 hours 昼夜节律的，生理节奏的

decrement /ˈdekrəmənt/ *n.* a reduction, or a lower level or amount 消耗；减缩

alignment /əˈlaɪnmənt/ *n.* an arrangement in which two or more things are positioned in a straight line or parallel to each other 排成直线；平行的行列

logistics /ləˈdʒɪstɪks/ *n.* the practical organization that is needed to make a complicated plan successful when a lot of people and equipment are involved 统筹安排

cardiovascular /ˌkɑːdiəʊˈvæskjʊlə/ *adj.* relating to the heart and the blood vessels (= the tubes that carry blood around the body) 心血管的

osteoporosis /ˌɒstiəʊpəˈrəʊsɪs/ *n.* a condition in which the bones become weak and are easily broken, usually when people get older or because they do not eat enough of certain substances 骨质疏松（症）

metabolic /ˌmetəˈbɒlɪk◂/ *adj.* connected with the chemical processes in living things that change food, etc. into energy and materials for growth 新陈代谢的

Phrases and expressions

stand alone 孤立存在

give sb. an insight into 给某人提供关于…的深刻见解

be exposed to 暴露在…中

adverse health outcomes 不良健康后果

further complicate the problem 使问题更复杂

optimal timing 最佳时机

Proper nouns

FDA (Food and Drug Administration) 美国食品和药物管理局

Technical terms

protective magnetic field 保护性磁场
circadian desynchronization 昼夜节律去同步化，生理节奏紊乱
variance of gravity 重力变化

Exercises

I For each of the following unfinished statements or questions, choose the most appropriate answer from A, B, C, or D according to the text.

1 Radiation ranks first among the five hazards of spaceflight because of its _____.

A. availability
B. visibility
C. invisibility
D. odd smell

2 Which plight is NOT mentioned for astronauts on a trip to Mars?

A. Performance reductions.
B. Discounted mission goals.
C. Unfavorable health results.
D. Hearing problems.

3 Astronauts should worry about important habitability factors EXCEPT _____.

A. temperature
B. space
C. exercise
D. recreation

4 How can the astronauts contribute to satisfying the needs of humans in space?

A. By providing data about their own physical status.

B. By keeping communication with Earth.

C. By neglecting the daily recycling of life.

D. By lowering the need of the requisite food.

5 Which of the following is true according to the text?

A. The professional training of crews will mainly focus on health and performance.

B. Muscular problems should be given much thought due to their high incidence for astronauts in space.

C. Not everything in the closed space shuttle will be carefully monitored.

D. The HRP mainly offers financial aids to relevant organizations in the US.

Questions for discussion

1 What will be the different effects of radiation on the astronauts in a ground-based research lab?

2 How long does it take for the crew to return home if emergencies arise on the International Space Station?

3 What gravity fields will astronauts traveling to Mars be concerned about?

4 What activity will greatly increase the intensity of gravity?

5 What will be more possibly transmitted in a closed setting?

Practical writing

How to write an experiment report

An experiment report is an essential part of all laboratory courses and usually a significant part of your grade. It is intended to explain what you did in your experiment, what you learned, what the results meant, etc. The report should contain at least six parts: abstract, introduction, purpose/problem, procedure, observations and data, and conclusion.

Abstract

Remember to include an abstract in your experiment report. Write it as one paragraph. This is a concise summary of the entire experiment, which includes the rationale, methods, results, and significance in a brief form.

Introduction

Briefly state what has been known or found out about the problem so that you can be fully aware of what you should focus on in the experiment. This is background information from books, teachers, or other sources, giving readers an overall understanding of possible principles and information about the experiment.

Purpose/Problem

The purpose or problem deals with why you are conducting the experiment. You should write down the exact problem that will be investigated or dealt with.

Procedure

The procedure demonstrates accurately what was done. Make it more specific. As the procedure affects the results, it is essential to accurately explain what was done in the experiment.

Observations and Data

The observations present exactly what happened when the lab experiment was underway. An observation is measurable information that can be observed through your senses. Results include experimental data in the form of tables, graphs, drawings and other observations. Observations and data should be included in this part, as well as calculations made during the experiment.

Conclusion

Review and summarize briefly what was done in this experiment and what was found in the results. State in general terms the most important discoveries. You may also suggest follow-up experiments, and make some predictions according to what has been discovered.

Exercise

Write an English experiment report relevant to your major. The report should cover the six parts introduced above.