Science and Technology
First Year of Secondary Cycle Two

Evaluation Situation

Technology for Today's Athlete

Student Booklet

Time: 2 hours 30 minutes

Éducation,
Loisir et Sport
Québec

Prototype Examination
Science and Technology
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The 29th Olympiad will be held in Beijing in the summer of 2008, 112 years after the first modern Olympic games. The athletes of ancient Greece have little in common with today's athletes. Performance levels have increased tremendously, and numerous records are broken every year.

Athletes have made such remarkable progress thanks to the development of new technologies (for example, those used to manufacture sports equipment) and innovative training methods, among other things. Athletic performances have also been enhanced as a result of doping, which has become widespread over the last few years.

Nutrition and the air that athletes breathe are of great importance. How does the human body react to the air conditions in different countries and what foods should athletes choose so that they can perform as well as possible during training sessions and competitions? How do athletes manage to interpret the different visual and auditory signals involved in their sport?

To better understand how athletes are able to accomplish these extraordinary feats, you will be required to answer different questions by carrying out the four tasks described below.

Task 1

Athletes who eat properly wonder whether there are food products that could help them in their sport. There are special products on the market such as energy bars, energy gels and recovery bars. Depending on their nature, these products are designed to be used at different times throughout a competition. They also differ in terms of their nutritional composition. Analyze the nutrition facts (composition and quantities) found on different labels, and then match each label with the corresponding product (energy bar, energy gel or recovery bar). Name each of the nutrients in each product and explain how it benefits athletes.

Task 2

There is so much air pollution in Beijing that the marathon may have to be cancelled. However, air pollution does not affect spectators in the same way as it does athletes. Give two reasons why air pollution affects athletes and spectators differently.

Task 3

For a sprinter, the starting signal is very important because the outcome of a race is decided by hundredths of a second. The sprinter's senses must therefore be razor sharp. A prototype starter pistol combining a light signal and a sound signal is being tested in an attempt to find a way of ensuring that the start of the race is fair for all athletes. How does a sprinter perceive each of these signals and how will they be transmitted to his/her muscles? What is the difference between these two types of waves?

Task 4

The issue of doping has made the news again over the last few months in the run-up to the Beijing Olympic games. Some believe that we must fight doping, while others think these efforts are useless. What is your opinion on the subject? Base your arguments on the background information provided.

BACKGROUND INFORMATION

Task 1

Nutrition for Athletes

Nutrition is very important for athletes because certain types of nutritional deficiencies cause a variety of health problems (e.g. muscle aches, cramps, fatigue, reduced endurance) that can hamper their performance.

Athletes have specific needs before, during and after their competition. For many years, the nutrition industry has worked relentlessly to attract them by constantly offering them new products that are claimed to be better adapted to their needs.

Before the competition

Top-level athletes require a diet consisting of nutrients that will **prevent hunger**, maintain hydration and **provide enough stored energy**. Certain energy bars attempt to meet these needs.

During the competition

During competitions lasting more than two hours, athletes must take in foods that will keep them hydrated, **replenish lost electrolytes**, and allow them to **maintain their pace** and to **avoid exhaustion**. Energy gels play this role.

After the competition

Athletes must make sure they are properly hydrated and replace **all** the nutrients they lost during the competition. Recovery bars can meet these needs.

The three labels below give nutrition facts for three of these products.

LABEL 1	
NUTRITIONAL COMPOSITION PER 100 g	
Protein	18.7 g
Carbohydrates	45.8 g
Fat	13.5 g
Sodium	0 g
Energy value	380 kcal or 1596 kJ

LABEL 2	
NUTRITIONAL COMPOSITION PER 100 g	
Protein	33 g
Carbohydrates	40 g
Fat	12 g
Sodium	114 mg
Potassium	190 mg
Vitamin C	0.6 mg
Energy value	400 kcal or 1672 kJ

LABEL 3	
NUTRITIONAL COMPOSITION PER 100 g	
Protein	0 g
Carbohydrates	76 g
Fat	0 g
Sodium	27 mg
Energy value	300 kcal or 1300 kJ

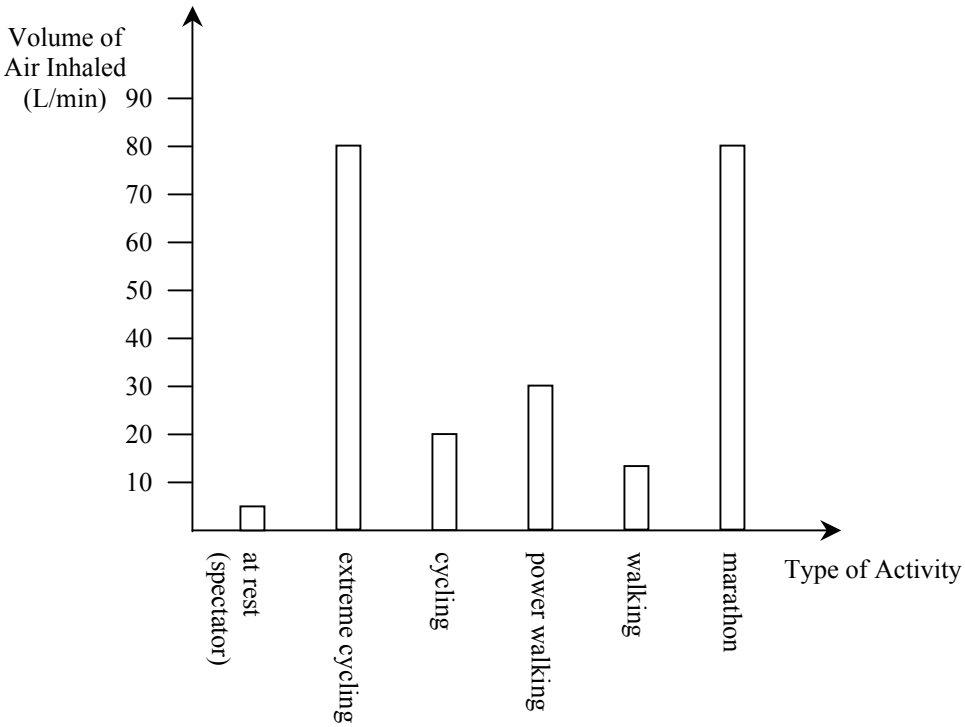
Task 2

Air Pollution

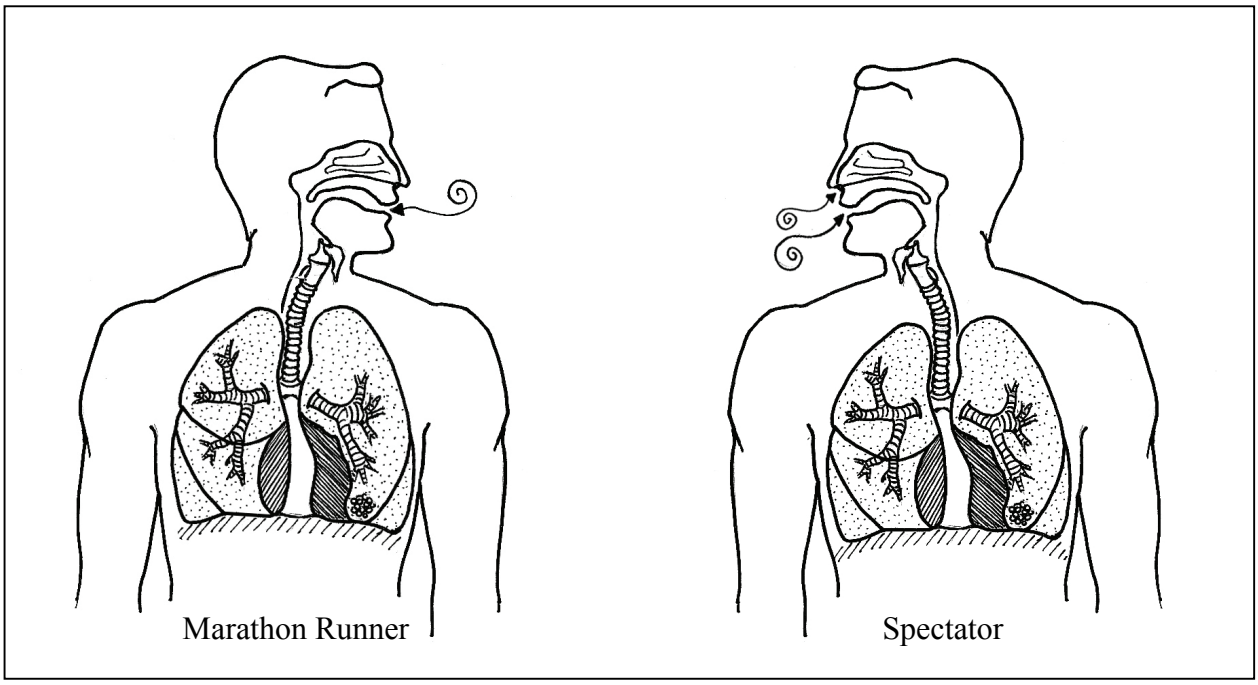
During their competition at the Beijing games, athletes will have to deal with heat, high humidity and the problem of air pollution. The substances found in the air could irritate the respiratory tract and trigger asthma attacks. In addition, these pollutants can be harmful if they reach the bloodstream because they may alter the heart rate, bring about a generalized inflammatory reaction and thicken the blood. Pollution is as bad for the heart as it is for the lungs. Moreover, it is known that red blood cells are more attracted to carbon monoxide (CO) than to oxygen (O_2).

Because of the great physical effort required during a competition, athletes may feel the negative effects of pollution more intensely than spectators. Some athletes, such as marathon runners, may be even more affected.

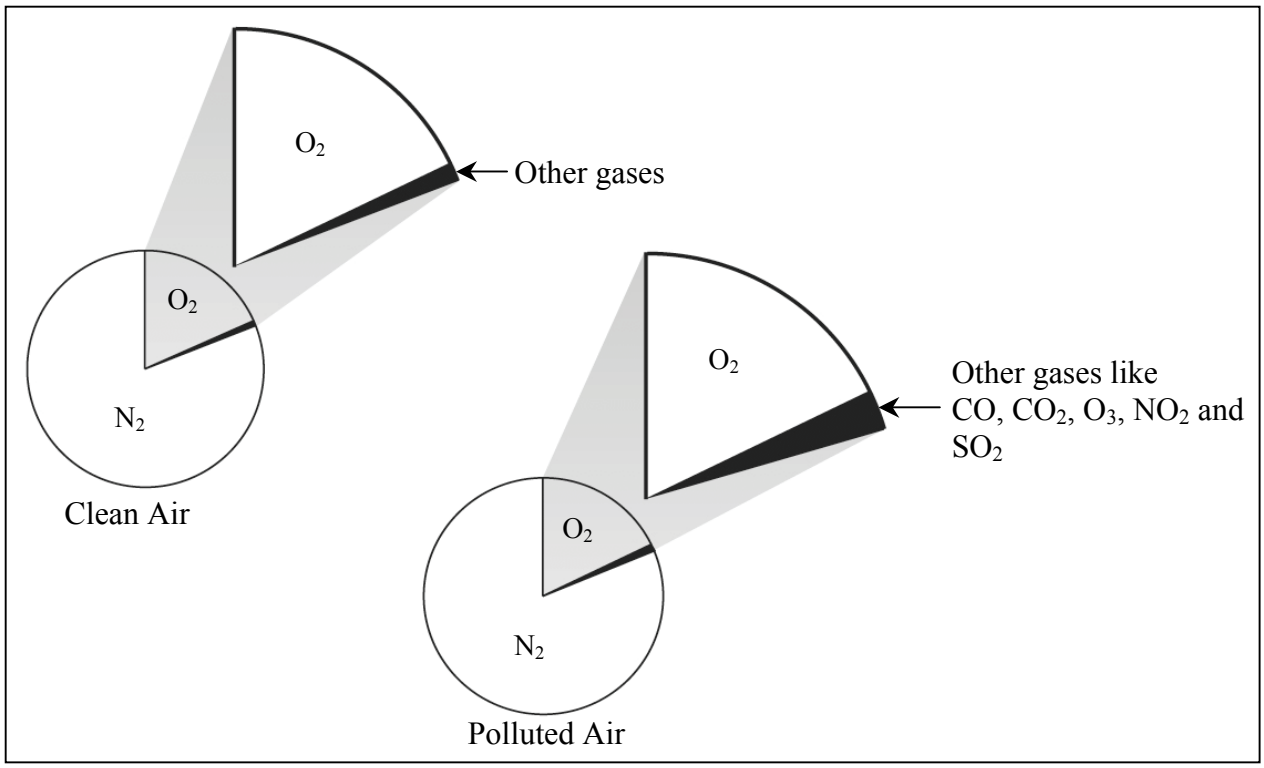
VOLUME OF AIR INHALED (IN LITRES PER MINUTE)
DURING DIFFERENT TYPES OF PHYSICAL ACTIVITY



DIFFERENCE BETWEEN THE RESPIRATION
OF A MARATHON RUNNER AND THE RESPIRATION OF A SPECTATOR



GASES AS A PROPORTION OF THE MAKE-UP OF CLEAN AIR AND POLLUTED AIR



Task 4

Doping

WADA Appealing for Help

The Word Anti-Doping Agency (WADA) is based in Montréal, and its mission is to promote, coordinate and monitor the fight against all types of doping in sports.

Although WADA has the expertise required to detect performance-enhancing substances, it is woefully short of the money needed to keep up with the rapid development of these substances. This is why it would like to work closely with certain pharmaceutical laboratories in the fight against doping. WADA would also like to introduce an athlete's passport to provide a more effective testing system aimed at making gains in the fight against doping and protecting the health of all athletes.

Athlete Profile

Striving to reach the top of the podium, Lilly White took some time out to talk about herself and her life as an athlete. Lilly is 19 years old and has been involved in synchronized swimming since the age of 8. She has remained in school despite a rigorous training schedule, injuries and the discipline required in her sport.

Life as an athlete became easier after she won some medals. She says winning makes it easy to get the sponsorship money that helps keep you on track toward achieving your goals. Many big companies want to be associated with winning athletes through advertising campaigns because this brings in a lot of money.

Winning requires enormous sacrifices, and Lilly claims that she has never resorted to doping to improve her performances. She feels that training and determination are enough to help make her Olympic dream come true. She knows athletes who have used performance-enhancing substances to reach the top more quickly. Lilly has never considered using these substances even though it might have been a shortcut to wealth and fame. She wants her success to result from her own efforts and not from the use of banned substances.

Another Cheat

Cyclist Billy Braggart, once the promotional face of a well-known sports equipment company, confessed to using performance-enhancing substances during his career. Testifying before the sports tribunal, he admitted that he used EPO and masking agents to avoid being caught. He apologized to his fans, but claimed that he never would have reached the top of the podium without the use of doping substances. He regretted promoting his sport under such circumstances, but admitted that his sponsorship deals have provided him with enough money to move on to a healthier life. By testifying before the sports tribunal, he avoids prosecution, but he will be banned from competition for the next two years.

Supplements: Handle With Care

Over the last few years, nutritional supplements have become more and more popular among athletes. These products should be used with caution, since they may cause problems. Some nutritional supplements contain banned substances and may lead to a positive result on a doping control test. Athletes and their coaches and trainers must be careful to check the ingredients in these supplements before using them.

Even if you read the ingredient list carefully, it may be difficult to determine exactly what the product contains. Some companies may use different techniques to incorporate hidden ingredients into their supplements. It is therefore important to make sure that you are using a product that complies with existing regulations.

Athletes must recognize that they are responsible for what they consume. They should ask themselves whether it is worth taking nutritional supplements, since a healthy diet should fulfill their energy needs.

Substances: for Better and for Worse

Many performance-enhancing substances are used in the sports world. For example, anabolic steroids, which are synthetic products derived from testosterone, are used to build up muscle mass and muscular strength. Steroids may also be used for therapeutic purposes. For example, they are prescribed to men whose testicles do not function properly. Taking too much of this substance can lead to different side effects in men and women such as muscle tears, behavioural difficulties, hormonal disruptions (may stop menstruation) and potentially fatal cardiovascular problems.

Other doping substances trick the central nervous system by masking the sensation of fatigue. This is the case of amphetamines that act like adrenaline, which is a naturally occurring substance in the body. They also increase concentration. Taking too much of this substance may lead to a loss of appetite, sleep disorders or behavioural difficulties, heart problems and even death.

Corticosteroids, which are naturally secreted by our body, are also used to reduce the sensation of fatigue and increase resistance to pain. Too much of this substance may lead to muscle tears or heart failure, or stunt children's growth. It should be noted that this substance is used therapeutically to reduce swelling and inflammation. For example, it is given to people with asthma to reduce inflammation in the bronchial tubes.

EPO is a substance used to increase the oxygenation of tissues by stimulating the production of erythrocytes (red blood cells). Our body produces it naturally to control our red blood cell count. It can be administered under medical supervision to treat anemia in people suffering from kidney failure. When used as a doping substance, however, EPO can cause potentially fatal high blood pressure, strokes and heart attacks.

Performance-enhancing substances are constantly evolving. In order to make synthetic substances more difficult to detect, laboratories attempt to manufacture them so that they most closely resemble substances naturally produced by the body. Furthermore, doping substances are increasingly harder to detect because of the use of masking agents. In this regard, diuretics are used, among other things, to more quickly evacuate doping substances before they are detected. In this context, it is difficult to design doping control tests fast enough to keep up with advances in biotechnology. To make matters even more complicated, the relatively near future holds the prospect of a world in which it will be possible for athletes to be genetically modified.