Unit 1 The Scientific Method

1. *Warm-up*

What is the role of research in modern sport and exercise science?

What do you think about when you hear the term "research"? For some people, it means people in white coats dropping things into petri dishes whereas for others it could mean big needles and complex machines. How do you think research is applicable to sport and exercise environments?

2. *First steps*

Every scientific enquiry begins with a question or a series of questions, which result from curiosity. Curiosity is a consequence of the interest people develop while interacting with various objects and aspects of their environment.

For example, athletes who are interested in improving their personal achievements show curiosity, which leads them to ask questions such as, "which erogenic acids can I use to help me to enhance my performance?" A question such as this leads to inquiry and investigation.

Use the following concepts to draw a diagram that describes a typical sequence of events:

investigation *answer* *person* *environment*

new question/s *curiosity* *question*

3. *The origins of modern science*

a) Read the text below. Who were the key figures in the history of science? What were their contributions?

The origins of modern science lie in a period of rapid scientific development that occurred in Europe between the years 1500 and 1750, which we now refer to as the scientific revolution. Of course scientific investigations were pursued in ancient and medieval times too – the scientific revolution did not come from nowhere. In these earlier periods the dominant world-view was Aristotelianism, named after the ancient Greek philosopher Aristotle, who put forward detailed theories in physics, biology, astronomy, and cosmology. But Aristotle´s ideas would seem very strange to a modern scientist, as would his methods of inquiry.

The first crucial step in the development of the modern scientific world-view was the Copernican revolution. In 1542 the Polish astronomer Nicolas Copernicus (1473-1543) published a book attacking the geocentric model of the universe, which placed the stationary earth at the centre of the universe with the planets and the sun in orbit around it. Geocentric astronomy, also known as Ptolemaic astronomy after the ancient Greek astronomer Ptolemy, lay at the heart of the Aristotelian world-view, and had gone largely unchallenged for 1 800 years. But Copernicus suggested an alternative: the **sun** was the fixed centre of the universe, and the planets, including the earth, were in orbit around the sun. On this heliocentric model the earth is regarded as just another planet, and so loses the unique status that tradition had accorded it. Copernicus´ theory initially met with much resistance but within 100 years Copernicanism had become established scientific orthodoxy.

Copernicus´ innovation did not merely lead to a better astronomy. Indirectly, it led to the development of modern physics, through the work of Johannes Kepler (1571-1630) and Galileo Galilei (1564-1642). Kepler discovered that the planets do not move in circular orbits around the sun, as Copernicus thought, but rather in ellipses. This was his crucial ´first law´ of planetary motion; his second and third law specify the speeds at which the planets orbit the sun. Taken together, Kepler´s laws provided a far superior planetary theory than had ever been advanced before, solving problems that had confounded astronomers for centuries.

Galileo´s most enduring contribution, however, lay not in astronomy but in mechanics, where he refuted the Aristotelean theory that heavier bodies fall faster than lighter ones. In place of this theory, Galileo made the counter-intuitive suggestion that all freely falling bodies will fall towards the earth at the same rate, irrespectively of their weight. Furthermore, he argued that freely falling bodies accelerate uniformly, this is known as Galileo´s law of free-fall. Galileo provided persuasive though not totally conclusive evidence for this law, which formed the centrepiece of his theory of mechanics.

The scientific revolution culminated in the work of Isaac Newton (1643-1727), whose achievements stand unparalleled in the history of science. Newton agreed with the mechanical philosophers that the universe consists simply of particles in motion, but sought to improve on Descartes´ laws of motion and rules of collision. The result was a dynamical and mechanical

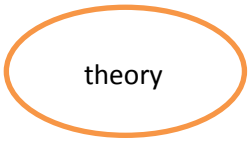
theory of great power, based around Newton´s three laws of motion and his famous principle of universal gravitation.

Confidence in the Newtonian picture was shattered in the early years of the 20th century, thanks to two revolutionary developments in physics – relativity theory and quantum mechanics.

(adapted from Okasha, S. *Philosophy of science.* OUP, 2002.)

b) Collocations

In the text above find words collocating with the word "theory".



c) Vocabulary task

Complete the missing prepositions in the sentences from the text:

1. We refer ……. this period as the scientific revolution.
2. Galileo´s most enduring contribution lay not …… astronomy but …….. mechanics.
3. All freely falling bodies will fall towards the earth ……. the same rate, irrespectively ……. their weight.
4. The theory was based …….. Newton´s three laws of motion.
5. On this heliocentric model the earth is regarded ……. just another planet.
6. Confidence in the Newtonian picture was shattered thanks ……. relativity theory and quantum mechanics.
7. The universe consists ……. particles in motion.

4. Discuss: What are the characteristic of scientific investigations?

The scientific method is the process by which scientists, collectively and over time, attempt to construct an accurate (that is, reliable, consistent and non-arbitrary) representation of the world. Recognizing that personal and cultural beliefs influence both our perceptions and our interpretations of natural phenomena, we aim through the use of standard procedures and criteria to minimize those influences when developing a theory.

What are the basic steps of a scientific method? Complete the gaps.

1. …….... of a phenomenon or group of phenomena

2. Formulation of a …… to explain the phenomena

3. Performance of …….. of the predictions

If the experiments bear out the hypothesis it may come to be regarded as a theory or law of nature. If the experiments do not bear out the hypothesis, it must be rejected or modified.

Complete the gaps in the text below with suitable words. Use the verb *falsify* to form words that fit in the gaps. You may use affixes such as un- / -able, etc.

Karl Popper, an influential 20th century philosopher of science, thought that the fundamental feature of a scientific theory is that it should be _____ . That does not mean that it is false. Rather, it means that the theory makes some definite predictions that can be tested against experience. If these predictions turn out to be wrong, then the theory has been _____ , or disproved. So a _____ theory is one that we might discover to be false – it is not compatible with every possible course of experience. Popper thought that some supposedly scientific theories did not satisfy this condition and thus did not deserve to be called science at all; rather they were merely pseudo-science.

Freud´s psychoanalytic theory was one of Popper´s favourite examples of pseudo-science. According to Popper, Freud´s theory could be reconciled with any empirical findings whatsoever. Popper argued that through the use of such concepts as repression, sublimation, and unconscious desires, Freud´s theory could be rendered compatible with any clinical data whatever; it was thus _____ .

Popper contrasted Freud´s theory with Einstein´s theory of gravitation, also known as general relativity. Unlike Freud´s theory, Einstein´s theory made a very definite prediction: that light rays from distant stars would be deflected by the gravitational field of the sun. Einstein´s theory had made a definite, precise prediction, which was confirmed by observations, so his theory satisfies the criterion of _____ .

(adapted from Okasha, S. *Philosophy of science.* OUP, 2002.)

5. Phrasal verbs in academic English

Although phrasal verbs occur most frequently in more informal spoken and written English, they are also not uncommon in an academic context. You will hear them used in lectures and will read them in serious journals.

Phrasal verbs often have one-word synonyms. These are usually of Latin origin and sound more formal that their phrasal verb equivalent but both are appropriate when writing or talking about academic subjects.

phrasal verb	*synonym*	*example*
put forward (an idea, theory, plan, opinion)	present	In her latest article Kaufmann puts forward a theory which is likely to prove controversial.
carry out	conduct	I intend to carry out a series of experiments.
make up	constitute	Children under the age of 15 make up nearly half of the country´s population.
be made up of	consist of	Parliament is made up of two houses.
point out	observe	Green points out that the increase in life expectancy has led to some economic problems.
set out	aim	In her article Losanova sets out to prove that…
go into	discuss	In this book the author goes into the causes of the civil war in some depth.
go through	check	Go through your calculations carefully.

Rewrite the sentences replacing the underlined word in each sentence with a phrasal verb from the table above.

a) In his article Kingston on the American Civil War discusses the reasons why the situation developed in the way it did.

b) Please check your work again carefully before handing it in.

c) Women now constitute over half the student population in most universities in this country.

d) We conducted a series of experiments to test our hypothesis.

e) Cole presents some fascinating theories on the development of language in his latest book.

f) The psychologist observed that it was very unusual for a young child to behave in this way.

g) In this article Simpson aims to prove that the Chines reached America long before the Vikings.