

CONTENTS

<i>Preface</i>	<i>iii</i>		
Part A: Evolution and Significance of science	1		
Evolution	1	6. Rocks and Minerals	102
Adaptation	1	7. Mineral Resources	106
Principal Areas of Science	1	8. Mountains, Valleys, and Caves	108
Scientific Laws	1	9. Glaciation	111
Early Scientific Advances	2	10. Oceans, Islands, and Coasts	112
Criticism of science	2	11. Rivers and Lakes	116
Science in our Daily Life	4	12. Climate and Weather	119
Chemistry in Everyday Life	5	13. A Future for the Earth	123
Branches of science	7		
15 Most Expensive Cars in the World	18		
Part B: Physics	18		
History	24	Part D: Laws of Science	125
Research	31	Laws of Physics	125
Chemistry	31	Laws of Classical Mechanics	126
Etymology	37	Laws of Gravitation and Relativity	131
Definition	42	Photonics	138
History	42	Laws of Chemistry	142
Chemical Structure	44		
Principles of Modern Chemistry	44	Part E: Science in Daily Life	147
Chemical laws	52	Universe	148
The Need for Green Chemistry	54	Origin of Universe	149
Goals of Green Chemistry	57	Origin of Solar System and Planets	150
Limitations/Obstacles	58	Origin of Earth	151
The Progress of Green Chemistry	58	The Early Atmosphere	151
Biology	60	Water	151
Outline of Biology	60	Carbon	157
Zoology	77	Energy	157
19th century	88	Minerals	160
Part C: Earth	92	Nutrients	168
1. Planet Earth	92	Household Chemicals	179
2. Earth's Plates and Continents	92	Polymers	186
3. Volcanoes	95	Pharmaceuticals	192
4. Earthquakes	96		
5. Landscape, Weathering, and Erosion	99	Part F: Current Science	210
	101	A Cell Therapy Untested in Humans Saves a Baby with Cancer	210
		Protein power for Vegetarians	211
		Genome Study Validates Claims of Ayurveda	214
		Appendix	243
		Dictionary of Chemical Formulae	243

Part A

NATURE AND SIGNIFICANCE OF SCIENCE AND TECHNOLOGY

EVOLUTION AND SIGNIFICANCE OF SCIENCE

EVOLUTION

Over millions of years, living things change in response to changes in their environment. This is called evolution and it happens through a process called natural selection. Changes that are more likely to help a plant or animal survive are passed to future generations, but living things with changes that are not suited to survival die out.

ADAPTATION

Natural selection has produced living things that are superbly adapted to life in the places they live in. Species that have adaptations better suited to an environment are more likely to survive than those that do not. Plants in deserts need to be able to save water, while animals in the Arctic need to survive the cold.

Human Evolution

Humans evolved from apelike ancestors over millions of years. In that time, different species evolved and were replaced until modern humans first appeared about 200,000 years ago.

Extinction

Changes to the environment, such as climate change, can lead to the disappearance of a whole species, a process called extinction. Extinction is an important part of the evolution process because it gives other species the chance to replace extinct ones.

Human Influence

Human activity is changing environments across the world. We are damag-

ing many natural habitats to meet our growing demands for food, energy, land, and other resources. We are also adding carbon dioxide to the atmosphere by burning fossil fuels such as oil, and this is changing our atmosphere and may be causing global warming.

Habitat Destruction

Many forests have been cut down to make use of the wood and to clear land for agriculture. This destroys the forest habitats and also reduces the number of trees in the world. Trees take carbon dioxide from the air, so cutting them down increases the level of this gas in the atmosphere, contributing to dangerous climate change.

Reducing the Impact

There are many ways in which we can reduce the impact of human activity. By planting trees, we replace the ones that have been cut down. We can also reduce our impact by recycling (using again) anything we might normally throw away.

Conservation

The destruction of habitats has left many species of plant and animal endangered. This means that they are close to becoming extinct. Scientists and conservationists study how these species live and grow to see how they can be saved from extinction.

PRINCIPAL AREAS OF SCIENCE

Science can be split into three main areas: (1) Material science, (2) Physical science, and (3) Life science.

Amazing Science Facts

Most Common Elements

- In the Universe:
Hydrogen – 75%
Helium – 23%
Other elements – 2%
- In Earth's crust:
Oxygen – 47%
Silicon – 28%
Aluminium – 8%
Iron – 5%
Calcium – 4%
Sodium – 3%
Potassium – 3% Magnesium – 2%
- In the human body:
Oxygen – 61 %
Carbon – 23%
Hydrogen – 10%
Other elements – 6%

Rarest Element

- The rarest element naturally occurring on Earth is francium. Only about 25 g (1 oz) of francium exists on Earth at any one time. It is highly radioactive, and turns into other elements just minutes after it has formed.

Massive Molecules

- The largest man-made molecule, PG5, is made up of thousands of carbon, hydrogen, and oxygen atoms bonded together. One molecule of PG5 has the same mass as 200 million hydrogen atoms.
- The largest molecules found in space are made of 60 carbon atoms joined together in patterns of hexagons and pentagons, like a football.
- One strand of DNA, the molecule that contains the code for life, can contain as many as 220 million pairs of instructions.

Speed Records

- The fastest-moving stuff in the Universe is light. A particle of light, called a photon, travels 299,792,458 m (983,571,056 ft) every second.
- The fastest animal is the peregrine falcon, which reaches speeds of 325 kph (200 mph) when it dives on its prey.

1. Material Science

Materials science looks at what materials are made of how, how they react with each other, how they can be combined to form new materials, and what uses they can be put to. Chemists often carry out research to create useful things rather than simply to learn about the world.

2. Physical Science

Scientists who study forces, energy, and how they interact, try to answer some big questions. How was the universe formed? What are the forces that held it together? Where does energy come from? What is light made of?

3. Life Science

Life scientists study all living things such as bacteria, fungi, plants and animals. They observe how organisms live, what they eat, how their bodies work, and how they would together to form different ecosystems.

SCIENTIFIC LAWS

Scientists discover laws that explain the world around us. They do this by making observations and then coming up with predictions or hypotheses, for how they think things work. They then test these hypotheses in experiments to see if they fit the evidence. If the test proves an hypothesis this becomes a scientific law.

EARLY SCIENTIFIC ADVANCES

Some scientific breakthroughs have changed the course of history. Inventions such as the wheel, penicillin, and the World Wide Web have transformed people's lives, while the development of theories on the laws of motion and natural selection have helped build our understanding of the Universe.

Inventions and Theories

An invention is something that humans have created, which did not exist before. But scientists do not just come up with new inventions, they also develop new ways of thinking about how the world works.

Invention of the Wheel

Invented in Mesopotamia, the first wheels were used as potters wheels, and were later attached to vehicles for transport.

The Iron Age

A new method was discovered to extract iron from iron ore through smelting (heating with carbon). Iron tools were harder and sharper than the bronze and stone tools of previous ages.

Agriculture

The development of farming in Mesopotamia allowed people to settle in permanent communities for the first time. This led to the development of large towns, such as Babylon.

The Age of Steam

Steam engines could perform much more work than animals. They were used to power everything from factory machinery to trains and helped kick-start the Industrial Revolution.

Invention of Paper

The Chinese produced the first paper from a mixture of tree bark, plant fibres, and rags mixed to a pulp and then squeezed flat.

Invention of Printing

Johannes Gutenberg invented a new printing process using movable metal letters, which made the mass production of books and newspapers possible.

Invention of Gunpowder

China was also responsible for gunpowder, an explosive mixture of sulphur, charcoal, and potassium nitrate, which they used in fireworks and firearms.

The Laws of Motion

One of the leading scientists of his day, Sir Isaac Newton devised important theories explaining how gravity works and how things move.

Discovery of Polonium and Radium

The French-Polish physicist Marie Curie discovered the radioactive elements polonium and radium. Her work on radioactivity paved the way for a new understanding of atoms.

- The fastest land animal is the cheetah, which can run at 114 kph (71 mph).
- The fastest fish is the sailfish, which can swim at 110 kph (68 mph).
- The fastest unpowered human was skydiver Felix Baumgartner who, on 14 October 2012, reached a top speed of 1,342 kph (834 mph) when he jumped from a high-altitude balloon. He was the first human to travel faster than the speed of sound without a powered vehicle.
- The fastest manned aircraft was the Lockheed SR-71 Blackbird, which was clocked at 3,530 kph (2,193 mph). Spacecraft are even faster—the Space Shuttles have travelled at 28,000 kph (17,400 mph) when orbiting Earth.
- The fastest passenger train is the JR-Maglev, an experimental Japanese train that has reached a top speed of 581 kph (361 mph) in test runs.
- The fastest unmanned train is a rocket sled. Powered by rockets, these can slide along rails at more than 10,000 kph (6,200 mph).
- The water speed record is 511 kph (317 mph). The record was set in 1978 by Ben Warby in a specially designed boat called Spirit of Australia.

Energy Matters

- The largest power station in the world is the hydroelectric power station at Three Gorges Dam in China. It produces enough electricity to power an area the size of the Netherlands.
- The largest solar power station is Nevada Solar One in the Mojave Desert, USA. It covers an area of more than 162 hectares (400 acres).
- A single bolt of lightning contains 5 billion joules of energy. If you could find a way to harness that energy, it would power a house for more than a month.
- Just 5 per cent of the energy used by an incandescent light bulb is used to make light. The other 95 per cent produces heat. Energy-saving light bulbs are four times more efficient.
- The world's strongest magnet is an electromagnet made by the Florida State University. It is 500,000 times stronger than Earth's magnetic field.

NATURAL HISTORY FACTS

Oldest Life

- The oldest living thing on Earth is the giant seagrass that grows in the Mediterranean Sea. Some of it may be 200,000 years old.
- The longest-lived animal is the clam,