CONTENTS

SCIENTISTS BIOLOGY

By Harry Jivenmukta

ARISTOTLE

Aristotle was born in Stagira, on the north-eastern edge of the Aegean Sea, in 384BC. His father was well known, and became the official physician to King Amyntas III of Macedonia. When he was seventeen, Aristotle went to Athens to study under Plato. He stayed with Plato for twenty years, but left just after Plato's death, very angry that he had not been chosen to take Plato's place as head of the Academy.

Aristotle crossed the Aegean Sea and set up his own school in Assos, in Troad. Three years later he moved to the island of Lesbos where he began his great work on the classification of matter.

He looked at 'change' and said that all change was either natural or mechanical.

For instance - an acorn grows into an oak tree, this is natural change

an acorn, chewed and digested by a pig undergoes mechanical change.

Late in 343BC, or early 342 BC, King Philip II asked Aristotle to become tutor to his son, the future Alexander the Great. He stayed with Alexander until Alexander died, then he moved to Chalcis in Euboea. Aristotle died of an acute stomach illness, possibly appendicitis, the following year in 321BC.

Aristotle's main interest was in the nature of matter, change, movement and classification. He believed that all matter was made up of one of the four elements, air, water, light and fire, two of which were 'light' and two were 'heavy' elements.

Activity: Looking at matter like Aristotle did

1. Choose any life form, plant insect or animal.
2. Find out how it changes from its beginning to death, (natural change).
3. Think about and record all the ways it could be usefully changed. (mechanical change)
4. Observe and record any natural movement.
5. How does it obtain and utilise nourishment (food)?
6. How does it fit into the environment? What is its habitat?
7. How hard does it have to struggle to exist? Has it any enemies or allies?
8. How does it die, or how is it destroyed?

Write a sentence or two about the differences in this type of study from the usual type of 'life-history' undertaken.

HARVEY 1578-1657

2

William Harvey was born in Folkestone. He was the eldest of nine children. His father was a well-known business man and had been the mayor. William was a clever boy, doing well at the King's School in Canterbury and going to Gonville and Caius College in Cambridge when he was sixteen. He became very ill, probably with malaria, and took a long time to recover. Eventually, he went to Padua, in Italy, to study medicine.

William's first job was at St. Bartholomew's Hospital where he earned £39 per year and had to pay for his own clinical coats and instruments! He worked hard and became well known. He even found some time for his own research. He watched the heart beating inside frogs and live fish, then intrigued, he cut up a human heart and found that it had hollow compartments. From this and the use of mathematics to calculate the flow and quantity of blood, he deduced that the blood must circulate round the body with the heart acting as the pump to maintain the flow at a steady rate.

In 1618, William became the official doctor to King James I. He soon grew to be a staunch friend of both James I and Charles I. He also helped to clear the name of the Duke of Buckingham who had been accused of trying to poison the king. These friendships were very dangerous to him during the Civil War. On one occasion, he looked after the two sons of the king as they watched the Battle of Edgehill being fought below them.

After the war, Cromwell put Harvey under house arrest and destroyed all his instruments and research projects. They harassed him so much that it became unsafe for him. Finally, he was allowed to go and live with his brother in the country. There he became ill with gout and kidney stones which made him very irritable from the pain. He died from a stroke in 1657. Sadly, all his notes and priceless manuscripts were destroyed in the Fire of London in 1666.

Activity: Circulation of the Blood

1. Find and measure your own pulse rate while at rest, or resting.

2. Check it again after some vigorous activity. What did you find? Record the difference.

3. Try again after, 5, 10, 15, and 20 minutes. How long did your heart take to resume its normal pace?

4. Watch the heart of a fish (the almost transparent kind) and a frog. Compare the two heart rates. Are their rates the same as yours? Why do you think this so?

5. Draw a body-map to show the main pressure points. (places where an artery passes over bone near the skin's surface and are easily felt).

RAY 1627-1705

3

John Ray was the son of a village blacksmith. He was born in Black Notley, near Braintree. He went to the village school where he learned enough to allow him to pass the exams to get into Braintree Grammar School. From the Grammar school he went to Trinity College in Cambridge.

Oliver Cromwell also came from East Anglia (Huntingdon and Ely) and John Ray became one of his most ardent supporters.

In 1660, John Ray became a minister in a non-conformist, puritan church. Apart from his pastoral duties, John was also able to spend time on his research on the plants which grew around the city of Cambridge. By 1662, four years after the death of Cromwell, the authorities demanded that all clergy signed the 'thirty-nine articles of faith'. John Ray as a puritan, refused to do this. He was dismissed and forced to leave Cambridge.

From this time onwards, John Ray worked as a naturalist, studying and classifying the animals and plants that he observed in his travels around the British Isles. On his travels he had a companion named Willoughby, a much richer man who funded their journeys. Eventually the information they amassed was so vast that they decided that Ray would be responsible for the plants and Willoughby, the animals.

When Willoughby died two years later, he left most of his work to be finished by John Ray, but only a very small pension for him. Ray was forced to return to his village and cut short his research. However, he still managed to find out about monocotyledons and dicotyledons, as well as the relationship between butterflies and caterpillars.

John Ray, in his observation of fossils, was the forerunner of Darwin. Against all the teachings of the Church, he couldn't believe that everything was perfect and unchanging. If this was so then there wouldn't be such things as fossils. He wrote up all his observations and spent years classifying them. He died in 1705 after suffering stomach and leg ulcers for fifteen years.

Activity: Observations

1. Make a vivarium, a large, clear plastic box will do.
2. Obtain some butterfly, or silkworm eggs.
3. Remember to feed them.
4. Watch them develop and record all your observations.
5. Note the stages and the time lapses.
6. Illustrate your work, label your drawings and remember to record the date and time accurately.

LEEUWENHOEK 1652-1723

4

Anton van Leeuwenhoek was the son of a poor man who found it a struggle to keep his son at school. While he was still young, Anton had to leave school and go to work in a draper's shop to help support his family.

However, being clever, he saved his employer a lot of trouble by using a magnifying glass to find flaws in the weave of the material before it was sold. He worked hard and saved enough money to buy his own shop by the time he was twenty-one.

In his spare time, Anton examined everything that he could through his magnifying glass, but he found that he had a huge problem. It was very difficult to see anything properly for any length of time through a hand-held glass that wasn't steady. By fixing the magnifying glass between two pieces of metal, Anton had produced the first, very primitive, microscope.

He looked at everything, even at the plaque that he scraped off from behind his teeth. He looked at a drop of water from a plant pot and was delighted to see tiny creatures swimming about in it. He called these creatures, 'beasties' and searched for more from different sources.

He also discovered that blood was made up of several different types of cells. The son of a poor draper, and a shopkeeper himself, had made some important discoveries through his own curiosity.

Activity.

1. Collect a small sample of slightly muddy water.
2. Use a pipette, or medicine dropper, to place a drop of the water on to a clean glass slide.
3. Lower a cover slip on to the droplet carefully, (start at one end and lower slowly, squeezing out the air as you go).
4. Examine the droplet under a microscope. Search for beasties.
5. Draw and describe what you can see.

LINNAEUS 1707-1778

5

Carl Linnaeus was the son of a curate. He was born in Rashult, in Sweden. The family was poor but they managed. There was no money for entertainment so Carl would wander in the fields and meadows near his home. By the time he was eight years old, the rest of his family called him the 'little botanist'.

When he was older, he managed to attend university where he studied medicine, but he left this to study botany instead.

He was such a good student that when he had completed his degree, he was asked to go to Lapland and study the plants and animals. Two years later, he returned and published all his observations.

This and other expeditions made him famous. He became a professor of Botany at Uppsala University in 1741.

Besides teaching, he wrote many books on plants and began the monumental task of classifying all the known species of plants.

The system he devised has been used throughout the world and up into modern times. The only reason why it is inadequate is because it is not complex enough to cover all the new species.

In 1761, Carl was awarded the equivalent of an English Knighthood. He went on teaching until 1774 when he suffered a severe apoplectic fit which left him an invalid. He died four years later, in 1778.

Activity. Classifying

1. You will need two different types of flowering plants (angiosperms)

2. In your book or on paper, make two columns.

3. Write down every observation you can make about your plants. Try: colour, number and arrangement of petals, scent, size, sepals, leaves, rough, smooth, Fibonacci sequence, stem, length, and anything else.

4. Draw your plant as accurately as you can.

5. Systematically, very gently, pull your plants apart and list all their similarities and differences.

6. Draw the inner parts of the plants as you find them. Label your drawings.

7. Summarise the similarities and differences in your plants. Describe both your plants as accurately as you can from your notes.

JENNER 1749-1823

6

Edward Jenner was the son of a clergyman. He was born in Gloucestershire, in the town of Berkeley. When he was five, Edward's father died and Edward was sent to live with his older brother. He went to the local Grammar school, but when he was thirteen, he was apprenticed to the local doctor to study medicine. He went to London to finish his studies at St. George's Hospital. Apart from medicine, Edward enjoyed finding biological specimens, listing them and publishing papers on them.

In his day, the most dreaded disease was smallpox. The disease was caused by a bacteria that is spread from person to person with alarming speed. The body develops terrible spots which grow deep into the dermis layers, leaving any survivor with terrible scars. Many thousands used to die of smallpox every year.

One day a Lady Montague witnessed an extraordinary event at a party. She saw an old woman stick a needle which had been dipped in smallpox pus into a person's arm. The victim suffered a mild dose of smallpox, but recovered. However, many did not recover and this practice was frowned on by most doctors. Then Edward Jenner remembered something that he had seen as a younger man. During an epidemic of smallpox, a young milkmaid proudly boasted that she would never catch the smallpox. Investigating further, Edward found out that she had been infected with cowpox, a similar disease but not deadly, from a sore on a cow's udder.

Remembering this, Edward asked local farmers if they had ever seen milkmaids catch smallpox. They answered, "No they hadn't".

Coming across another milkmaid, Edward started his experiments. Then, when he was ready, he took the huge risk of injecting a seven year old boy with serum from cowpox, followed six weeks later with an injection of smallpox. The waiting time began. Luckily, the boy did not develop smallpox and all was well. Edward publicised his results and his technique developed into the vaccination we know today.

Jenner never became rich; he never charged his patients for vaccination, but the government gave him a pension which was sufficient. He retired in 1815 when his wife died of tuberculosis. He died eight years later in 1823.

Activity: Inoculation and vaccination

1. Find out which diseases are now prevented by inoculation.

2. Find out when these inoculations are given and how often. (Try your local doctor's surgery for a leaflet).

3. Ask your parents to give you details of your own inoculations

4. In this connection, what does the word 'booster' mean? Do you need any boosters at the moment, if so, which ones?

5. Find out all you can about how infectious diseases can be spread from person to person.

6. Find out what 'incubation' means and have a class discussion on air travel. What can be done about it?

HUMBOLDT 1769-1859

7

Friedrich Wilhelm Heinrich Alexander Humboldt, the son of an officer in the army of Frederick the Great of Prussia, was born in Berlin. His mother was a French Hugenot (Protestant) whose family had fled from France after Louis XIV had revoked the laws of toleration. Alexander's mother, a rigid Calvinist, had Alexander educated by very strict tutors at home.

Alexander was a sickly little boy and a poor student. He often had to be forced by his mother to complete his lessons. After his early years, he failed to learn economics at university, so he was sent to Berlin to study engineering. Here he discovered biology! He threw himself into the study of every living thing in his environment. First, he classified all the wild plants he found around the university and further afield. He finished with engineering and went to the University of Gottingen were the known sciences were taught. His engineering wasn't totally wasted because his main studies were in geology and mineralogy. After Gottingen, he went for extra training to the School of Mines.

Alexander's first job was with the Government of Prussia Mines Dept. where he was expected to inspect all the mines in the country. This gave him splendid opportunities for travel and exploration of environments. He was concerned for the welfare of the miners and invented a type of safety lamp for them. However, none of this was enough. He wanted to participate in proper scientific exploration. He had the funds after both his parents had died and it was a only a matter of where and when.

His high aristocratic standing gave him entrance to many in high places. Eventually, after considerable effort, he managed to persuade the Spanish Government to allow him to explore the Spanish lands in Central and South America.

In 1799, he with Aime Bonpland, a friend and botanist from Paris, set sail for South America. They spent the next five years in exploration, writing their observations and having several adventures. They climbed mountains with none of the modern aids and learned much that would help mountaineers in the future. They saw hundreds of unknown species of plants, animals and insects.

On their return, they lived in Paris writing up their notes, giving lectures, publishing accounts of all they had done and seen. Life was easy and enjoyable, but eventually the money ran out. The King of Prussia demanded that Humboldt should return to Berlin where he tutored the Crown Prince. Here he began work on KOSMOS, his huge set of scientific data. He was busy on the fifth volume when he died at ninety years old with all his faculties unimpaired.

Activity: Geology

1. You will need; small piece of granite, shale and sandstone, or other soft stone, equipment for heating and scratching.

2. Prepare your heat source with a small sand tray.

3. Examine your granite, note down all your observations.

4. Using tongs all the time. Heat your granite until it is extremely hot. (Usually takes a minute or two)

5. Now drop it into a small tin of cold water. Allow it to cool thoroughly.

6. Remove it from the water and examine it carefully. Describe your observations and any changes.

7. Take a piece of soft rock and test how easy it is to scratch, or scrape it.

8. Soak the soft rock in water for several hours, then remove it and test for scratchability again. Note down differences.

9. Formulate a hypothesis about the affects of weather on different rocks.

LYELL 1797-1875

9

Lyell was the eldest of ten children. He was born in Forfar in Scotland. His father was a bookish man, a naturalist and well off. He moved his family to the New Forest to give himself greater opportunities to study the wildlife. Little is known of Charles' early life except that his father coached him into getting a place at university.

At university, Charles was influenced by William Buckland, a famous fossil collector of that time. During his vacations, Charles roamed the countryside seeking geological specimens. He observed the rocks and land formations and wrote copious notes on everything he saw.

After getting his first degree, Charles went to London to study law, but he suffered terrible eyestrain trying to pore over his books in poor light. He gave up law and returned to the countryside to continue studying what is now known as geology. He did eventually finish his law degree but rarely practised.

He married his childhood sweetheart, and together they travelled far and wide in search of new specimens. At one time he climbed Mount Etna in Sicily on the back of a donkey to prove that the mountain had been built up by a series of eruptions and had not been like it was for eons in an unchanging world. He followed Ray's thinking about the world and everything perpetually changing.

He wrote and published all his theories and observations which made him famous. He was one of the commissioners for the Great Exhibition of 1851. He was very unhappy when his wife died in 1873, and lasted only two more years before he too died. He was buried in Westminster Abbey.

Activity: Land observation

1. Make a contour map of your local area.

2. Sketch a profile of the highest ground in your area, use your house as the central point.

3. Try to find out about the geological structure of the high ground in your profile - try school and community libraries, council offices and estate agents for information.

4. Label your contour map, and your profile with any information you gain.

5. Compare your findings with the findings of other members of your class.

6. Collect as many different types of stones and small rocks as you can find in your area. Classify them by listing them or charting them.

AGASSIZ 1807-1873

10

Jean Louis Rodolphe Agassiz was born in the village of Motier, on the shores of Lake Morat, in Switzerland. His father was the pastor of the Protestant Church. They weren't a wealthy family so Jean Louis went to the local village school. He worked hard and went to a secondary school, called a 'gymnasium' before getting into university. With no television, or money to spend on entertainment, Jean Louis spent all his spare time exploring along the shores of the lake beside his home. He learned about the fish as well as the plants along the edge.

He planned to become a doctor, but he later changed his studies to icthyology, or the study of fish. He also began to study the glaciers in the mountains of his country. He became so well known that he was invited to America to give a series of lectures. Later, both he and his wife explored in Brazil and wrote up their experiences. After his return he undertook some research at Harvard University in America.

Jean Louis maintained that students of any type of natural history, zoology and biology should learn from practical experience and not just from books. In spite of his work and experience, Jean Louis did not believe in a changing or developing world like Ray, Lyell and Darwin. He believed in a 'Supreme Being', a pre-ordained world and that any change was only due to the intervention of this Supreme Being.

Jean Louis died at his home in Cambridge, Massachusetts, USA when he was only sixty-six years old.

Activity: Dissection of Fish

Like Agassiz, it is fun to find out by examining something carefully.

1. Catch, or obtain a small complete fish from your fish-shop.

2. Measure your fish from nose to tail and around its girth.

3. Describe your fish, note its colour, scales, eyes, mouth, fins, shape and anything else that is notable.

4. Working on a board and using a sharp knife very carefully, slice along one edge of the fish and open it up. (Cut lengthwise)

5. Try to identify the internal organs. Make sketches of the different organs.

6. Cut into the various organs and note down what you find. Try the eye and see what you find. If you have access to a fish tank: Observe and note down the behaviour of the fish.

DARWIN 1809-1873

Charles Robert Darwin came from a well known family. His grandfathers were Josiah Wedgewood the pottery manufacturer and Erasmus Darwin, the inventor, poet, philosopher and physician. Even with this background, Charles was not a good boy. He refused to stay in with a tutor, but roamed the countryside getting into mischief wherever he went. He explored everywhere and then went home to tell about his exploits to his parents. His parents never understood him and called him a "dreadful liar". Later, he went to Shrewsbury Grammar school where he failed to learn Latin and Greek. His teachers called him a dunce and his parents called him a dunce and a liar! His father said that he was a "disgrace to the family". Charles was sent to Edinburgh to study medicine, but he hated it. He began to wander along the banks of the River Forth instead of attending 'boring' lectures.

Eventually Charles changed from medicine to zoology where he was much happier. He made friends with many local people and he learned the techniques of taxidermy (stuffing and preserving skins of dead animals) from a Negro taxidermist in the vicinity.

After many arguments and rows with his family, who wanted him to enter the Church, Charles entered the Navy as a naturalist. His first trip was to Patagonia, Chile and Peru. Charles was in his element. He explored and took notes and specimens on every possible occasion.

It was after a visit to the Galapagos Islands that Charles began to develop the thesis that was to make him famous.

He maintained that all creatures developed according to their situation. That the world and all the creatures and plants developed and changed as time passed. He wrote his theory in a famous book called 'The Origin of Species'. Many people were horrified. People were developed from apes, the world and creatures were changing? Never! God created the world and Darwin's theory was blasphemy. Thus began one of the world's greatest arguments. Many people still deny his Theory of Evolution, and believe in the unchanging world of the Bible.

Charles, still arguing, suffered a heart attack in 1873 and died soon afterwards. He is buried in Westminster Abbey.

Activity: Observation; the key to all of Darwin's work.

1. Choose any living thing, creature or plant.

2. Observe it for as long as you can manage every day for at least three months. Think of it as a long project.

3. Write down everything you notice, however insignificant. Illustrate your notes with sketches and charts.

4. From your notes, can you deduce any pattern or signs of change? Record them.

5. Hypothesise on reasons for any pattern or occurrence that have been noted.

6. Write up all you notes and sketches and present your work to the rest of the class.

MENDEL 1822-1884

Johann (Gregor) Mendel was born in Heinzendorf, in Austria. His father was a poor, but hard-working farmer. Johann had to help his father from a very early age. Johann went to the local school, but he was too poor to be able to go to university. However, when he was nineteen, he did manage to spend some time studying in Olomouc, in Czechoslovakia. He could only stay for two years, then he had to go into the Church if he wanted to go on studying, or he would have to return to the farm. Johann chose the Church. When he was ordained, he changed his name to Gregor.

He was sent to a secondary school as a substitute teacher. A year later, he failed his exams to become a properly qualified teacher. His worst marks were in Biology and Geology. His tutors said that he lacked insight and enough knowledge.

Luckily, his Abbot had faith in him and he was sent to Vienna to study. He also had to teach in the local school when he wasn't studying. He stayed in Vienna for fourteen years and still never managed to pass his exams!

In 1868, he was appointed as the new Abbot of his old monastery. He built himself a small vegetable garden inside the Abbey grounds and continued working on experiments begun in Vienna.

Following his experiments using sweet-pea plants, Gregor wrote his Theory of Genetics in which he claimed that 'genes' were passed down from plant to plant and that the ratio of their re-occurrence followed a set series. He said that some genes were 'dominant' and some were 'recessive' or less likely to recur.

He published his results in 1865, but no-one recognised their importance. His papers were left to gather dust for over thirty years. Gregor died, tired and forgotten in 1884.

Activity: Genetics

1. Research your own family's external, or visible characteristics.

2 .If you are able to, ask your grandparents about their parents. Find out such things as eye-colour, hair-colour, height, physique, sight, and ears (attached lobes), type of nose and any other items you can think of.

3. Chart your information. How often does each trait occur?

4. Do the different traits appear more in boys than in girls?

5. Plot any unusual trait through the generations on your chart. How often does it occur? Is it occurring more often girls or boys?

6. How many dominant genes, or recessive genes can you find in your family's chart?

Refer to appendix 1.

FABRE 1823-1915

13

Jean Henri Fabre, the insect man, was born in the French village of St. Leon, in the Haute Provence. His parents were very poor peasants who tried to feed their family from a tiny plot of land. Jean Henri was sent to the village school, but being a poor scholar, he hated it. He was a dreamer who was lost to anything his teachers might say.

One day, his father decided that a few ducks might help the family to survive, but he needed someone to look after them. Jean Henri left school and became a 'duck-boy'. He took the ducks up the nearby hill every morning and while they scrabbled about and swam in a small pool, Jean Henri explored and observed everything around him. In the evening, he took the ducks home again. He loved this period of his life.

When he was twelve, his parents thought that they might be better off in the town. The ducks and land were sold and they bought a small cafe with the money. This didn't prosper either, but at least it was easier for Jean Henri to go to school. This didn't last long, the cafe was sold and they were on the move again so Jean Henri never went to school regularly, but often sold fruit in the market, or worked on the railways to help out. However, he must have found time to study because he won a scholarship to the local teacher's training college when he was eighteen.

He worked hard as a teacher until he became very ill with malaria. While he was recovering, he began his study of insects. He published his work on the hunting wasp in 1855. Then needing money to support his own family, he sent two papers on centipedes and millipedes to the university. The university awarded him an honorary degree, but they never really helped him because he had never had a proper education and achieved the right qualifications.

For the rest of his life, he studied and wrote about insects, struggled against ill health and battled the authorities for recognition.

Eventually, he was given a small pension which allowed him the peace to study in his old age. As his work began to be recognised and valued, he grew famous throughout the world. Jean Henri died in 1915 when he was almost ninety-two years old.

Activity: Classification of insects

1. Choose at least two different types of insect from your environment. Catch them and place them in clear jars for observation.

2. Draw a chart in your book and use the information in the appendix to classify each of your insects.

3. Write up what you have done and any observations that you have recorded.

4. Sketch your insects and add the drawings to your finished piece of research.

Refer to appendix 2

HUXLEY 1825-1895

Thomas Huxley, the son of a schoolmaster, was born in Ealing, London. He was one of eight children. He went to the same school as his father, who taught mathematics. He wasn't popular. He was always arguing and he was very quick to start fighting with the other pupils. After two years, his father lost his job and returned home. Thomas went home too and it is thought that his father taught him rather than send him to another school.

At fourteen, Thomas was apprenticed to a local doctor to study medicine. A year later, he won a scholarship to finish his studies at the Charing Cross Hospital Medical School. He won prizes for excellence, but by the time he was twenty-one, he had still failed to qualify and his scholarship ceased. He needed a job.

He obtained the position of 'assistant surgeon' on a cockroach-infested frigate which was bound for exploration in the southern seas. He knew it was a rotten job, but determined to make the best of it, he fitted a microscope to the side of the ship and used it to examine the marine-life that he caught during his four years at sea. Every time he reached another port, he sent his notes and observations back for publication by the Royal Society, or the Royal Institute. He became famous before he even arrived back in England.

The Navy was so impressed with him that they gave him three years leave on full pay to continue his studies. He worked on molluscs, squid, fossils, and animal behaviour. When they wanted Thomas to return to Naval duties, he avoided it with one excuse after another, so the Navy discharged him. From that time he held several different jobs which gave him enough money to continue with his naturalist interests. Perhaps his most important achievement was his classification of birds into different species and families. He made many friends and several enemies. His support of Darwin and the 'Evolution of Species' against the establishment didn't help.

When he was sixty, he retired to Eastbourne, but continued his work as a naturalist. In 1889, he caught a bout of summer influenza, which worsened into bronchitis. He died from this infection and was buried in Finchley, in North London.

Activity: Classification of Birds

1. Try to classify the birds that you can find and observe in your own environment.
2. Use the list in the appendix to help you.
3. Use a bird identification manual to identify your birds.

Refer to appendix 3

LISTER 1827-1912

15

Joseph Lister was born in Upton, in Essex. His father was a wine merchant who liked to dabble in physics and microscopy. Joseph, from a very early age, was involved in his father's experiments. The Listers were Quakers and Joseph was sent to a Quaker school which had a reputation for teaching science as well as Latin and Greek. At school, Joseph found that his main interest was in the anatomical structure of animals. He dissected dead rats and frogs to find their differences and similarities, and by the time he was sixteen he had decided that he would become a surgeon.

Joseph did so well in his studies and in his early career that he became the Regius Professor of Surgery at Glasgow University when he was only thirty-two years old.

In those days, people dreaded surgery. Surgeons rushed around in aprons covered in blood, the more the better. They boasted of how many amputations they could perform in a day, regardless of the number that died. Hospital wards reeked of rotting flesh and nurses struggled to look after dying patients with some semblance of dignity. Many surgeons cauterised, or burned the wounds, in attempt to stop infection, but it rarely worked. They said it was caused by miasma, or bad air, and they were powerless to prevent it. Joseph thought differently.

At first Joseph said it was caused by dust, and while not completely wrong, he came to believe that it was due to the 'bacteria' recently publicised by Louis Pasteur. Determined to try out his theory, he had the operating theatre, tables, floors and walls scrubbed with a solution of carbolic acid. His instruments were soaked in carbolic, he and his nurses scrubbed their hands in it and wore clean aprons before carrying out the operation. The other surgeons laughed at his efforts and ridiculed the small number of patients that he completed in a day, but Lister persevered.

Joseph's results were immediate, the death rate on his wards dropped to fifteen per cent compared with the 70-80 per cent on the other wards. Many other surgeons refused to listen to him, but some began to follow his ideas with success.

Eventually Joseph moved to London, to King's College Hospital, where he successfully performed operations that would have meant certain death by the old dirty methods. He was awarded a baronetcy in 1877, and retired in 1893 as his sight and hearing were failing. He died in Walmer in Kent in 1912. He had saved thousands from a miserable death.

Activity: Experiment with antiseptics

1. Next time you go to a supermarket, list all the different brands of antiseptics on sale.

2. Ask your parent which one they prefer to use and why.

3. Working in a group, list the different claims made by the manufacturers. Compare the different claims.

4. Note and list the different ingredients of each brand.

5. Ask the class to bring small samples of the different brands to class.

6. Prepare enough petri dishes, one for each sample and one control.

7. Skim the agar in the petri dishes with a scrape of rotting cooked potato or apple.

8. Leave for a day or two until growth of bacteria is obvious.

9. Using a wire-ring dropper, or pipette, drop a minute quantity of a disinfectant on each dish except one (control). Use a different sample for each one. Leave for a day or two.

10. Assess the results of the action on the bacteria by the different disinfectants.

ROSS 1857-1932

Ronald Ross was born in Almora in India. Until he was eight years old, he was looked after by an amah, an Indian nursery nurse. Then like most English children in India, he was sent back to England to go to boarding school. He did well at school and showed a talent for music, poetry, drawing and painting.

Ross' father wanted Ross to become a doctor, and English boys of that time, did as they were told. He trained at St. Bartholomew's Hospital in London before returning to India as a doctor in the Medical Service. His main concern as a doctor was the terrible scourge of the disease known as malaria which killed thousands every year. In order to find out more about it, he returned to London to study bacteriology. Here he came across the work of Lavaran, a French doctor working in Algeria who discovered tiny black specs in blood cells of malaria victims.

Ross bought a microscope and returned to India. He thought that the most likely carrier of Laveran's black specs was the mosquito. He spent, hours, weeks, months, even years trying to prove his theory. Late one night, five years after his return to India, he had a dapple-winged mosquito under the lens. He peered for a long time and was just about to give up when he saw a 'very delicate circular cell' which was different from the others surrounding it. He had made the connection from the mosquito to the disease, but he still didn't understand the process.

Examining the mouthparts of this and other mosquitoes, he discovered some spores at the base of the probiscus. He hypothesised that these bacteria spores were able to survive between feeds and were transported from person to person by the mosquito. Ross found only found these spores on the anopheles mosquito. He confirmed his results by dissecting and examining sparrows which he knew suffered from malaria in the same way as humans.

In the course of his studies he discovered much helpful knowledge on many other tropical diseases. He also founded the Institute for Tropical Diseases in London.

Activity.

1. Copy the drawing of the mouthparts of the mosquito into your book.

2. Catch the next mosquito you hear buzzing around you and place it in a petri, or clear magnifying covered container. Examine it and record your observations. Draw a sketch.

3. Research mosquitoes; food, habitat, life-span, reproduction, particular habits of female, and the diseases they carry.

4. List and discuss all the preventative methods of preventing the spread of mosquitoes that you can.

FRISCH 1886-1982

Karl Ritter von Frisch was born in Vienna, in Austria. His parents were academics and financially comfortable. Karl did well at school, but preferred to rush home to look after his collection of pets. He was still at secondary school when he started publishing papers on natural history. After leaving school, he studied medicine at Vienna University. He didn't complete his degree, but went instead to the University of Munich to study zoology.

His experimental studies included work on sea anemones,and the ability of fish to see colours and hear sounds. During World War I, he worked in a military hospital and whenever there was a lull in the fighting, or the wards were quiet, he gave lectures to the nurses on bacteriology.

After several different appointments, Karl became Professor of Zoology in Munich in 1925. He stayed in Munich and suffered harassment when the Nazis came to power because his mother's grandmother was part Jewish. To survive, he kept a very low profile, working quietly during semesters and spending his holidays at his family home in Brunnwinkl.

It was at Brunnwinkl that he began his famous research into the behaviour of bees. He discovered that bees send out scouts to find food and that the scouts informed the other bees where to find food by dancing and positioning their bodies in the direction of the food. The faster the bee-scout danced the further away the food. During World War II, he lost his laboratory when Munich was bombed by the allies. He moved to Graz, but returned to Munich in 1950.

He retired in 1958 at the age of seventy-two. In 1973, he shared the Nobel Prize for medicine/physiology with Konrad Lorenz and Nickolas Tinbergen, two other scientists who were working on aspects of animal behaviour. He continued with his own private experiments until his death at ninety-six years old.

Activity: Animal Behaviour

Scientists, and especially naturalists of any kind, learn most of their knowledge from careful and meticulously recorded observations.

1. Choose a pet that you have access to for long periods. Fish, and birds can be fun and very interesting, but kittens, cats, dogs, hamsters, mice, tortoises and others can be equally rewarding. You have to be willing to sit and observe for long periods, five minutes here and there and you will miss the best activities!

2. Use the appendix as a guide.

3. Write up your observations and include photographs, sketches, charts and graphs wherever you can - you never know, it might get published one day. Some amazing studies have been produced by amateurs on such creatures as foxes, beavers, badgers, squirrels and many others, but try a pet first.

4. If you have a zoo, or sanctuary near your home, ask them if you can have free entry for your study, but remember to explain what you are doing very politely and ask for their guidance. People like to be involved and helpful.

LORENZ 1903-1989

Konrad Lorenz was born near Vienna. His father was a well known orthopaedic surgeon who specialised in helping children born with dislocated hip joints. Like many other young children, Konrad was fascinated by the wild creatures living in his environment. His home was like a menagerie, filled with birds, fish, beetles, dogs, frogs and worms.

When he was six years old he, and a little girl destined to become his wife, found some tiny ducklings that followed both children home as if the children were their parents. Neither of them ever forgot this episode.

As he grew, Konrad made many visits to a zoo nearby. Sometimes he was even asked to take some of the sick smaller animals home and care for them. After finishing secondary school, he went to America to study medicine at Columbia University in New York for one year before finishing his studies at home in Vienna. He never practised as a doctor, but went on to specialise in anatomy and take a second degree in zoology.

His studies included work on jackdaws, greylag geese and on response behaviour in birds. He was particularly interested in the responses of the newly hatched goslings. He discovered that tiny new-born hatchlings will latch on to the first stimulus they receive and treat it as a parent. He called this process imprinting.

During World War II he served in the army as a doctor and was sent to the Russian Front. He was captured by the Russians and 1944 and not released until 1948. He returned to Vienna and resumed his studies.

In 1973, he shared the Nobel Prize with Frisch and Tinbergen. Konrad's greatest strength as a naturalist was his ability to observe his subjects for many hours and notice minute differences in behaviour. He was also able to write up his observations in a way that was both learned and amusing and include delightful sketches in the text. His writing did much to help the layman understand the beauty and importance of every animal species and to encourage conservation whenever possible.

Activity: Conservation and Reading

1. Find out about any conservation projects being undertaken in your local area.

2. Discuss the advantages and disadvantages of these projects.

3. What is your personal point of view? Be prepared to advance supporting arguments.

4. Which world-wide conservation project has your support?

5. Make a block or bar graph to show the amount of class support for a variety of conservation projects.

6. Read Konrad's book, 'King Solomon's Ring', it is very amusing and full of great sketches. Lorenz, K., King Solomon's Ring, Methuen, London, 1952.

FOSSEY 1932-1985

Dian Fossey was born in America and did all the normal things that young girls in America do. She was particularly caring about the welfare of animals. After finishing school she went to college to become a vet. She didn't manage to finish this course and changed over to studying occupational therapy. Her first job was to help disabled children in Kentucky, but all the while her dream of going to work with animals in Africa never faded.

Dian had to borrow money to go to Africa, but there she went and started travelling to see as much as she could in the time she had. Part of her travels took her to the Olduvai Gorge, in Tanzania, where she met Dr. Louis Leakey and his wife, Mary.

Louis, thought her a bumbling tourist. She had tripped over, broken some of his fossils and broken her ankle! The accident forced Dian to stay with the Leakeys far longer than any of them had hoped, but this time enabled the Leakeys to revise their opinion of her.

When recovered, Dian went to the gorilla reserve in the Virunga Mountains. She was entranced. Here was where she wanted to be, but she had to return to America. Once back, she wrote about her experiences in the local paper and received some acclaim, but it wasn't until three years later and Dr. Leakey's lecture tour in America that she gained any hope of returning to her gorillas. Dr. Leakey wanted Dian to study gorillas in the same way as Jane Goodall had studied Chimpanzees. Money and support for the project and Dian returned to the Virunga Mountain reserve in 1969.

Dian now began the study that was to last nearly sixteen years. Her observation techniques, recording and writing up, bravery and ability to overcome difficulties were outstanding. However, she sometimes tended to be ill-tempered and didn't always manage to get along with people too well. She fought the authorities over the habitat and welfare of her beloved gorillas, and never ceased in her war against the poachers.

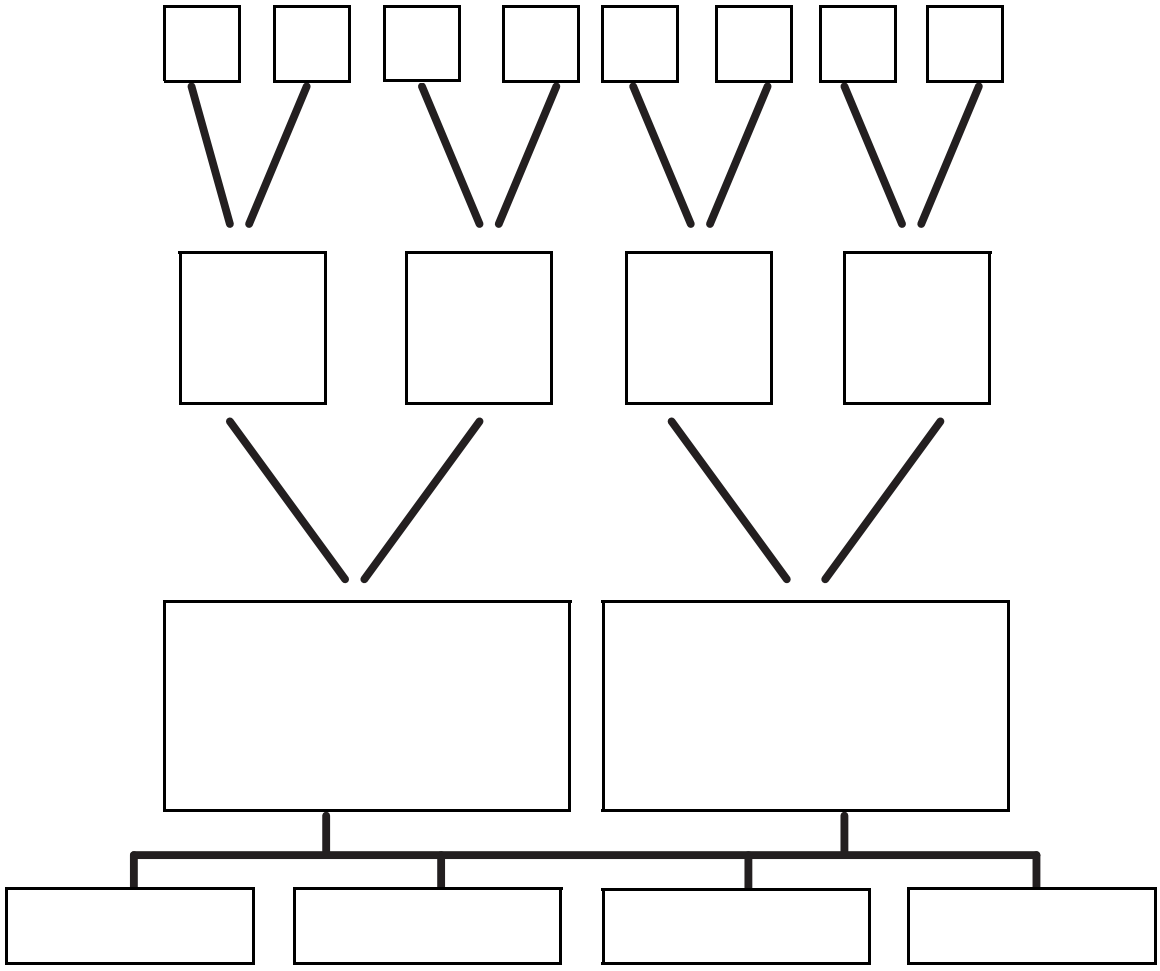
Her war against the poachers was to be her downfall. She was murdered, hacked to death by poachers on Christmas Eve, 1985. She is buried on the mountain with her animals in the gorilla cemetery. She lies there with thirteen of the gorillas she loved and cared for so well. Her contribution to the knowledge of the world on this terribly endangered species has been immense.

Activity: Read, View, Think and Discuss

1. Read the book by Dian Fossey, 'Gorillas in the Mist'. Do this first before viewing the film if possible.

2. View the film by the same name. Remember that the film has to suit huge audiences and so has been somewhat romanticised.

3. Have a class discussion on any of the following: a. the merits of the film and/versus the book. b. the contribution of Dian Fossey to science. c. women in science d. time spent in observation - is it worth it? e. poaching and conservation - why bother? f. prevention of extinction.



The top row of squares represent your great grandparents, the next row your grandparents and the two large boxes, your parents. The four small boxes represent you and any brothers or sisters you may have. Vary these boxes appropriately.

Investigate the genetic characteristics of your family and trace them back up the chain of the family tree. Consider the following characteristics and illnesses:

Hair Colour	Diabetes
Eye Colour	High Blood Pressure
Blood Group	Heart Disease
Skin Pigmentation	Asthma
Sight, (long, Short)	Other Illnesses Which Can Be Passed From Generation To Generation

CLASSIFICATION OF INSECTS

BODY	Short And Sturdy
	Long And Fragile
	Soft Or Hard
HEAD	Shape
	Size - In Relation To Body
ANTENNAE	Knobbed At Ends
	Hairy Or Smooth
	Saw Edged
	Short Or Long
EYES	Separate Or Touching
	Compound Or Simple
WINGS	Same Or Different Sizes
	Long And Narrow Or Short And Broad
	Few Or Many Veins
	Position At Rest
	Smooth Or Hairy
	Wingless
ABDOMEN	No Of Segments
	Hairy Or Smooth
	Soft Or Hard
	Pincers Or Sting
WINGCASES	Shorter Or Longer Than Body
MOUTHPARTS	Simple or With Long Probiscis
	Biting Mouthparts

CLASSIFICATION OF BIRDS

Classify birds in your environment using the following guides:

SIZE	
COLOURING	Single Or Multicoloured
SHAPE OF BEAK	And Type Of Food
TYPE OF CLAWS OR TALONS	And How These Are Used
NATURAL HABITAT	
MIGRATORY OR NOT	
SHAPE OF TAIL FEATHERS	Reason For This
NESTING HABITS	Do They Return To The Same Nest Each Year?
EGGS	Number, Size, Colour, Incubation Period
ENEMIES	How Do They Deal With These?
OTHER OBSERVATIONS	