



THE
FEARNHILL
SCIENTIST
YEAR 8

The Fearnhill scientist

“The important thing is not to stop questioning. Curiosity has its own reason for existence. One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvellous structure of reality. It is enough if one tries merely to comprehend a little of this mystery each day.” **Albert Einstein**

Getting better at science means knowing more science. We have developed an ambitious and wide-ranging curriculum designed to foster a love of learning science as well as a natural curiosity about the scientific world.

We have identified a collection of scientific facts and ideas that we think a student should know by the time they reach year 11. These form the Fearnhill scientist.

The knowledge contained within the Fearnhill scientist provides a solid grounding for taking the GCSE exams at the end of year 11. It also helps prepare our students for life after school ensuring that they are equipped with the knowledge needed to understand the modern world.

The Fearnhill scientist has been split into four editions. Each addition represents the knowledge that students should have learned by the end of each year.

This is the year 8 edition. It contains all the powerful knowledge we expect students to have learned by the end of year 8.

The Fearnhill scientist is split into 11 themes that match our teaching modules

The text in black is the list of knowledge learned in year 7.

The text in blue is the list of new knowledge from year 8.

CELLS

1. Animal cells contain the following structures:
 - a. Nucleus (contains the DNA / controls the cell)
 - b. Cell membrane (controls what can enter the cell)
 - c. Cytoplasm (jelly like site of chemical reactions)
 - d. Ribosomes (site of protein synthesis)
 - e. Mitochondria (site of respiration (releasing energy from food))
2. Plant cells contain the same structures but also three additional ones:
 - a. Chloroplast (site of photosynthesis)
 - b. Cell wall (supports the cell)
 - c. Permanent vacuole (stores cell sap)
3. Diffusion is the movement of particles from a region of high concentration to a region of low concentration
4. An electron microscope has much higher magnification and resolving power than a light microscope.
5. magnification = size of image / size of object
6. Respiration is a process whereby energy is released from food.
7. Eukaryotic cells have a cell membrane, cytoplasm, and genetic material enclosed in a nucleus.
8. Bacterial cells (prokaryotic cells) are much smaller in comparison and have cytoplasm and a cell membrane surrounded by a cell wall.
9. Diffusion sites in living things have adaptations to perform their function. For example, the alveoli:
 - a. Have thin walls;
 - b. Are ventilated with fresh oxygen by breathing;
 - c. Have a good blood flow to remove the diffused oxygen;
 - d. Have a large surface area.
10. Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane
11. Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient).

HUMAN BIOLOGY

12. The main structures of the male reproductive system are:

- a. Penis (delivers sperm into female)
- b. Testes (produce sperm)
- c. Glands (produces seminal fluid)
- d. Scrotum (skin sac that holds testicles)

13. The main features of the female reproductive system are:

- a. Vagina (muscular canal ending in the cervix)
- b. Uterus (where the baby develops)
- c. Ovary (produces the eggs)
- d. Fallopian tubes (delivers the egg to the uterus)
- e. Cervix (the neck of the uterus)

14. The male human gamete is the sperm cell.

15. The female human gamete is the egg cell.

16. Ovulation is the release of the egg from the ovary

17. Fertilisation occurs when the sperm cell fuses with the egg cell forming a zygote.

18. The role of the placenta is to bring the maternal and foetal blood close together without them mixing

19. Puberty is the name given to the series of physical and emotional changes that occur during adolescence

20. In males the main changes are:

- a. Sperm production begins.
- b. Pubic hair grows.
- c. Voice breaks.
- d. Growth spurt

21. In females the main changes are:

- a. Menstrual cycle starts.
- b. Breasts develop.
- c. Growth spurt
- d. Pubic hair grows

22. The menstrual cycle lasts approx. 28 days and includes the following events:

- a. Menstruation (period)- the loss of the uterine lining
- b. Ovulation- the release of an egg from the ovary

23. A tissue is a group of similar cells working together to perform a function.

24. An organ is a group of different tissues working together.

25. A collection of organs working together is an organ system

26. Joints are formed from the bones, cartilage and ligaments

27. Cartilage forms a cushion between bones in order to stop them rubbing

28. Ligaments are like very strong string that holds bones together

29. A balanced diet is formed from both macronutrients and micronutrients.

30. Macronutrients include:

- a. Fats to provide energy and insulation.
- b. Carbohydrates provide energy.
- c. Proteins for growth
- d. Water to keep hydrated and for cooling.
- e. Fibre to maintain healthy digestion.

31. Micronutrients include:

- a. Vitamins to keep our bodies healthy.
- b. Minerals to keep our bodies healthy.

32. Proteins can be tested for using biuret solution with a positive test producing a purple colour

33. Starch can be tested for using iodine with a positive test producing a black/blue colour

34. Sugars can be tested for by Benedict's reagent with a positive test producing a orange- red colour

35. A drug can be

- a. Recreational such as nicotine
- b. Medicinal such as paracetamol
- c. Illegal such as heroin or cocaine

36. Cigarette smoke contains a number of poisonous chemicals.

- a. Nicotine which is addictive and raises the heart rate
- b. Tar which can cause cancer (is a carcinogen)
- c. Carbon monoxide which reduces the blood's ability to transport oxygen

ENVIRONMENT

37. Classification is the process of grouping organisms which have similar characteristics
38. Vertebrates have spinal cords;
39. Photosynthesis is an endothermic reaction involving plants and algae absorbing light energy and using it to produce glucose.
40. Plants obtain their raw materials via:
 - a. stomata for carbon dioxide
 - b. roots for water and minerals
41. Leaves are broad to absorb maximum light; thin to provide a short diffusion distance for gases; contain veins for transporting substances and support; contain chloroplasts filled with chlorophyll which absorbs the light energy for PS
42. Food chain: Part of a food web, starting with a producer, ending with a top/apex predator.
43. Arrows represent the flow of energy through a food chain which decreases at each trophic level.
44. Producer: Green plant or algae that makes its own food using sunlight.
45. Consumer: Animal that eats other animals or plants. Food chains can contain primary, secondary, tertiary and quaternary consumers.
46. A predator is an animal that is adapted to eating other animals.
47. Prey are animals that are eaten by other animals
48. Organisms in a food web (decomposers, producers and consumers) depend on each other for nutrients. So, a change in one population leads to changes in others.
49. Ecosystem: The living things in a given area and their non-living environment
50. A pesticide is any chemical used to kill, repel, or control certain forms of plant or animal life that are considered to be pests
51. A gene is a short string of DNA that codes for a characteristic.
52. A chromosome is a long strand of DNA. It will usually contain many genes.
53. Genotype is the alleles an organism has.
54. Phenotype is the actual appearance or an organism.
55. Variation is the term given to the small differences that occur between individuals of the same species

56. This variation can be caused by the genes inherited from parents or can be caused by the environment we live in
57. Continuous variation can take any value on a scale for example weight, height, length of finger
58. Continuous variation is plotted on a line graph
59. Discontinuous variation takes specific values such as shoe size, blood group or ability to tongue roll
60. Discontinuous variation is usually plotted in a bar graph
61. Adaptations are features that help an animal or plant to survive in its habitat.
62. Animals compete for: food, water, space, mates.
63. Plants compete for: light, water, space, minerals, pollinators.

MATTER

64. In solids the particles are close together, in a regular pattern and vibrate on the spot.
65. In a liquid the particles are close together, are arranged randomly and move around each other.
66. In gases the particles are far apart, are randomly arranged and move quickly in all direction
67. Changes of state are reversible changes as they can be undone.
68. Melting is the process of turning a solid into a liquid.
69. Freezing is the process of turning a liquid into a solid
70. Boiling is the process of turning a liquid into a gas.
71. Condensing is the process of turning a gas into a liquid
72. Boiling requires an energy input - whereas evaporation is the release of the molecules with the highest energy
73. A mixture consists of two or more different substances, not chemically joined together.
74. A solvent is a liquid that can dissolve a solute.
75. A solute is a solid that will dissolve in a solvent.
76. A solution is formed when a solute dissolves in a solvent
77. Filtration is used to separate an insoluble solid from a solvent
78. Distillation can be used to separate liquids that have different boiling points.
79. Chromatography is used to separate mixtures of soluble substances.
80. An element is a substance made up of only one type of atom
81. A compound is formed from more than one element chemically combined.
82. A compound will have different properties than its component element
83. A mixture is formed from elements and compounds that are not chemically combined
84. Oxides are compounds formed from oxygen and another element.
85. The columns in the periodic table are called groups.
86. The rows in the periodic table are called periods.
87. Elements in the same group tend to have similar properties.
88. The atomic number shows the number of protons or electrons.
89. The mass number shows the number of protons and neutrons
90. The key properties of metals are:
 - a. Conductive

- b. High melting and boiling points
- c. Sonorous
- d. Ductile
- e. Malleable
- f. Shiny (when freshly cut)
- g. Dense

91. Group 1 metals are very reactive.

92. The halogens are the non-metal elements in group 7

93. Group 0 elements are also called the noble gases

94. They have a number of distinct properties:

- a. Low reactivity
- b. Gases at room temp
- c. Coloured
- d. Glow when an electrical current is passed through them

95. Ceramics are a product made from a non-metallic mineral by firing at high temperature

96. A composite material is one made from several different material mixed together

97. Polymers are long chain molecules formed from repeating smaller molecules (monomers) joined together

REACTIONS

98. Bases are substances that can react with acids and neutralise them.
99. Alkalis are bases that can dissolve in water
100. Acids have a pH of less than 7.
101. Alkaline solutions have a pH greater than 7.
102. A neutral solution has a pH of 7.
103. A chemical reaction happens if you mix together an acid and a base. The reaction is called neutralisation.
104. Metal oxide + acid → water + salt
105. Metal hydroxide + acid → water + salt
106. Metal carbonate → water + salt + carbon dioxide
107. Hydrochloric acid forms chloride salts
108. Sulphuric acid forms sulphate salts
109. Nitric acid forms nitrate salt
110. A chemical reaction is a change in which atoms are rearranged to make new substances
111. The substances before the arrow are called reactants.
112. The substances after the arrow are called product
113. Fuels are substances that burn in oxygen to transfer energy.
114. conservation of mass' – matter cannot be created or destroyed, just rearranged
115. In an exothermic reaction energy is given out to the surroundings
116. In an endothermic reaction energy is taken in from the surroundings
117. The state symbols are: s (solid), l (liquid), g (gas) and aq (aqueous)

EARTH

118. Igneous rocks are formed when magma (below the Earth's surface) or lava (above the Earth's surface) cool
119. Sedimentary rocks are crumbly, have layers and may contain fossils.
120. Sedimentary rock formation involves weathering, erosion and transport, deposition/sedimentation, compaction and cementation
121. Metamorphic rocks have been subjected to tremendous heat and/or pressure, causing them to change into another type of rock.
122. Global warming is the gradual increase in surface temperature of the Earth.
123. Climate change is causing melting of ice caps, rising sea levels, loss of habitats, extinction of species, extreme weather, changes in seasons and migration patterns
124. Human activities such as transport and farming have an impact on the environment
125. As the human population expands the impact we are having on the environment is increasing

WAVES

126. The planets in order of increasing distance from the sun are Mercury, Venus, Earth, Mars (rocky planets), Jupiter, Saturn, Uranus and Neptune (gas giants).
127. Planets in the Solar System orbit the sun rather than the Earth because the sun has the largest mass and the strongest gravitational field.
128. Year length varies on different planets due to different durations to complete one orbit of the sun.
129. Earth rotates on its axis; one complete rotation is a day and takes 24 hours
130. Earth orbits the sun; one complete orbit is a year and takes 365.25 days
131. At different points in the orbit, each hemisphere is tilted towards the sun (summer) or away from it (winter)
132. A solar eclipse happens when the moon passes between the sun and the Earth;
133. A lunar eclipse happens when the Earth passes between the sun and the moon
134. Sound travels to us by vibrating air particles
135. Wavelength is measured in metres and is the distance between two identical points on neighbouring waves
136. Frequency is measured in Hz and is the number of waves passing a point per second.
137. Amplitude is the height of a wave above the undisturbed point
138. The speed of sound in air is 340m/s
139. A compression occurs when the vibrating particles are close together.
140. A rarefaction occurs when the vibrating particles are spaced further apart
141. Light travels at 300,000,000 m/s.
142. Light travels in straight lines.
143. The law of reflection states that the angle of reflection = the angle of incidence
144. The image will be the same size as the reflection.
145. The distance between the object and the mirror will be the same as the mirror and the image.
146. The image will undergo lateral inversion- right and left will be swapped.
147. If the light ray approaches the change in material at an angle this change in speed will cause the ray to bend. This is refraction.

148. An object appears to be a colour because it absorbs all other colours of light but reflects the one it appears to be

FORCES

149. Forces can change the shape, speed and direction of objects.
150. Contact force: One that requires objects to be touching e.g. friction, air resistance, reaction force, upthrust, tension.
151. Non-contact force: One that acts without direct contact between objects e.g. magnetism, static electricity, gravity
152. Resultant force: Single force which can replace all the forces acting on an object and have the same effect.
153. When the resultant force on an object is zero, it is in equilibrium and does not move, or remains at constant speed in a straight line
154. Friction is a stopping force. It resists motion.
155. Friction can occur between two solids, a solid and a liquid and two and liquids.
156. When two surfaces rub together friction is caused. It generates heat
157. Air resistance occurs due to collisions between air molecules/particles and moving objects.
158. large, bulky shapes experience more drag than smaller, spherical or pointed shapes as the bulky shapes are less able to smoothly displace air molecules
159. Mass: The amount of matter/particles in an object (kg).
160. Weight: The force of gravity on an object (N).
161. Gravitational field strength, g : The force from gravity on 1 kg (N/kg).
162. Speed is scalar and is a measure of how fast an object is travelling
163. It is calculated by dividing distance travelled by time taken
164. On a distance time graph:
- A horizontal line means stationary.
 - A diagonal line pointing up means moving away from the origin.
 - A diagonal line pointing down means moving towards the origin.
 - A straight diagonal line means moving at constant speed.
165. The pressure depends on the force applied and the area that it is applied to
166. Pressure is calculated by force / area
167. The atmosphere presses down on the Earth with a force called atmospheric pressure

168. The pressure in a liquid increases with depth as the pressure depends upon the weight of liquid above
169. A lever turns around a pivot and pushes against a load.
170. The turning effect of a force is called a moment.
171. The moment of a force depends on how big the force is and how far the force is from the pivot.

ENERGY

172. Energy is measured in joules, J.
173. The law of conservation of energy states that energy cannot be created or destroyed, only transferred from one store to another
174. Thermal energy store: Filled when an object is warmed up;
175. chemical energy store: Emptied during chemical reactions when energy is transferred to the surroundings;
176. kinetic energy store: Filled when an object speeds up;
177. gravitational potential energy store: Filled when an object is raised;
178. elastic potential energy store: Filled when a material is stretched or compressed.
179. Temperature: A measure of the motion and energy of the particles, measured in °C.
180. When heated, particles gain kinetic energy, vibrate/move faster and spread further apart
181. Conduction: Transfer of thermal energy by the vibration of particles. Particles heat up, gain kinetic energy, vibrate more, collide with neighbouring particles and transfer the energy.
182. Convection: Transfer of thermal energy when particles in a heated fluid (liquid or gas) rise.
183. Renewable: An energy resource that can be replenished as it is used and will not run out. Examples are solar, wind, waves, geothermal and biomass.
184. Non-renewable: An energy resource that cannot be replenished as it is used and will run out. Examples are fossil fuels and nuclear power.
185. Static charge is caused by the transfer of electrons between surfaces when those surfaces are rubbed together
186. The surface that loses electrons will have a positive charge
187. The surface that gains electrons will have a negative charge
188. Like charges repel
189. Current is the flow of electrons
190. This flow is from the negative end of the power source towards the positive end
191. Current is measured in Amps using an ammeter

192. Potential difference is a measure of the energy given to charge carriers (electrons) in a circuit
193. Potential difference is measured in volts using a voltmeter
194. A series circuit is formed from one continuous loop
195. A parallel circuit is formed from more than one loop so that there is more than one route round the circuit
196. Resistance is a measure of the opposition to current flow in a circuit and is measured in ohms (Ω)
197. Conductors have (relatively) low electrical resistance
198. A magnet has two poles- north and south.
199. When brought together like poles repel (push apart) each other.
200. Electromagnets are formed from a coil wound round a metal core. They occur when a current flows in the wire