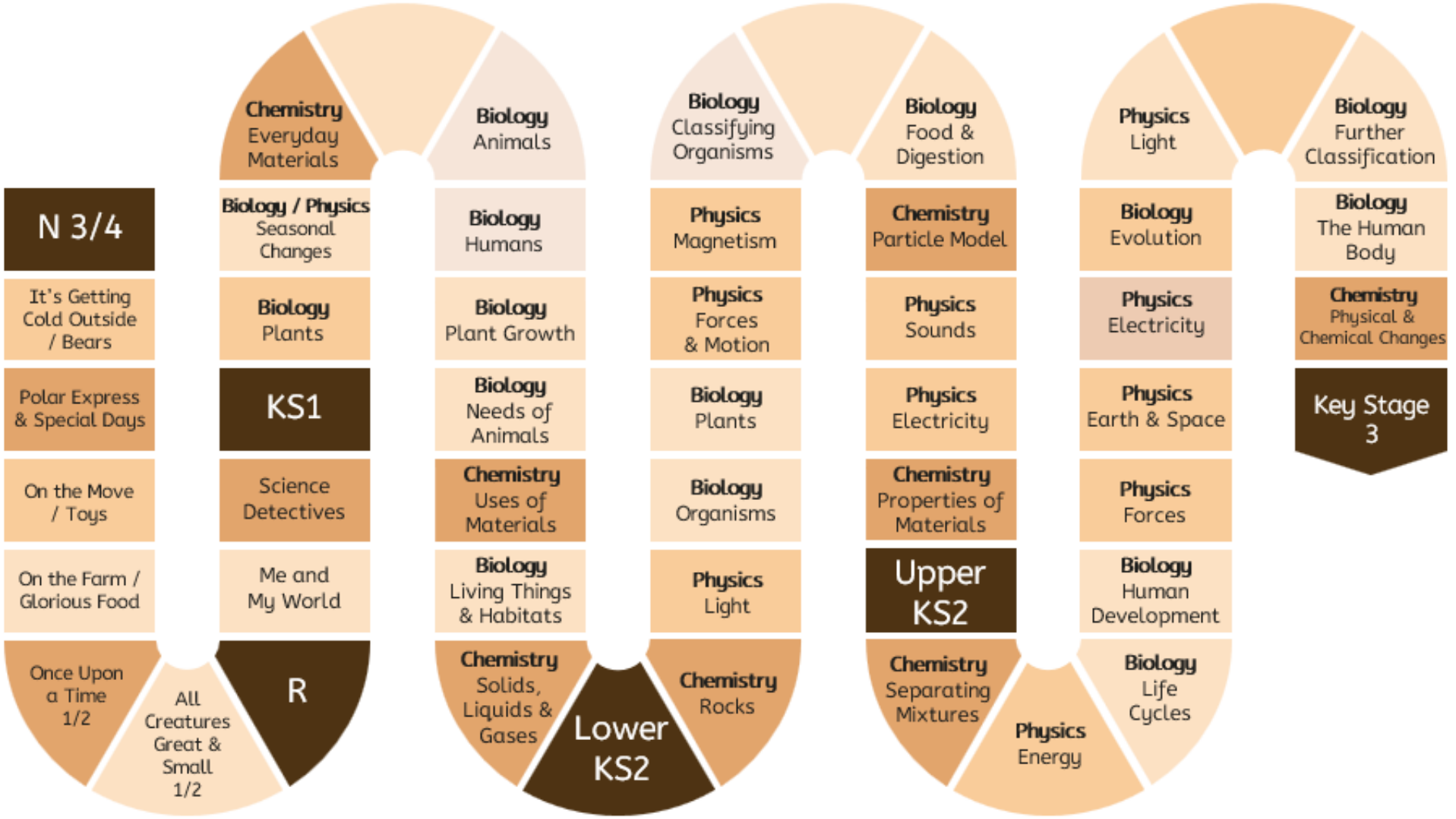
United Curriculum: Science



Progression in Vertical Concepts

Chemistry

1.

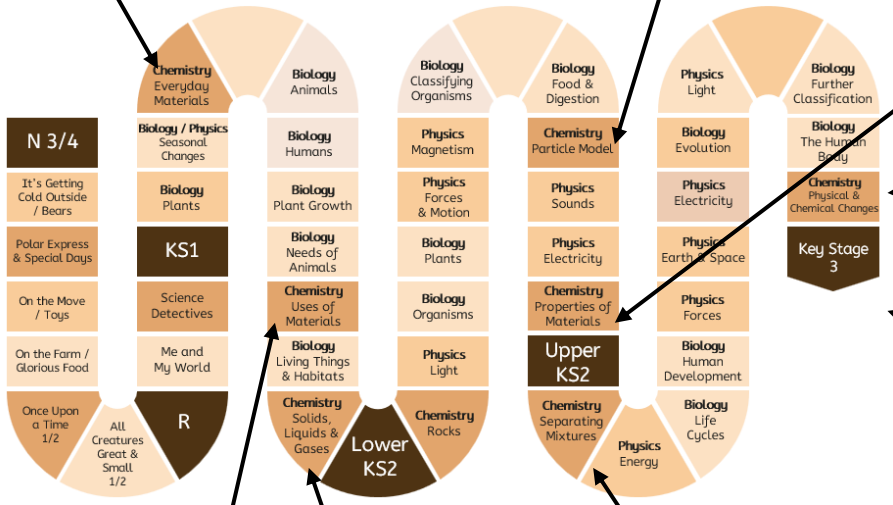
All material in the universe is made of very small particles.

Objects have a purpose and are made of different **materials**.

If a material could be divided into smaller and smaller pieces, it would be found to be made of **particles**, which smaller than can be seen even with a microscope. These particles are not *in* a material; they *are* the material.

The particles of a substance are arranged differently when it is solid, liquid or gas.

Properties of materials can be physical (such as hardness) or chemical (such as toxicity).



The same thing (water) can look different when it is hot or cold (ice).

A **chemical change** is where a new substance – that is made of a different type of particle – is formed.

The smallest piece of a material is called an **atom**. All materials, anywhere in the universe, living and non-living, are made of a very large numbers of these basic 'building blocks', of which there are about 100 different kinds.

All the 'stuff' encountered in everyday life, including air, water and different kinds of solid substances, is called **matter**.

Different materials are recognisable by their **properties**.

Materials have different properties, which make them suitable for specific purposes.

Matter can exist in three different **states**: as **solids**, **liquids** and **gases**.

The amount and type of **substance** does not change when the matter changes state.

A **pure substance** is one that contains only one type of particle.

A **mixture** is created when two or more substances are mixed. The two types of particle are mixed together, but the particles themselves stay the same.

Progression in Vertical Concepts

Physics

2.

Objects can affect each other at a distance.

3.

Changing the movement of an object requires a net force to be acting on it.

3. Forces act in pairs. Forces acting against each other are **opposing**.

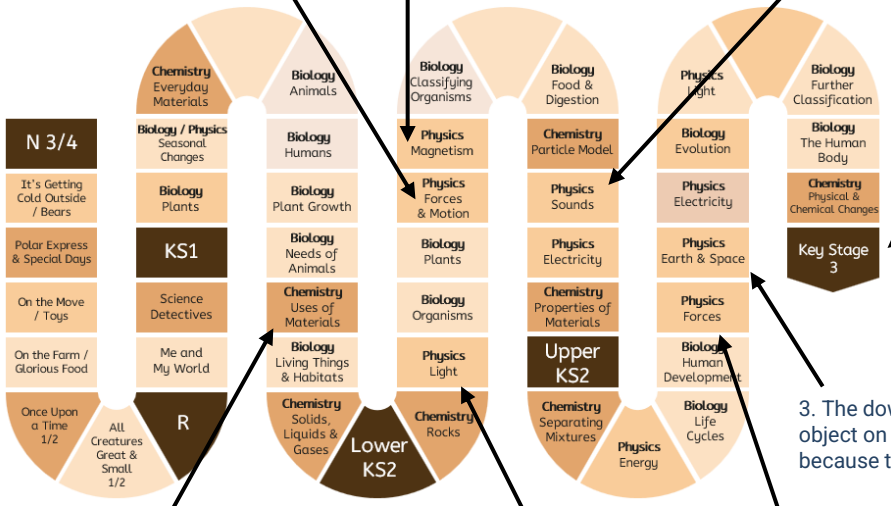
If opposing forces equal, they are **balanced,** and the object's motion will stay the same; this includes staying stationary. If opposing forces are unequal, they are **unbalanced** will change an object's speed, direction or shape.

Friction is a force that will slow an object down.

2. The **non-contact** force of magnetism mean magnets can attract or repel other magnets and attract objects made of magnetic materials.

3. Friction is an example of a **contact** force.

2. Sound comes from objects that **vibrate** and can be detected at a distance from the source, because the air or other material around is made to vibrate. Sounds are heard when the vibrations in the air reach our ears.



2. **Magnets** can **attract** or **repel** other magnets.

Magnets attract **magnetic** objects.

3. We can **push** and **pull** objects to make them move.

2. There is attraction and repulsion between objects that are electrically charged. Visible light and other forms of radiation can travel through any empty space.

3. How quickly an object's motion is changed depends on the force acting and the object's mass. The greater the mass of the object, the longer it takes to speed it up or slow it down (inertia).

3. The downward force of gravity on an object on the Moon is less than that on Earth because the Moon has less mass on Earth.

3. We can move or change the shape of objects by pushing and pulling: by squashing, bending, twisting or stretching the materials.

2. Objects can affect other objects even when they are not in contact with them. Light reaches our eyes, even though the light source may be far away.

2. The non-contact force of **gravity** pulls objects towards the centre of the Earth.

3. There is **gravitational** force between all objects, but it is only felt when one or more of the objects has a very large mass. The greater the mass, the greater the gravitational force.

Objects on Earth are pulled to the centre of the Earth because the Earth's mass and therefore gravitational force is much larger than that of the objects.

Progression in Vertical Concepts

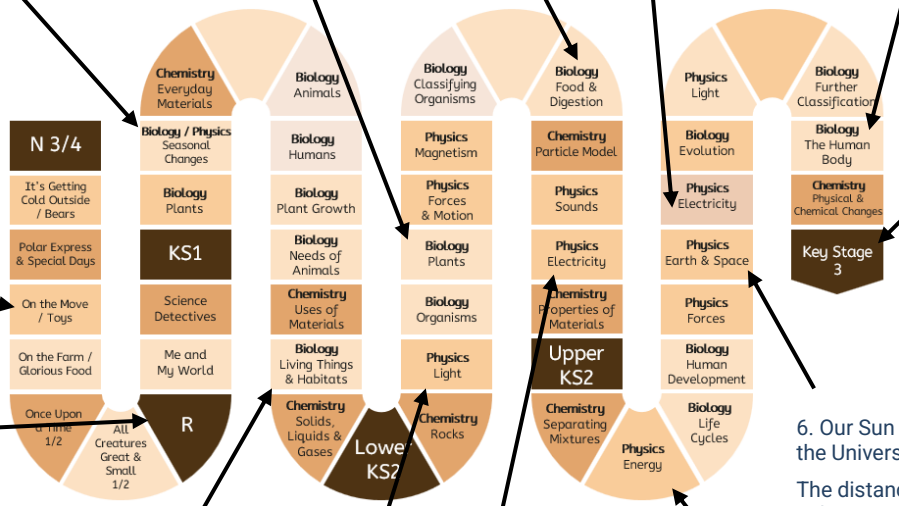
Physics

4.

The total amount of energy in the Universe is always the same, but energy can be transformed when things change or are made to happen.

6.

Our solar system is a very small part of one of millions of galaxies in our universe.



4. In most plants, sunlight, carbon dioxide and water are used to make food in the leaves.

4. The arrows in a **food web** show where energy is being transferred from and to.

4. Energy resources can be **renewable** (such as wind, solar, geothermal and hydrological) or **non-renewable** (such as fossil fuels).

4. All organisms **respire**.

6. Daytime is when the Earth is facing the Sun; nighttime is when the Earth is facing away from the Sun.

4. We have to push or pull objects to make them move; they do not move on their own.

6. Naming the Sun, Earth and Moon.

4. Objects have energy because of their chemical composition, their movement, their temperature, their position in a gravitational or other field, or because of compression or distortion of an elastic material.

6. The tilt of the Earth's axis gives rise to seasons.

The movements of galaxies suggest that the Universe is expanding from a past state called the 'big bang', towards a future that is still unclear.

6. Our Sun is one of many stars that make up the Universe.

The distances between us and the bodies in solar system is huge, and even bigger in the Universe.

4. All living things need **food** to give them energy (and other things).

All **food chains** start with a **producer** (a living thing that makes its own food).

The arrows in a food chain show where **energy** is being transferred from and to.

6. The Sun emits light, some of which reaches Earth. The Moon reflects light from the Sun.

4. A cell in a complete circuit can make a bulb light or buzzer sound. This will not happen without a cell.

4. Many processes and phenomena are explained in terms of energy exchanges.

Energy cannot be created or destroyed. When energy is **transferred** from one object to others, the total amount of energy in the universe remains the same; the amount that one object loses is the same as the other objects gain.

Two examples of **energy stores** are **thermal** stores and **chemical** stores of energy.

Energy resources – but not energy – can be depleted.

Progression in Vertical Concepts

Earth Science & Geology

5 (A)

The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.

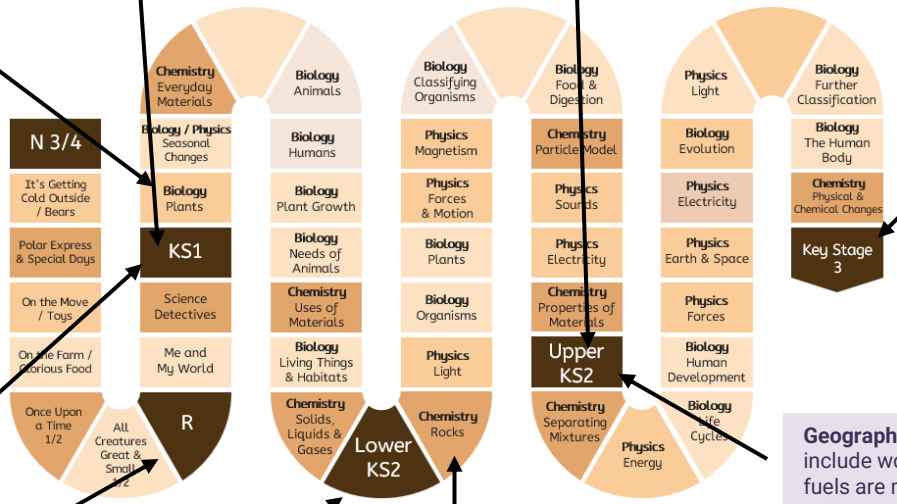
Geography: Features of hot deserts include rocks, sand dunes and oases. Features of cold deserts include mountains and ice sheets.

Rivers travel from highland areas to lowland areas. Physical features around rivers include valleys, mountains, hills and vegetation.

Geography: Use of fossil fuels to create plastics, and the effects this can have on the Earth.

Some plants grow in soil.

Describing the natural things in our local area.



Geography: Formation of volcanoes and mountains at different types of plate boundaries. Movement of tectonic plates as caused by convection currents.

Radioactive decay of material inside the Earth since it was formed is its internal source of energy. Understanding the use of Earth's energy resources in terms of energy stores and transfers.

Geography: We live on the Earth. Physical features occur in nature and include river, forest, soil and hill.

Coastal areas are areas of land that are near the sea. Features in coastal areas include beach, cliff, sea and ocean.

Geographical features include beach, hill, forest, sea and river.

Geography: There are several mountain ranges in the UK.

The Earth has four layers. Its upper layer of tectonic plates move.

Shield and composite volcanoes can form at plate boundaries, which produce lava, pyroclastic flows and lahars.

Soil is rich with nutrients around volcanoes.

Rocks are formed when placed under pressure.

Much of the solid surface of the Earth is covered in soil, which is a mixture of pieces of rock of various sizes and the remains of organisms. Some soil also contains air, water and some nutrients.

There are three main kinds of rock: igneous, sedimentary and metamorphic, which each have different composition and properties.

Geography: Examples of natural resources include wood, food, water and fossil fuels. Fossil fuels are materials made from fossils over millions of years, like coal and oil. Humans use these to run cars and electrical items.

Natural resources are unevenly distributed across the world and can be renewable or non-renewable (finite).

The upper course of a river is in high, mountains ground and the river is narrow and fast flowing. The lower course of a river is in low, flat ground and the river is wide and slow flowing. The middle course is between the two. Rivers erode, transport and deposit to form waterfalls, meanders and floodplains.

Progression in Vertical Concepts

Environmental Science

5 (B)

The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate.

Geography: The weather is short-term. Climate is long-term summary of the weather conditions.

Precipitation is the fall of water as rain, sleet, snow or hail.

Deserts are places where there is very little precipitation.

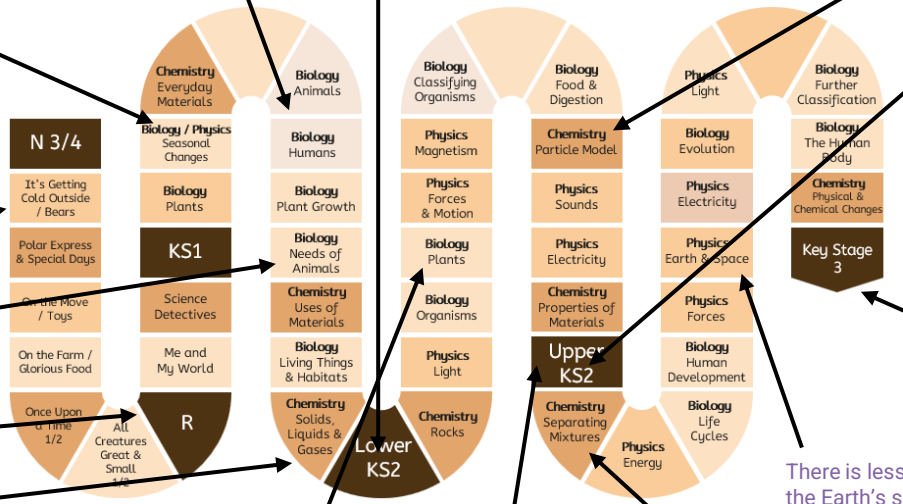
Geography: The layer of air around the Earth is called the atmosphere.

Atmospheric circulation causes some areas on Earth to have higher levels of precipitation than others.

Tropical rainforests are places where there is lots of precipitation.

The water cycle involves evaporation of water from oceans and condensation of water, which falls as precipitation.

The weather can change rapidly. The four different seasons have different weather patterns.



Geography: Mitigation and adaptation are ways that humans can reduce and live with the effects of climate change.

Geography: Weather is determined by conditions of the air. The pressure, temperature, direction and speed of the movement and the amount of water vapour in the air combine to create weather.

Understanding convection currents in terms of pressure and particles.

Types of weather include sunny, rainy, windy, and snowy.

The air is all around us on Earth. Air has oxygen in it.

We experience different types of weather in different seasons (focus on spring and winter).

Global warming describes the increase in Earth's average temperatures.

Air has carbon dioxide in it.

There is less and less air further away from the Earth's surface; space is a vacuum.

Air is a mixture of lots of different gases, including oxygen and carbon dioxide.

Geography: The amount of water on Earth is constant. Most is saltwater stored in oceans, and most freshwater is stored as ice or underground.

Water cycle: Evaporation from the air and transpiration from plants means that water vapour rises in the air. It condenses to form clouds and precipitation occurs when the clouds get heavy. Surface runoff is the flow of water overground; throughflow is the flow of water underground.

Climate zones share long-term weather patterns. There are six main climate zones: polar, temperate, arid, tropical, Mediterranean and mountains.

Biomes are areas of the world that, because of similar climates, have similar landscapes, flora and fauna. The major biomes of the world are tundra, tropical rainforests, coral reefs, temperate forests and hot deserts.

The natural greenhouse effect, the enhanced greenhouse effect, global warming and resulting climate change.

The increase in frequency of extreme weather events like heatwaves and drought as a result of climate change.

Progression in Vertical Concepts

Biology

7.

Organisms are organised on a cellular basis.

8.

Organisms require a supply of energy and materials for which they are often dependent or in competition with other organisms.

7. Plants are organised with roots, stem, leaves and flowers.

8. Living things, including humans, react to their surroundings with their senses.

8. Plants make their own food using sunlight, carbon dioxide and water.

8. The feeding relationships between organisms can be represented as food chains and food webs. They show where the energy is being transferred from and to.

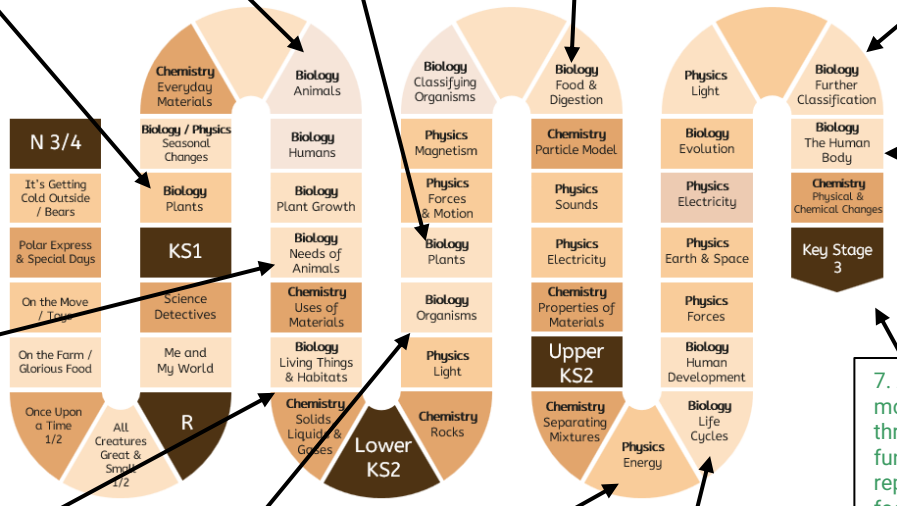
8. There is a wide variety of living things on Earth, including plants and animals.

7. Micro-organisms are organisms that are so small that we cannot see them with our eyes alone.

7. Respiration takes places in cells.

8. Living things move, reproduce, are sensitive to their surroundings, grow, respire, excrete, and need nutrition (MRS GREN).

8. All living things need food, oxygen, water and certain temperature conditions.



7. All organisms are made of one or more cells, which can only be seen through a microscope. All the basic functions of life – growth, reproduction, extracting energy from food – are the results of what happens inside cells. Cells are often aggregated into tissues, tissues into organs, and organs into organ systems.

8. Decomposers are essential (alongside producers and consumers) for a stable ecosystem.

8. Most plants make their own food. Animals' food comes from eating plants (herbivores) or by eating animals (carnivores), which have eaten plants or other animals. These relationships can be represented in a food chain.

Plants and animals are often dependent on each other.

Organisms are adapted to their environment. If conditions in a habitat change, organisms may not be able to survive.

Organisms move, reproduce, are sensitive to their surroundings, grow, need oxygen, get rid of their waste, and need nutrition (MRS GOWN).

7. Humans are organised with organs like hearts and lungs, which do particular jobs. The skeleton and muscles allow the body to move.

8. Energy is transferred to the Earth by light. When making their own food, plants transfer some of this energy to their chemical store. As other organisms eat these producers, some energy in this chemical energy store is transferred.

7. A cell is the smallest building block of living things. All organisms are made of cells.

There are lots of different types of cell (e.g. sex cells), which each have different purposes.

Progression in Vertical Concepts

Biology

9.

Genetic information is passed down from one generation of organisms to another.

10.

Diversity of organisms, living and extinct, is the result of evolution.

10. To help scientists make sense of the diversity of organisms, they are classified into different groups. Each group has similar features.

9. When a plant reproduces, it goes through stages of **pollination**, **fertilisation** and **seed dispersal**. The seed will then germinate and grow into a plant.

9. A **species** is a group of one type of organism. Individuals in this group can breed with each other to produce offspring that can go on to reproduce.

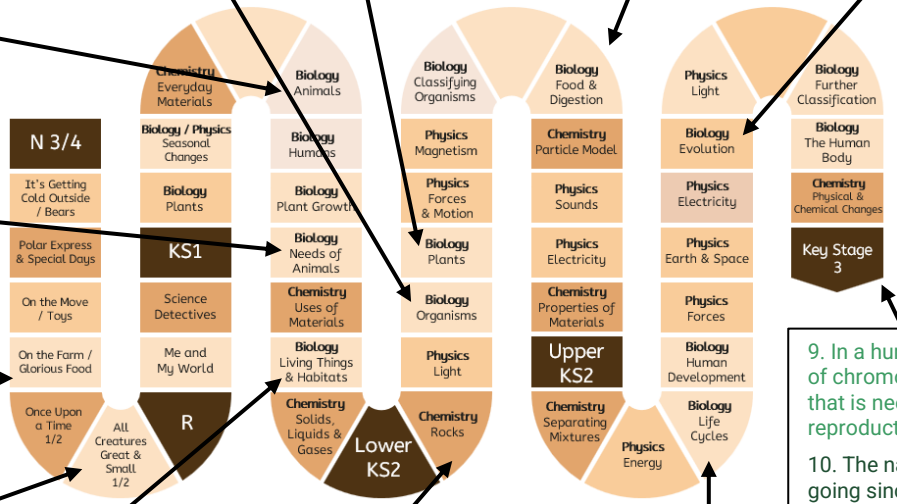
10. Variation exists within species, caused by genetic and environmental factors.

Living things are found in certain environments because they have the features that enable them to survive there. This adaptation to their environment has come about because of the small differences that occur during reproduction, resulting in some individuals being better suited to the environment than others. In the competition for materials and food, those that are better adapted will survive and are more likely to pass on their adapted feature to their offspring. Fossils are evidence of evolution.

10. There are lots of types of animal, and some types can be grouped as amphibians, birds, fish, mammals and reptiles.

9. Plants and animals **reproduce** (have **offspring**).

9. Young animals grow into adult animals. The young look similar, but not the same, as the adults.



9. In a human body, most cells contain 23 pairs of chromosomes. These provide information that is needed to make more cells in growth and reproduction.

10. The natural selection of organisms has been going since the first form of life appeared on Earth 3.5 billion years ago. Multi-cellular organisms evolved around 2 billion years ago.

10. There are many different kinds of plants and animals in the world today.

9. A **species** is a group of living things of the same type.

10. **Biodiversity** describes all the different living things in an area.

Living things are adapted to their environments. If the environment changes, the organisms may no longer be adapted and may struggle to survive.

9. When there are no living individuals of a species to reproduce, the species is **extinct**.

10. We know about extinct and dead species from **fossils**. These are the preserved remains (or traces) of organisms that lived many years ago.

9. An organism's **genome** is the information that controls how that individual organism will develop.

In **sexual reproduction**, two parents contribute to the formation of offspring. They each pass down half their genome through specialised cells called **sex cells**. The two halves are combined during **fertilisation**. While it inherits genetic information from both parents, the offspring's genome is distinct, which means the offspring is not identical to a parent.

Asexual reproduction involves only one parent. In this process, the offspring's genome is an exact copy of the parent's genome. The offspring is identical to the parent.

Progression in Vertical Concepts

Biology

11.

Organisms are healthy when physically, mentally and socially well and free from disease.

11. Humans have five senses. Some people have impairments, like visual and hearing impairments.

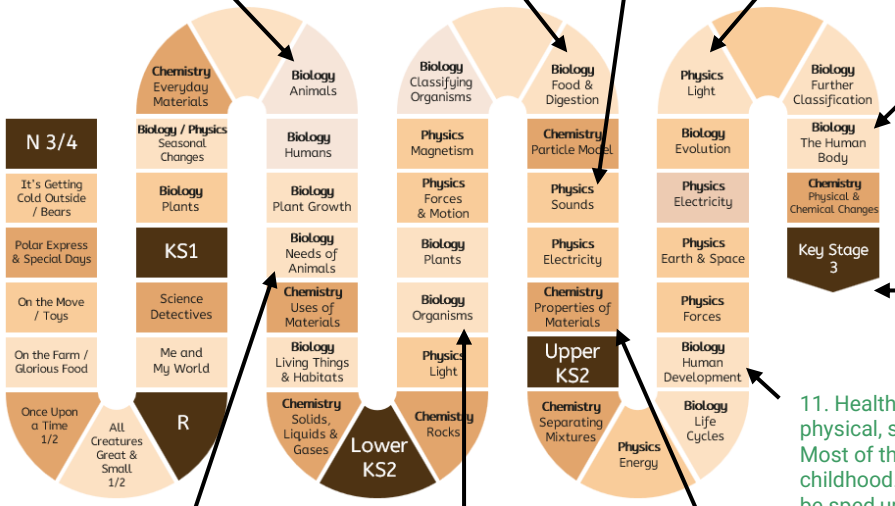
11. Bacteria are tiny living things. Some are useful for humans, and some can cause diseases. Bacteria can cause tooth decay.

11. Humans with hearing loss may use closed captions, hearing aids and/or sign language.

11. Visual impairments include long and short sightedness, colour vision deficiency, and blindness. Some of these can be corrected, and some people with visual impairments will use Braille, magnifying devices, canes and/or guide dogs.

11. Being healthy means we are in a state of physical, mental and social well being and are free from disease. Some drugs can help us and some can harm us (particularly in the wrong quantities).

11. Humans need to practise good hygiene, like brushing teeth and washing hands.



11. The biological causes and effects of diseases (e.g. coeliac disease and emphysema), exercise, lifestyles (e.g. vaping) and deficiencies on the body. Pathogens, their transmission and how transmission can be prevented.

11. Healthy development includes cognitive, physical, social and emotional development. Most of this happens during infancy and childhood. Ageing happens naturally, and can be sped up by environmental factors like smoking.

Some adults are unable to become pregnant. IVF and other treatments can be used.

11. Humans need to exercise, practise good hygiene and eat a healthy and balanced diet to stay healthy. Their diet should be high in fruits and vegetables and low in fats, sugar and salt.

11. A balanced diet includes the right proportions of the main food groups of carbohydrates (starch and sugars), proteins, fats, fibre, vitamins and minerals.

Animals, including humans, may get diseases (like scurvy) if they are deficient in vitamins and minerals.

11. Some substances are toxic; this means they can be poisonous. Humans and other organisms need to avoid these to stay healthy.