Learn-AT Science Curriculum Framework:
Big Ideas in the National Curriculum

Our ambition is for our learner scientists to understand and marvel at the world around them, incrementally building on concepts about science as they progress through our schools. The Association for Science Education (ASE) argues that children should "…conceive the goals of science education, not in terms of the knowledge of a body of facts and theories, but as a progression towards understanding key ideas – 'big ideas' – of relevance to students' lives during and beyond school." In 2015, the ASE produced a document entitled "Working With Big Ideas in Science Education (https://www.ase.org.uk/bigideas). This publication describes 10 Big Ideas of science and 4 Big Ideas about science. The 14 Big Ideas cover all the different concepts about science and how we understand it and apply it in our world.

In contrast to this, the Primary Science National Curriculum is written as a set of units of learning. The content of each unit might seem to students to be disconnected from each other.

This document combines the National Curriculum Programmes of Study for Primary Science with the ASE Big Ideas document, showing the ways in which each science unit relates to others. Read horizontally, each of concepts in each of the National Curriculum science units are plotted against the 14 Big Ideas. Read vertically, the document shows the conceptual progression through the primary phase for each of the Big Ideas.

The document covers all of the concepts in the National Curriculum. It does not state all of the content of the National Curriculum – please refer to the programmes of study to ensure compete content coverage is taught for each unit. The context in which schools choose to deliver the units, and the specific content taught, will be determined by individual schools.

Big Ideas of science

1 All matter in the Universe is made of very small particles
Atoms are the building blocks of all matter, living and non-living. The behaviour and arrangement of the atoms explains the properties of different materials. In chemical reactions atoms are rearranged to form new substances. Each atom has a nucleus containing neutrons and protons, surrounded by electrons. The opposite electric charges of protons and electrons attract each other, keeping atoms together and accounting for the formation of some compounds.

2 Objects can affect other objects at a distance
All objects have an effect on other objects without being in contact with them. In some cases the effect travels out from the source to the receiver in the form of radiation (e.g. visible light). In other cases action at a distance is explained in terms of the existence of a field of influence between objects, such as a magnetic, electric or gravitational field. Gravity is a universal force of attraction between all objects however large or small, keeping the planets in orbit round the Sun and causing terrestrial objects to fall towards the centre of the Earth.

3 Changing the movement of an object requires a net force to be acting on it
A force acting on an object is not seen directly but is detected by its effect on the object's motion or shape. If an object is not moving the forces acting on it are equal in size and opposite in direction, balancing each other. Since gravity affects all objects on Earth there is always another force opposing gravity when an object is at rest. Unbalanced forces cause change in movement in the direction of the net force. When opposing forces acting on an object are not in the same line they cause the object to turn or twist. This effect is used in some simple machines.

4 The total amount of energy in the Universe is always the same but can be transferred from one energy store to another during an event
Many processes or events involve changes and require an energy source to make them happen. Energy can be transferred from one body or group of bodies to another in various ways. In these processes some energy becomes less easy to use. Energy cannot be created or destroyed. Once energy has been released by burning a fossil fuel with oxygen, some of it is no longer available in a form that is as convenient to use.

5 The composition of the Earth and its atmosphere and the processes occurring within them shape the Earth's surface and its climate
Radiation from the Sun heats the Earth's surface and causes convection currents in the air and oceans, creating climates. Below the surface heat from the Earth's interior causes movement in the molten rock. This in turn leads to movement of the plates which form the Earth's crust, creating volcanoes and earthquakes. The solid surface is constantly changing through the formation and weathering of rock.

6 Our solar system is a very small part of one of billions of galaxies in the Universe
Our Sun and eight planets and other smaller objects orbiting it comprise the solar system. Day and night and the seasons are explained by the orientation and rotation of the Earth as it moves round the Sun. The solar system is part of a galaxy of stars, gas and dust, one of many billions in the Universe, enormous distances apart. Many stars appear to have planets.

7 Organisms are organised on a cellular basis and have a finite life span
All organisms are constituted of one or more cells. Multi-cellular organisms have cells that are differentiated according to their function. All the basic functions of life are the result of what happens inside the cells which make up an organism. Growth is the result of multiple cell divisions.

8 Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms
Food provides materials and energy for organisms to carry out the basic functions of life and to grow. Green plants and some bacteria are able to use energy from the Sun to generate complex food molecules. Animals obtain energy by breaking down complex food molecules and are ultimately dependent on green plants as their source of energy. In any ecosystem there is competition among species for the energy resources and materials they need to live and reproduce.

9 Genetic information is passed down from one generation of organisms to another
Genetic information in a cell is held in the chemical DNA. Genes determine the development and structure of organisms. In asexual reproduction all the genes in the offspring come from one parent. In sexual reproduction half of the genes come from each parent.

10 The diversity of organisms, living and extinct, is the result of evolution
All life today is directly descended from a universal common ancestor that was a simple one-celled organism. Over countless generations changes resulting from natural diversity within a species lead to the selection of those individuals best suited to survive under certain conditions. Species not able to respond sufficiently to changes in their environment become extinct.

Big Ideas about science

11 Science is about finding the cause or cause of phenomena in the natural world
Science is a search to explain and understand phenomena in the natural world. There is no single scientific method for doing this; the diversity of natural phenomena requires a diversity of methods and instruments to generate and test scientific explanations. Often an explanation is in terms of the factors that have to be present for an event to take place as shown by evidence from observations and experiments. In other cases supporting evidence is based on correlations revealed by patterns in systematic observation.

12 Scientific explanations, theories and models are those that best fit the evidence available at a particular time
A scientific theory or model representing relationships between variables of a natural phenomenon must fit the bservations available at the time and lead to predictions that can be tested. Any theory or model is provisional and subject to revision in the light of new data even though it may have led to predictions in accord with data in the past.

13 The knowledge produced by science is used in engineering and technologies to create products to serve human ends
The use of scientific ideas in engineering and technologies has made considerable changes in many aspects of human activity. Advances in technologies enable further scientific activity; in turn this increases understanding of the natural world. In some areas of human activity technology is ahead of scientific ideas, but in others scientific ideas precede technology.

14 Applications of science often have ethical, social, economic and political implications
The use of scientific knowledge in technologies makes many innovations possible. Whether or not particular applications of science are desirable is a matter that cannot be addressed using scientific knowledge alone. Ethical and moral judgments may be needed, based on such considerations as justice or equity, human safety, and impacts on people and the environment.

Reference

Harlen, W. (2010) Principles and Big Ideas of Science Education. Association for Science Education. Herts