The Cosmic Engine – Overview Preliminary Topic 4

Topic: The Cosmic Engine

Year: Preliminary

Context: Our place in the universe

PFA: History (P1), Society & Environment (P4), Current Research (P5)

Knowledge: Kinetics & Dynamics (P6), Energy (P7)

Values: P16

The Universe began with a singularity in space-time. After the initial explosion, the Universe started to expand, cool and condense, forming matter. As part of this ongoing process the Sun and the Solar System were formed over $4x10^9$ years ago from a gas cloud which resulted from a supernova explosion. The condensing gas and dust that formed the Sun and the planets contained all its original elements. The planets were formed when matter came together under the influence of gravity.

The Cosmic Engine – Assumed Knowledge Preliminary Topic 4

- 5.6.5a
  identify that energy may be released from the nuclei of atoms
- 5.7.1a
  describe the features and location of protons, neutrons and electrons in the atom
- 5.9.1a
  discuss current scientific thinking about the origin of the universe
- 5.9.1c
  describe some of the difficulties in obtaining information about the formation of the universe

- 5.93b

  describe some changes that are likely to take place during the life of a star.

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The Cosmic Engine – Outcomes Preliminary Topic 4

Big Idea 1: Our Sun is just one star in the galaxy and ours is just one galaxy in the Universe

	• **Outline** the historical development of models of the Universe from the time of Aristotle to the time of Newton
	• **Identify** data sources, and gather, process and analyse information to assess one of the models of the Universe developed from the time of Aristotle to the time of Newton to identify limitations placed on the development of the model by the technology available at the time

Big Idea 2: The first minutes of the Universe released energy which changed to matter, forming stars and galaxies

	• **Outline** the discovery of the expansion of the Universe by Hubble, following its earlier prediction by Friedmann
	• **Describe** the transformation of radiation into matter which followed the 'Big Bang'
	• **Identify** that Einstein described the equivalence of energy and mass
	• **Identify** data sources and gather secondary information to describe the probable origins of the Universe

Big Idea 3: Stars have a limited life span and may explode to form supernovas

	• **Define** the relationship between the temperature of a body and the dominant wavelength of the radiation emitted from that body
	• **Identify** that the surface temperature of a star is related to its colour
	• **Identify** that Einstein described the equivalence of energy and mass
	• **Gather** secondary information to relate brightness of an object to its luminosity and distance
	• **Solve** problems to apply the inverse square law of intensity of light to relate the brightness of a star to its luminosity and distance from the observer
	• **Describe** a Hertzsprung-Russell diagram as the graph of a star's luminosity against its colour or surface temperature
	• **Identify** energy sources characteristic of each star group, including Main Sequence, red giants, and white dwarfs
	• **Process** and **analyse** information using the Hertzsprung-Russell diagram to examine the variety of star groups, including Main Sequence, red giants, and white dwarfs

Big Idea 4: The Sun is a typical star, emitting electromagnetic radiation and particles that influence the Earth

	• **Identify** that energy may be released from the nuclei of atoms
	• **Describe** the nature of emissions from the nuclei of atoms as radiation of alpha α and beta β particles and gamma γ rays in terms of: Ionising power, Penetrating power, Effect of magnetic field, Effect of electric field
	• **Identify** that Einstein described the equivalence of energy and mass
	• **Perform** a first-hand investigation to gather information to compare the penetrating power of alpha, beta and gamma radiation in a range of materials
	• **Identify** the nature of emissions reaching the Earth from the Sun
	• **Describe** the particulate nature of the solar wind
	• **Outline** the cyclic nature of sunspot activity and its impact on Earth through solar winds
	• **Describe** sunspots as representing regions of strong magnetic activity and lower temperature
	• **Identify** data sources, gather and process information and use available evidence to assess the effects of sunspot activity on the Earth's power grid and satellite communications