**Lesson Plans – Astronomy**

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**Year 10 Physics:** Astronomy Lesson 1 **Lesson Title:** The Moon

Lesson Length: 50 minutes

* Play the Youtube clip (<https://www.youtube.com/watch?v=m8P5ujNwEwM>) on moon formation and discuss the main points with class (i.e. How we explain the formation of the moon and how this is related to the Earth’s axial tilt) **(20 minutes)**
* With help from students use a basketball (Earth), a tennis ball (Moon) and a lamp (Sun) to understand the phases of the moon. **(15 minutes)**
* Use the balls and lamp to demonstrate how eclipses occur and the consequences of the inclination of the Moon’s orbit. **(15 minutes)**

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**Year 10 Physics:** Astronomy Lesson 2 **Lesson Title:** Distances

Lesson Length: 50 minutes

* Show youtube clip on distance measures (<https://www.youtube.com/watch?v=AC7yFDb1zOA>) and the size of the universe, then discuss methods for measuring astronomical distances (parallax and standard candles). Also discuss measures of large distance: light years and Astronomical Units). **(15 minutes)**
* Take kids to the oval with a measuring tape and have the stand where the planets of our solar system would be if the Sun had a 3 inch diameter, about the size of a tennis ball (<http://blair.pha.jhu.edu/scale.html>). Then investigate how far away the Andromeda galaxy would be using the same scale. **(20 minutes)**
* Run some quick calculations on the board to compare how long it would take a car travelling at 110 km/h to get to planets vs how long it takes a space shuttle vs how long it takes light. Investigate how long it would take these things to travel to another star of the student’s choice, still within the Milky way. **(15 minutes)**

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**Year 10 Physics:** Astronomy Lessons 3 & 4 **Lesson Title:** Temperature, brightness and Stellar Evolution.

Lesson Length: 100 minutes

* On the board, discuss the colours of several everyday hot objects and place them in order of temperature (e.g. kettle element, soldering iron, Bunsen burner, bar heater, oxy-acetylene torch). This will give the idea that temperature and colour are related. **(10 minutes)**
* Define absolute and apparent brightness as they apply to astronomical objects. Apparent brightness is what we see, absolute brightness is the actual brightness, or what we would see if we were on the star. **(10 minutes)**
* Introduce the concept of stellar evolution and the life cycles by listing the following on the board:
  + Nebula and Protostar
  + Source of a Stars Energy
  + A Stars Characteristics
  + Red Giants and Supernova
  + White Dwarfs, Neutron Stars and Black Holes.

and asking students how we have so many different types of astronomical objects, before telling them that it’s due to stellar evolution. **(10 minutes)**

* Split the class into groups and have each group research a separate dot point to gain a basic understanding of what each of these astronomical objects are with particular reference to their brightness, colour and temperature, using a guiding worksheet. These notes are to be emailed to the teacher who will assist in putting together a set of class notes on stellar evolution. **(70 minutes)**

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**Year 10 Physics:** Astronomy Lesson 5 **Lesson Title:** Hertzsprung- Russel diagrams

Lesson Length: 50 minutes

* Relate the stages of stellar evolution researched in the last lesson to positions on the Hertzspring-Russel diagram and follow the life cycle of a star similar to our Sun, a star more massive than our Sun, and a star less massive than our Sun, working through the H-R diagram handout (“The Life Cycle of a Star and the Hertzsprung-Russell Diagram”). **(30 minutes)**
* Show a video of what will happen to our solar system as the Sun evolves. (<https://www.youtube.com/watch?v=FBbQHmuw9Lo>) Video also recaps what happens to stars of different mass*. Emphasize that massive stars undergo supernova explosions since it will be important next lesson*. **(10 minutes)**
* Recap the H-R diagram, since it’s a tricky concept. **(10 minutes)**

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**Year 10 Physics:** Astronomy Lesson 6 **Lesson Title:** Types of Galaxies

Lesson Length: 50 minutes

* Recap the concept of stellar evolution and massive stars undergoing supernova explosions at the end of their life cycles. **(10 minutes)**
* Explain, with pictures and notes on board: These massive explosions send out shockwaves (similar to soundwaves), which create compressions and rarefactions in regions of dense gas and dust. This leads to regions of increased density and thus increased gravitational pull, creating a domino effect for accumulating dust. This is roughly how stars are formed. If there is a lot of dust around, many stars are formed in the same region and we call this a galaxy. **(25 minutes)**
* Different types of galaxies have different shapes. Give galactic shape handouts to students in groups of two or three and have them classify pictures of galaxies on the slideshow. **(15 minutes)**

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**Year 10 Physics:** Astronomy Lesson 7 **Lesson Title:** Constellations

Lesson Length: 50 minutes

* Constellations are made up of groups of stars. Constellations “move” through the night sky as the Earth orbits the Sun. Different constellations can be seen at different times of year depending on where the Earth is in relation to the Sun. Use pictures to illustrate this. **(10 minutes)**
* Use the program Stellarium to investigate these constellations, guided by a handout. **(40 minutes)**

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**Year 10 Physics:** Astronomy Lessons 8 & 9 **Lesson Title:** Aboriginal Constellations

Lesson Length: 100 minutes

* Different cultures saw different patterns in the stars, according to their beliefs. In particular, Aborigines had their own interpretations of star patterns. Tell dreamtime stories about the Emu and 3 brothers constellations, and the Sun and the moon (<http://www.abc.net.au/news/2017-04-05/aboriginal-astronomy-basis-of-dreamtime-stories-stargazing/8413492>) **(15 minutes)**
* These constellations were also used to determine the seasons (e.g. the position of the Emu in the sky indicated when to collect Emu eggs), for navigation and to explain the presence of natural features on Earth. Watch the following videos: <https://www.youtube.com/watch?v=Wv8hKMj6ikA> (BTN indigenous astronomy)

<https://www.youtube.com/watch?v=uRD3HbJQSGI> (Radio Interview)

**(15 minutes)**

* Use the “Boorong” setting on Stellarium to identify Aboriginal constellations and determine which stellar objects they are made up of. Work on the Aboriginal Astronomy assignment (See “Aboriginal Astronomy Assignment” document)

**(70 minutes)**

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**Year 10 Physics:** Astronomy Lesson 10 & 11 **Lesson Title:** Redshift, expanding universe, Microwave background radiation and big bang.

Lesson Length: 100 minutes

* Watch the video (<https://www.youtube.com/watch?v=1kTXmT_KJvE>) to give students a qualitative understanding of the Doppler shift and how it can be used to measure the velocities of objects along one’s line of site. **(20 minutes)**
* Edwin Hubble used this Doppler technique to measure velocities of nearby galaxies. No matter which direction he looked, he found them to be receding. This means the universe must be expanding (isotopically and homogeneously). It may seem counter-intuitive that all other galaxies appear to be receding since we’re not at the centre of the universe, so illustrate this point by blowing up a balloon which has smarties stuck on it. Imagine you’re sitting on a smartie. All the other smarties appear to be receding no matter which smartie you’re sitting on. i.e. this redshift is not a true Doppler shift, rather, a measure of the expansion speed of the universe! **(30 minutes)**
* We know that the universe is expanding *at and accelerating rate* because the recessional velocity is approximately proportional to distance from us (with constant of proportionality ). Knowing the rate at which the expansion of the universe is accelerating and the current rate of expansion, we can calculate how long the universe must have been expanding for to reach its current level of separation. I.e. We can calculate the age of the universe! **(20 minutes)**
* The expansion of the universe is evidence for the Big Bang theory of the creation of the universe since it’s what you’d expect to see from an explosion. Further evidence comes in the form of Cosmic Microwave Background Radiation (Discovery of CMB: <https://www.youtube.com/watch?v=2bnL_ztPo6s> and explanation of CMB: <https://www.youtube.com/watch?v=3tCMd1ytvWg> ). This ties together a few of the things we discussed earlier about the relationship between colour and temperature. This isotropic and homogeneous nature of the CMB offers compelling evidence for the Big Bang Theory. **(30 minutes).**

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**Year 10 Physics:** Astronomy Lesson 12 **Lesson Title:** Revision lesson

Lesson Length: 50 minutes

* Students are to spend time working on their assignment or revising for the upcoming test.

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**Year 10 Physics:** Astronomy Lesson 12 **Lesson Title:** Test

Lesson Length: 50 minutes

* Students are to complete the test in this lesson.