Unit 3 - Scale of the Universe

This unit takes the student through a series of views of the universe, showing the universe in a sequence of scales;

1. A view of the home planet ('Earth'), for which the field of view is 20,000 km across.
2. A view of the inner planets of a virtual solar system, for which the field of view is 200,000,000 km (2×10^8 km) across.
3. A view of the outer planets of a virtual solar system, for which the field of view is 10,000,000,000 km (1×10^{10} km) across.
4. A view of the portion of the galaxy in the vicinity of the solar system and its nearby stars, for which the field of view is 2×10^{14} km across.
5. A view of the entire galaxy, for which the field of view is 2×10^{18} km across.

Planet

In this view the only object visible is the home planet. The student is required to make one measurement and one deduction from that measurement

i. A measurement of the radius of the home planet
ii. The time that it would take light to cross the planet. This is intended to establish a distance scale for the universe to bring out the rapidly expanding scale as we go through the sequence of views. This initial scale is very small, only of the order of a few hundredths of the light second, to be compared with the scale of thousands of light years in the later views.

After getting both answers correct the simulator will zoom out to a view of the inner planets, as if the student were traveling on a spacecraft.

Inner Planets

The student's home planet is the second planet away from the Sun. In this view the student can she his/her home planet as well as the one planet which lies closer to the Sun than the home planet, and the Sun itself. The student has three questions to answer here.

i. How far is the home planet from the Sun
ii. How far is the other inner planet from the Sun
iii. How long would it take light to travel from the Sun to the home planet. This is meant to establish a scale for the solar system of the order of a few hundred light seconds.

After getting these three questions correct the spacecraft zooms out until the entire solar system is visible.

Outer planets

In this view the three outer planets of the virtual solar system become visible. Note though that the inner planets are now so close to the Sun that they are no longer easily discernable, as is the case for our own Solar System. There are three questions to answer, being measurements of the radii of the three planetary orbits. When these are correct the view zooms out to a view of the nearby stars.

Nearby Stars

Now the planets are no longer visible, they are just too close to the Sun. However we have now zoomed out until some of the nearby stars are visible. The student to answer two questions

i. How far is it the nearest star in kilometers.
ii. How far is this in light years. At this point the student should note the greatly increased scale, from light-seconds to light-years.

When these answers have been answered correctly, then the spacecraft zooms out until the entire galaxy is visible.

Galaxy

Now the distance between neighboring stars becomes insignificant as the scale shifts to being equal to the distance across the galaxy. The student has to answer the questions

i. How far is the Sun from the center of the galaxy. For convenience the Sun is marked as yellow so that it can be identified. The student should note not only the very large distance, but also that there is nothing special about the Sun. It occupies no special place in the galaxy, but is just an ordinary star much like the others.
ii. How far this is as a fraction of the distance across the galaxy.
iii. How far this is in light years. The answer is now of the order of tens of thousands of light years.