

Weighing the Universe

This whole-class activity focuses on the value of standard index notation in making astronomical data manageable. Pupils will obtain a rough estimate of the **mass** of the entire observable **Universe**.

Resources required

Hubble deep field image © NASA/HST
Hubble Deep Field Survey Plate (from NSO website)
Transparent Grid, OHP, glass, calculators

Content

Begin with a brief resume of **standard index notation**. Then:

1. Split the plate in equal strips. Assign a strip to each pupil.
2. Each pupil now counts the galaxies in his or her strip.
3. When each pupil has finished, he or she writes the result on the board.
4. Teacher now adds together all the results - or gets the pupils to do this.
5. Pupils multiply this number by 100,000,000,000 (approximate number of stars in a typical galaxy) to give the number of stars in the plate.
6. It should be clear that the calculators are unable to cope with the answer given in decimal form. This is an opportunity to introduce or reintroduce the idea of standard form.
7. Now multiply again by 10 to the power 30 (mass of typical star) to give the mass in kilograms in the photograph.
8. Finally multiply by the scale factor required to give the total mass in the whole sky (95,000,000 i.e. this number of Hubble Deep Field plates that will cover the whole sky.).
9. You could compare the final result with authenticated values, although the point of the lesson is to reinforce mathematical rather than astronomical concepts, so this isn't strictly necessary.
10. Discuss the possible sources of error which might affect the results of the above calculations.



Keywords

Standard form, estimation, approximation

Teachers' Notes

1. We are actually estimating **masses**, not weights. For the purposes of the activity it does not matter.
2. Only two objects in the HDF image are stars, the rest are galaxies, you can spot these by their diffraction spikes.
3. The possible sources of error include:
 - Miscounting the galaxies
 - Mistakenly identifying other objects as galaxies
 - Using 100,000,000,000 to get the total number of stars - this is an approximation
 - Clustering - the plate may contain more or less than the average number of galaxies