

The Universe by Numbers

Dr Andrew French. July 2016.

Course summary

This is a five day introductory Science course. It will begin with a discussion of what Science is, and how Science is done in practice. A significant aspect of this is being able to *quantify* aspects of the Universe over a huge range of scales, from the tiniest of sub-nuclear dimensions to the large scale structure of the Cosmos. We will therefore begin with a review of how to manipulate numbers using *standard form*, and how to convert between various *units*.

The course will then explore what the Universe is made of, and indeed how its constituent parts interact.

We will then look in more detail at three key concepts which underpin almost all of Physics, Chemistry and Biology. The first of these will be *Energy* and the concept of *Heat*. The second will be *Mechanics* and the third *Waves*.

Overall aims

The main aim is to give a broad overview of Science as an interconnected body of ideas, and indeed what the key ideas are. There will be a blend of experiments, presentations, quizzes, games, discussions, computer models and calculations, which are hoped to be representative of the various skills and approaches associated with Science in practice.

The course difficulty is aimed at bright 10-13 year olds, and therefore the Mathematical sophistication required will be mostly limited to basic arithmetic, use of indices and some simple algebra.

The teaching style and course content is likely to be similar to what to expect from a Year 9 Physics class, so participation in this course should be good preparation for future study.

Contents

Day 1 What is Science? How do we quantify the Universe?

Day 2 What is the Universe made of? How do its constituent parts interact?

Day 3 Energy and Heat

Day 4 Mechanics and Machines

Day 5 Sound, Light and other Waves

Equipment

Please bring writing equipment (pencil, sharpener, pens, eraser, ruler etc) and a calculator. Geometrical equipment (compass, protractor) might also be useful.

Although photocopies of handouts will be provided, it is highly recommended all notes, calculations, reflections etc are written into an exercise book. A spiral bound A4 book is recommended. Lined or blank as per personal preference!

Although use of a Smartphone for social media shall be distinctly frowned upon, there are many useful calculator, stopwatch and other measurement apps available. I am happy for students to use these as appropriate, as long as they don't distract from the course.

If a student wishes to bring a laptop, this is also encouraged. The course will include a number of practical tips regarding Excel, PowerPoint and other popular software packages. However, a laptop is certainly not required in order to participate fully.

How to get the most out of this course

Active engagement in the course is key!

- Write clear notes during presentation and discussion phases. Don't just listen!
- Always try out any calculation, even if some of the Mathematics might be new to you. Don't be afraid to ask a question if you don't understand something or get an answer wrong.
- When we do experiments, don't wait for others to make the measurements. Offer to help! Make sure you write down any measurements you make in a nice clear table or on a graph.
- When the day is done, spend some time reviewing what you have learnt. Write down any questions that you might have in your exercise book. Ask them the next day, and write the answers next to the question.

Resources

Handouts will be provided. Feel free to write on these. Electronic copies of many of the resources will be available for download from www.eclecticon.info

Check out the Maths, Programming or Physics pages for links to resources associated with this course, and many other topics!

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