Overview

This document gives an overview of the Comet Chasers project, what it aims to achieve, and how.

Overall, the project has 5 main aims:

1. To increase the level of knowledge and interest of pupils (and teachers) in astronomy, particularly comets and galaxies.

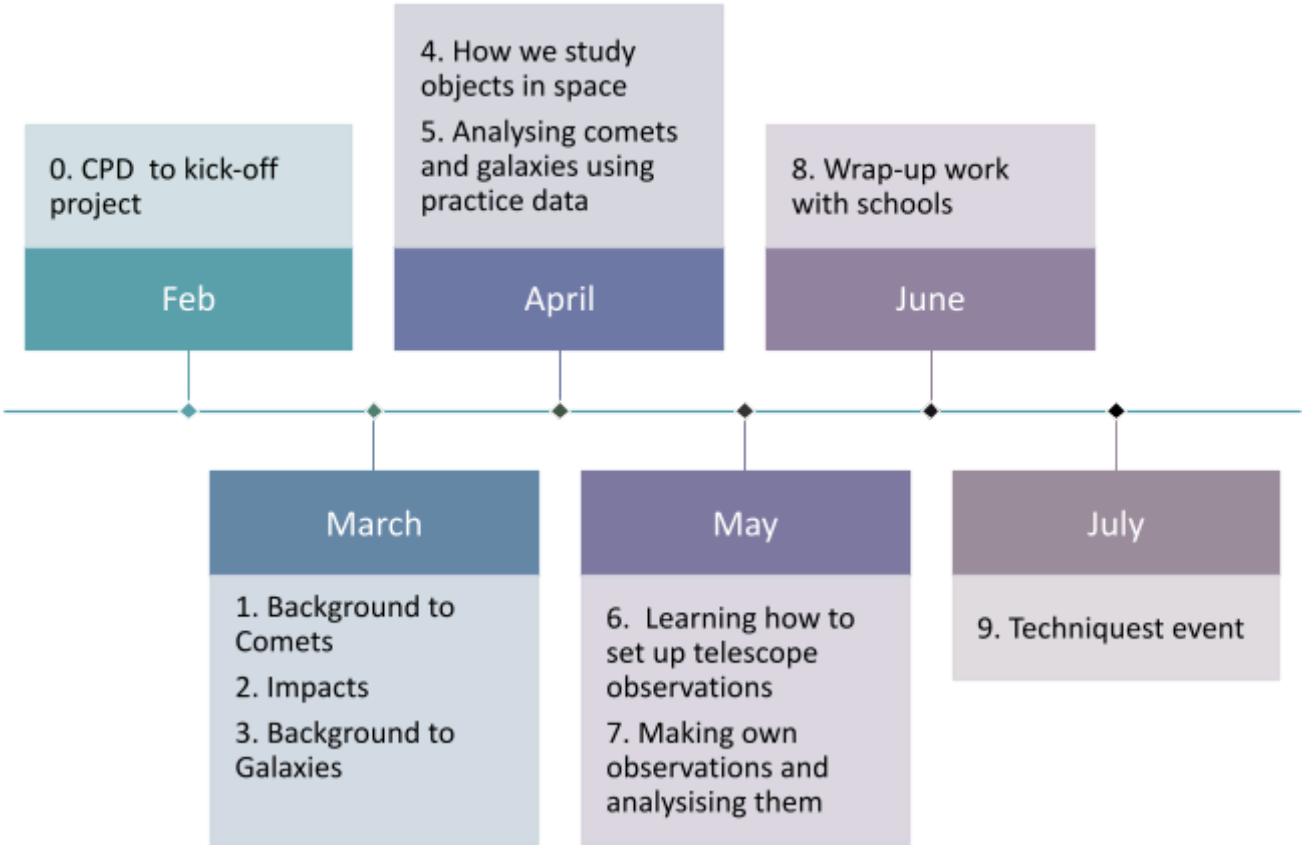
2. To use astronomy as a vehicle for helping teach other core elements of the curriculum: maths, science, geography, teamwork and communication.

3. To encourage pupils to think scientifically – plan, implement, test, review, adapt – and to analyse and draw conclusions.

4. To raise aspirations by getting pupils involved in real research with research scientists, supported by amateur astronomers.

5. To reinforce the idea that science, and problem solving, is interesting and fun.

The project is designed to have a range of activities of different complexities, with resources being added based on the timetable below. It is not a requirement that schools undertake all activities, or only at the times indicated. Some elements are stand alone, but others rely on learning and understanding from earlier modules. We will indicate where there is a prerequisite.



Elements of the Project

A core element running through the activities is the **Scientific method.**
Pupils will consider problems, look for solutions, choose options, implement, test, analyse and review results. They can also communicate their results to others through various means.

Module 1 : Background to comets

Pupils will learn what comets are, how they have been observed in history and how we observe them now. They will learn about their path and speed through space, how they are named, and why we study them. They will also be introduced to the Rosetta Mission which sent a spacecraft to make a long-term study of a comet.

The resources include fact sheets with quizzes, cartoons and associated comprehension tests, making models, interactive orbit diagrams, build a solar system including comets using Scratch, and some videos of comets being made in a laboratory setting.

Module 2: Impacts

One reason we monitor the position of comets is to provide alerts if they may be on track to come very close to, or even impact, Earth (although this is very, very rare!). It is likely that a comet or asteroid impact caused the Dinosaur mass extinction event – so the consequences of an impact can be very severe! Pupils will learn about different impactors and impacts. They will use an impact simulator to look at how varying the type of material, speed, angle and impact site affect the size and depth of crater produced and the consequences for the area. The differences between impacts on the Earth, the Moon and Mars will be considered.

The resources include factsheets, a practical demonstration (using flour and cocoa powder), an on-line impact simulator and, when possible, the loan of boxes of meteorites and fossils.

Module 3: Background to Galaxies

Pupils will learn what galaxies are, how they have been observed in history (including by Charles Messier), how we observe them now, how big they are, where they are, how they are classified, and why we study them.

The resources include fact sheets with quizzes, classification sheets, some videos of different galaxies, spotting differences (supernova), Messier bingo, and working out when we can see them (based on location of observers, date and time).

Module 4: How we study these objects

Pupils will learn about how we use light to understand more about these objects. This will include thinking about how cameras collect light (like buckets collect water), how we can see that different parts of objects have different characteristics, and how measuring changes in brightness over time can tell us a lot about an object. And finally, how measuring different colours of light using filters can help too. We will explore the way it can be difficult to know whether an object is bright because it really is bright or whether is just close. We will introduce the idea of a light curve graph and measure everyday objects. Pupils will plot and interpret graphs, will see demonstrations of light curves and when back in class be able to experiment with different objects.

We will introduce the concept of using comparisons to make measurements: how we can determine the position of a moving comet by comparing with the position of fixed stars whose positions are known; how we can determine the brightness and colour of an object by comparing it with the brightness and colour of known stars.

The resources include fact sheets with diagrams, videos, worksheets, and hands-on experimental demos of light curves using a loan kit. Data sets will be provided so that pupils can plot light curves. They will be shown examples of light curves for types of objects and be asked to estimate which type of object corresponds to their plotted graphs.

Module 5: Using Archive Data

Pupils will use data drawn from the telescope archive to look for shapes of galaxies for classification, and for any changes to spot supernovae (exploding stars). They will assemble images from different coloured filters into a coloured image. For comets they will look for changes in position, shape and brightness over time, using software.

Resources include detailed guides on using the software, and worksheets for pupils to log their findings and conclusions. The data will be checked beforehand to ensure the analysis is straightforward, and model answers will be provided. A guide to producing colour composite images will also be provided, along with how to put together short movies/gifs showing the comet moving through space.
We will provide hands-on support for teachers and pupils for software analysis elements.

Module 6: Using Telescopes to Make Observations

Pupils will learn about the telescopes in the global Faulkes Telescope/Las Cumbres Observatory network, their geographical location (including time zones), and how to control them to make observations. They will learn how the Earth's rotation, and the Earth's orbit around the Sun, affect what we can see in the night sky and when. They will learn about how a telescope compensates for the fact the Earth rotates. They will learn about how it is tricky to track objects which move through space. They will learn to plan observations.

We will run a teacher training session on use of the Faulkes Telescopes.

The resources include facts sheets on the telescopes, maps, illustrated guides and videos, for setting up observations. There are also guides to using software to see what is in the night sky at any time (using a free software package called Stellarium) and also to see when objects are high in the sky and so are best for observing.

Module 7: Gathering New Data – Making Observations and Analysing Results

Pupils will contribute to actual research on comets by making new observations themselves. They will then analyse the data. A list of comets which are coming close to Earth have been chosen. One of these is a potential target for a new space mission called 'Comet Interceptor'. We want to monitor these comets as they get close to the Sun and so become more active, giving off more dust and gas and so getting bigger and brighter. We will also add any interesting targets – comets are unpredictable, and so if another comet outbursts or breaks up we can add it to the list. We may also seek to 'recover' comets which haven't been seen for a while.

Resources include guidance on what observations to make and when – including all the detailed information need to schedule observations (and hands-on support to do this if needed). Guidance on how to download

the resulting observations will also be provided, and then how to do the analysis. There will be worksheets to allow pupils to look for and document changes in a comet's appearance and/or brightness. If big differences are noted, we would like schools to share this quickly so that we can follow up with more observations – and report to the scientific community. We will provide hands-on support for teachers and pupils for software analysis elements.

Module 8: Wrap-up Work with Schools

Schools will be encouraged to document and present the work they have done. This can be in the form of reports or posters, pictures or videos, and either for individual pupils or groups. We would love to showcase this work.

Resources will include some guides to poster and report presentation, and engagement and feedback.

Module 9: Techniquest Event

The final part of the project is a conference for schools at Techniquest in July. Schools will have the opportunity to present their work. There will also be special displays and speakers from space missions. A new planetarium show is being developed which will be launched at the event. Pupils will also have access to the huge array of exhibits in Techniquest's main displays.