Objective - to generate a series of exercises that build a scientific foundation for understanding comets, meteors, meteorites and fireballs. Applying various observations and inquiries that pertain to a single phenomenon help tie various elements of the curricumulm together and provide a context in which the outcomes achieve some relevence.

Grade	Unit	Outcome	Exercise
6	Flight	204-2, 205-5, 207-2 rephrase questions about drag ina testable form - test the performance of a flying device	How would the shape of a meteorite change the way it interacts with the atmosphere? Small bodies are slowed by the atmosphere, and often have fusion (melt) crusts. Many are smoothed on one surface only - suggesting they orient themselves so that the face with the least drag presents itself to the direction of travel. Water acts as a fluid, rather like air, though with greater resistance. Shaped plasticene could emulate the shape of meteorites and could be dropped in water to see how they orient themselves - which face would be affected most by entry? Pebbles could also be used.
6	Space	300-23 describe the physical characteristics of components of the solar system - specifically, planets, sun, moons, comets and meteors	Experiment making cookie-dough comets - NASA have such an exercise available. Exercise illustrating the origin of asteroids and meteoroids - the differences between meteoroids, meteors and meteorites. Where different types of meteorites (irons/stones) come from (compare layered Earth - irons come from the core, stones come from the mantle). The relative volume of the rocky mantle is much greater (could they calculate this with an exercise using math or bits of plasticene?... but the number of meteorites hitting the ground is heavily skewed to iron meteorites. Why? Because stony meteorites are wekaer and break up in the atmosphere more easily - the irons make it to the ground more often. Can you generate an exercise to help them appreciate this?
6	Space	300-23 describe the physical characteristics of components of the solar system - specifically, planets, sun, moons, comets and meteors	How do rocks (meteorites) from Mars or the moon get to Earth? Problem solving exercise to get them to think about this. Ans: impacts on Mars launch rocks that may intersect Earth's orbit. What is ther probability of that? Ans: Very low! Exercise to demonstrate that low probability? Launching rocks from Venus is even lower - because Venus atmopshere is 40x denser than earth's - its like lauching through jello. Incorporate into experiment? (Suggestion: fire marbles into sand (Mars) - how many sand particle to make model of Mars? - how many sand particles land on earth (a nearby pebble of the appropriate size?) - calculate/demo probability. Fire Marble onto sand under water/jello (Venus) to emulate the thick Venusian atmopshere.
6	**Space [THESE 2 EXERCISES WERE COMPLETED SUCCESSFULLY BY PREVIOUS STUDENTS]**	**302-13 identify constellations in the night's sky**	**Using Heavens-above.com website for a given date/time, and viewing location, bring up a constellation map - get students to define the path of a meteor/fireball based on a starting and ending constellations (where the meteor was first and last observed by a camera or observer). Design a table to present the results (207-2). Perhaps illustrate that a constellation is a 2D representation of a 3D arrangement of stars using a simply constructed model/mobile.**
6	Space	302-13 identify constellations in the night's sky	Research online how constellations change with time, and use as an example. What did they look like 50,000 years ago, 10,000 years ago? How might todays constellations look in 10,000 years time?
6	Space	302-13 identify constellations in the night's sky	Define radiants of meteor showers. Knowing the time of different meteor showers and their radiants, get students to find and mark the location of the constellations on a star map. A second idea: Provide an annual time line witht the meteor show dates - say 20 days ago a meteor shower occurred with a radiant in Leo. 60 days ago, a radiant occurred in Taurus. What is the date today? What are meteor showers? Whats a meteor?
6	Space	206-4 evaluate the usefulness of different information sources in answering a given question	Design a question about meteorites/meteors/meteoroids - and ask the students to find resources to answer the question and compare 1) ease of reading, 2) content and 3) likelihook the information is correct - for these different sources (online and print (book from library)).
6	Space		Check out Celestial Sentinels video (705327). This is an NB Education Instructional video - now distributed to schools. It could form the basis of a Q and A exercise, and spawn an activity. Find the video...What is this about? Relevant?

Grade	Unit	Outcome	Exercise
6	Space	104-8, 300-23 describe the physical characteristics of components of the solar system	Exercise to inform students about the new planetary order, including the minor planets Pluto, Ceres and Eris. They could use this to investigate the definition of a planet.
6	Space	104-8, 300-23 describe the physical characteristics of components of the solar system	asteroids, comets and meteors are mentioned - they should know the size, appearance and orbits of these. Long and short period comets - the difference. Why comets have tails. Why Pluto doesn't have a tail. The direction of the tail relative to its motion/the sun.
9	Space Exploration	312-4 describe and explain the apparent motion of celestial bodies.	Kepler's laws and why comets travel fast in inner solar system and meteorites travel much slower. An elliptical orbit (that of a comet) could be drawn on some graph paper. A wedge containing 100 small gridded squares could be presented. The task: draw an adjacent wedge containing 100 squares, then another adjacent wedge, etc. What is noted about the size of the wedge, the length of arc on the ellipse etc. What does this mean for the velocity a comet travels in the inner solar system versus the outer solar system? Check out the ellipticity of the planets, especially Pluto. How is Pluto unusual from the other planets?
9	Space Exploration	312-4 describe and explain the apparent motion of celestial bodies.	Describe the rotation direction of all the planets - are they the same? They mainly are - why (think of water bucket with milk poured in, it is all moving in same direction, even the vortices are generally in the same direction. Make a model of the rotation axes? Come up with ideas as to why two (Venus and Uranus) are so different from the other? Ans: they were hit by impacts Early on in the solar system history and their rotation direction either reversed or tilted dramatically
9	Space Exploration	111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems.	Investigate various methods for viewing objects in space: naked eye, ground and space-based telescopes (Hubble telescope), radio telescopes, orbiting spacecraft, landing spacecraft, rovers. How have these advances changed our knowledge of say, Mars, through history?
9	Space Exploration	109-11 relate personal activities and various scientific and technological eandeavours to specific science disciplines and interdisciplinary studies. 209-4 (organise data) 210-16 (analyse and identify questions from the data)	Define the time of an annual meteor shower during the school year. Formulate an exercise the teachers can use to encourage the students to make measurements, record and interpret data.
9	Space Exploration	312-4 describe and explain the apparent motion of celestial bodies.	p.67 of the Curriculum document suggests students must understand Ptolemy's view of planetary motion (earth-centred universe). It can be complicated for teachers to describe the evidence against a geocentric solar system - though some online animation webpages can assist dramatically. Fundamental to an undertanding of this is the phenomenon of retrograde motion of the planets and how it can be explained by earth- or solar-centred universe models. http://www.mhhe.com/physsci/astronomy/applets/Retro/frame.html
	MATH		Draw histograms of meteor frequencies/hr over the duration of a meteor storm and meteors/day at other times. These scribe a bell curve that peaks at the centre of the storm. What is a bell curve? Do exercises on finding 66, 95% under the bell curve by superimposing on graph paper?
	MATH		Exercise to convert geographic coordinates from degrees, minutes and seconds to decimal degrees (i.e., converting from Base 60 to decimal degrees)
	MATH		2D trigonometry and 3D trigonometry. Provide spreadsheet?