TEACHER RESOURCE

SCIENCE CONTENT/ CURRICULUM LINK
• NATURE OF SCIENCE – INVESTIGATING IN SCIENCE/ PARTICIPATING & CONTRIBUTING.
• PLANET EARTH AND BEYOND – ASTRONOMICAL SYSTEMS.
• PHYSICAL WORLD – PHYSICAL INQUIRY AND PHYSICAL CONCEPTS

STARDOME OBSERVATORY & PLANETARIUM
FACTS, RESOURCES AND ACTIVITIES ON...

ANCIENT ASTEROIDS
(PART TWO - CATEGORIES, COMPOSITIONS AND COLLISIONS!)

Barringer crater Arizona – the result of an iron meteorite impact 50,000 years ago. Credit: NASA

When our solar system was forming there was gas, dust, ice and rock swirling around our central Sun. It is thought that most asteroids are pieces of rock and ice from a 'planet to be' that was prevented from pulling itself together. Nearby Jupiter's strong gravity kept pulling at the pieces causing them to collide and scatter so our little planet to be never stood a chance.

Asteroids are either solid or just piles of rubble held together by their own tiny gravity.

Scientists have classified asteroids by composition into three main types: C, S, and M. Most are C-types (chondrites) probably made up of clay and silicate rocks and are quite dark. The S-types (stony) are brighter and made up of silicate materials and nickel-iron. The M-types are metallic (nickel-iron) which are also reasonably bright. People are thinking about the future possibilities of mining asteroids for their precious cargoes!

Scientists understand asteroid compositions by using spectroscopy to study the light coming from them. Radar signals have also been bounced off asteroids and studied.

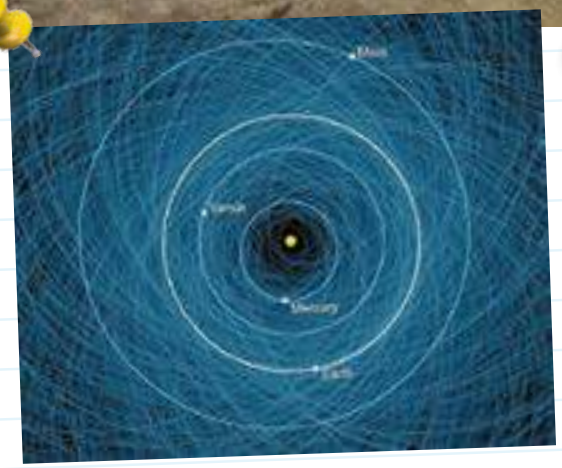
In 2005 the Japanese Aerospace Exploration Agency sent the Hayabusa probe to an asteroid and returned with a sample in 2010. NASA's OSIRIS-Rex probe launched in 2016 and hopes to return a sample in 2023.

Scientists also study space rocks that have impacted with Earth (meteorites) many of which are from asteroids. Some 200 impact craters have been identified on Earth. Fortunately, most impacts are small and catastrophic collisions are rare (like the one that crashed during the time of the dinosaurs).

In our resource 'Ancient Asteroids – part one' we learned that different groups of asteroids exist in various regions of the solar system. The category of most concern is near-Earth asteroids (NEA's). NEA's can be divided up into even more groups, but only two, the Atens and Apollos, ever cross Earth's orbit.

NASA's recent 'potentially hazardous asteroid' (PHA) map reveals the orbits of 1,400 objects. The map might look bad, but remember that space is really huge. PHA's are objects larger than 150 metres that can pass within 7.5 million kilometres of Earth (twice the Moon's distance). None of these are currently a threat.

Astronomers worldwide are constantly tracking asteroids and searching for others. They are confident that >90% of the largest asteroids that could endanger the Earth have already been identified. There are programmes in place, such as NASA's Planetary Defence Coordination Office, that investigate ways to help avert dangerous impacts.



Near Earth Asteroid map. Credit: NASA/JPL-Caltech

100 tons of asteroid and comet material hit Earth's atmosphere every day.

Water ice may be common on asteroids.

As at October 2016, 15,000 'near-Earth asteroids' have been discovered.

Check out these other resources...

- http://www.space.com/51-asteroids-formation-discovery-and-exploration.html
- http://www.space.com/22369-nasa-asteroid-threat-map.html
- https://www.nasa.gov/planetarydefense

DISCUSSION POINTS

Discuss the pros and cons of asteroid mining. What things would we look for? Would we look for water and why?

How dangerous are NEA's? Research and discuss recent impacts.

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ASTEROIDS

PART ONE: MEASURE ACTUAL IMPACT CRATERS ON EARTH

you'll need...

- Google Earth – download from: http://earth.google.com/

Instructions...

In the search box in Google Earth enter the latitude and longitude of one of the impact craters listed below – e.g.: Barringer, enter N35 02 W111 01.

To measure the craters click on Tools > Ruler (or click on the ruler symbol at the top of the window). In the pop up box select km. You can now measure the diameter of each crater by dragging a line across the width.

Once you have the diameters you can compare them with localities you're familiar with. E.g.: in Google Earth, search your school address, choose the ruler tool, select km, zoom out so you can fit the lines on your new map, and draw them out.

Crater Name	Latitude	Longitude	Size (km)
Barringer Meteor Crater 50,000 years old. Easy to find in Google Earth	N35 02	W111 01	
Manicougan One of the oldest known.	N51 23	W68 42	
Clearwater Lakes Two impact craters formed by a pair of asteroids	N56 13	W74 30	
Upheaval Dome Has a central peak, inner crater, and outer concentric shock rings.	N38 26	W109 54	

With thanks to Back Down to Earth: *http://education.down2earth.eu*

Take a photo of your activity and send it to us. We'd love to see it! education@stardome.org.nz

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PART TWO: DISCUSS THE PROBABILITY THAT AN ASTEROID WILL HIT EARTH.

Astronomers can observe the paths of NEA's and predict the chances of them impacting Earth. For example, if they figure out that a particular asteroid might take a thousand possible paths, just one of which would result in an impact, then the odds of impact are a thousand to one.

Review probability by putting different coloured marbles (or jelly beans) into a jar. Use the following equation to calculate the chances of selecting a marble of a particular colour.

Number of chances possible for the event
(e.g., the number of a certain colour marble)

Number of total chances
(e.g., the total number of marbles)

Make sure the marbles are well mixed up and test the theory. Zero probability means the event will not happen; one means it is certain to happen.

With thanks to PBS NOVA Education:
http://www.pbs.org/wgbh/nova/education

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