

Asteroid Hunters Educator Guide

A resource for using QUEST video and audio in the classroom

Watch it online <http://www.kqed.org/quest/television/view/26> | TV story length 8:18 minutes
Listen online <http://www.kqed.org/quest/radio/an-asteroids-close-call> | Radio story length 5.45 minutes



QUEST SUBJECTS

<p>Life Science</p> <p>Earth Science</p> <p>Physical Science</p>	<p>Biology Health Environment</p> <p>Geology Weather Astronomy</p> <p>Physics Chemistry Engineering</p>
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CA SCIENCE STANDARDS

Grade 3

Earth Science

1. An object's motion can be described by recording the change in position of the object over time. (b)

Grade 5

Earth in the Solar System

5. The solar system includes the planet Earth, the Moon, the Sun, seven other planets, their satellites and smaller objects, such as asteroids and comets. (b)

Grades 9-12

Earth Science

Earth's Place in the Universe

1. Evidence for the dramatic effects that asteroid impacts have had in shaping the surface of the planets and their moons and in mass extinctions of life on Earth. (a)

PROGRAM NOTES

Watch **Asteroid Hunters**

Call them traveling wanderers through our solar system, asteroids and their fellow wanderers, comets, have the potential to greatly impact and alter life as we know it should one strike planet Earth.

Listen to **An Asteroid's Close Call**

On January 30, 2008, it seemed possible that an asteroid the size of a Boeing 737 jet was due to collide with Mars. Today that seems far less likely, but, as this radio segment describes reports, astronomers consider the event a wake up call.

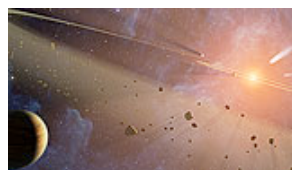
In these segments you'll find...



- ⦿ what tools and techniques scientists use to find asteroids.
- ⦿ possible ways to deflect asteroids heading toward Earth.
- ⦿ the implications of an asteroid of substantial size hitting Earth.

TOPIC BACKGROUND

Too small to be considered planets, asteroids, also known as minor planets, are rocky and metallic objects that inhabit our solar system. Usually found in the Asteroid Belt (the area between Mars and Jupiter), asteroids usually take between three to six Earth years to complete their orbit around the Sun. Ranging in size from pebbles to larger than 150 miles in diameter, asteroids are kept in line by Jupiter's gravitational force, which prevents asteroids from slipping out of orbit and hitting the inner planets.



Not much is known about the origins of the asteroids, but one hypothesis suggests that they were formed from material that did not accrete (condense) into a single planet.

Occasionally, some of these asteroids have hit Earth (near-Earth asteroids) and left impact craters as evidence. The most recent example of a collision with a significantly-sized asteroid was in 1908, when a large asteroid hit Tunguska, Siberia, exploding with the force of a nuclear bomb. That impact took place in the wilderness with no major loss of human life and property. However, there has been much discussion about the role of asteroids in several mass extinctions of plant and animal life on Earth in the past, and what must be done to prevent the same thing from happening in the future. Ideas abound on how to alter the paths of asteroids headed toward Earth.

More Background Information and Resources for Teachers

http://www.nasa.gov/worldbook/asteroid_worldbook.html

VOCABULARY

Asteroids

rocky, metallic objects, too small to be considered planets, that orbit the Sun

Comet

a celestial object made of dust and ice

Tunguska

a powerful explosion that occurred in Russia, believed to be caused by a near-Earth object like an asteroid, comet, or meteor.

Gravity Tractor

a spacecraft that hovers in space and changes the speed of asteroids

Apophis

asteroid named after the Egyptian god of chaos and destruction

Solar System

eight planets and all other celestial bodies that orbit the Sun.

Planet

a celestial body larger than an asteroid or comet

Keyhole

small corridor in space

Minor Planet Center

an international body that tracks asteroids and comets

PRE VIEWING

- What is an asteroid?
- Do you think we should worry about asteroids hitting the Earth?

VIEWING FOCUS

NOTE: You may choose to watch the television and radio segments twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- Does the size of an asteroid matter?
- How often do asteroids hit Earth?
- What is the method used for finding asteroids?
- Where is the main asteroid belt located in the solar system?
- What are some of the ideas scientists have to prevent a future asteroid collision?

QUEST, PBS, and NPR LESSON PLANS & RESOURCES

NOTE: Resources from the Teachers' Domain collection require a fast and free registration

What Killed the Dinosaurs? Teacher's Domain

<http://www.teachersdomain.org/resource/tdc02.sci.life.div.dinokill>

This activity focuses on the investigation of evidence and clues that suggests the asteroid-impact hypothesis as the most convincing reason why dinosaurs became extinct.

Doomsday Asteroid NOVA

http://www.pbs.org/wgbh/nova/teachers/activities/2212_spacewat.html

This activity investigates crater force, size and mass of objects that strike a surface through a simulation of crater impacts.

Nudging with Nukes? QUEST

<http://www.kqed.org/quest/television/web-extra-asteroid-hunters>

This video segment focuses on the theories of David Dearborn of Lawrence Livermore National Laboratory about how nuclear explosives could be used to effectively nudge an asteroid into a new orbit that causes it to miss Earth entirely.

Comets, Asteroids, and Meteors Science Friday

<http://www.sciencefriday.com/topics/c020300/>

A collection of past Science Friday conversations on comets, asteroids, and meteors.

The Asteroid That Hit L.A. NOVA: Science NOW

<http://www.pbs.org/wgbh/nova/sciencenow/3313/01-aste-flash.html>

A catastrophe calculator lets you try some "what if" scenarios.

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California Academy of Sciences
www.calacademy.org

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www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

U.S. Geological Survey
www.usgs.gov

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21ST CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?

<http://www.kqed.org/quest/downloads/QUESTWhyMedia.pdf>

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning

<http://www.kqed.org/quest/downloads/QUESTMediaTips.pdf>

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis

<http://www.kqed.org/quest/downloads/QUESTMediaAnalysis.pdf>

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps

http://www.kqed.org/quest/files/download/52/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

OTHER WAYS TO PARTICIPATE IN QUEST



LOG ON

www.kqed.org/quest



LISTEN

**KQED 88.5 FM San Francisco &
89.3 FM Sacramento
Mondays at 6:30am and 8:30am**



WATCH

**KQED Channel 9
Tuesdays at 7:30pm**

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Had things been just a little different, the doors to this telescope at Chabot Space and Science Center in the Oakland hills would have been open wide early on the morning of January 30 when the giant rock that astronomers call WD5 was scheduled to collide with Mars. Staff astronomer Ben Burrell was planning on throwing a party here to celebrate.

BURRELL: We were getting pretty excited there, you know, and the odds of it hitting kept getting better and better, until it was like a 1 in 25 chance that this big asteroid is going to hit Mars.

But as more measurements were taken, the odds got worse. And worse. Until finally, NASA announced that the chances of asteroid WD5 hitting Mars are 1 in 10,000. That's about as likely as an average golfer making a hole-in-one.

But WD5 still matters, in part because it was discovered by accident. Even though NASA routinely scans the skies for nearby asteroids, it often doesn't pick up asteroids as small as this one. Which means that if WD5 was Earth-bound, instead of Mars-bound, we might not have spotted it at all, until it was too late.

(Deep Impact trailer): "Good luck to us all"

The movie *Deep Impact* gave a reasonable, if extremely unlikely depiction of two enormous comets hitting Earth.

(Deep Impact trailer): "Last summer two comets were discovered that are on a collision course with Earth. Oh my god!"

In real life, comets, which are made of ice and rock, are far less likely to hit Earth than asteroids which are just rock and metal. And those don't hit very often either.

David Morrison is an astrobiologist with NASA's Ames Research Center in Mountain View. He says the last time Earth got hit by an asteroid, roughly the size of WD5 was, actually, not that long ago.

MORRISON: On June 30, 1908, just about a hundred years ago, a brilliant meteor, a fireball, came out of the sky and landed in a wilderness area with an explosion that knocked down trees over several thousand square miles.

Later an eyewitness would say that the collision looked like "a second sun. The sky opened up, hot wind raced between the houses, like from cannons, which left traces in the ground like pathways." But geographically, it was the luckiest of breaks.

MORRISON: Nobody was there. People saw it from a distance, but the first scientific expedition didn't arrive for twenty years. But we now recognize that as the one concrete example we have on earth of a cosmic impact, a rock from space that plunged into the atmosphere, exploded and did almost no damage, because it was a wilderness, but would have been a terrible tragedy if it had happened over a city.



AN ASTEROID'S CLOSE CALL — QUEST RADIO TRANSCRIPT

NOTES & QUESTIONS

Statistically, asteroids this small hit the earth every few hundred years. Much rarer and larger are asteroids the size of what probably wiped out the dinosaurs 65 million years ago. That one was about 10 miles wide. But asteroids don't have to be even nearly that large to do a lot of damage, says Ben Burress.

BURRESS: If it hit the ocean, there would be enormous tsunamis that would probably wipe out coastal areas all over the world. There would be an enormous amount of material blown into the atmosphere. Some of us would survive. I don't think it would be a total whole earth killer.

The chances of this happening in the next century are about 1 in 5,000. But it could happen anytime. So, if we saw an asteroid hurtling toward Earth, the question is, could we stop it? Burress describes one possible method.

BURRESS: A large spacecraft that would basically park itself next to the asteroid and it would have engines; it would be like a tug boat, basically. Over time it would just gradually tug on the asteroid, from its gravitational attraction, just kind of alter its course a little bit but over a long period of time.

STANDEN: How long?

BURRESS: Well, the longer the better. Years. Probably years.

And developing that technology, which doesn't even exist yet?

BURRESS: You know it'd be, at least on the order of when we first went to the moon, I would think.

Two years ago, Congress ordered NASA to survey the majority of asteroids and other objects larger than 450 feet across whose orbits are near Earth. The goal, says Morrison, is to buy ourselves some time.

MORRISON: The key to defending the planet is to have long warning time. If we discovered an object that was on a collision course 20 years before it hit, then I think we have the technology to deflect it. If we found it a month or two before it hit, then no. We might be able to evacuate the area, but we could not deflect it.

Each year, NASA spends about \$4 million on its Near Earth Object program, which collects information about nearby asteroids. In November, a NASA spokesman said that without more money, that project will take a century to complete.

For QUEST, I'm Amy Standen, KQED Radio News.