



OVERVIEW

This activity uses the context of asteroids and meteorites, and the film Armageddon, to allow students to explore kinetic energy, momentum, and critical thinking by asking them to establish whether the information presented in the film is correct.

CURRICULUM LINKS

Kinetic energy.

Unit conversion.

Problem solving.

Critical analysis.

WHAT YOU NEED

A18 Powerpoint

18.1 Armageddon time? worksheets (one per student)

Optional – meteorites from the loan box (if you have it at the time of this lesson)



STARTER

Go through the introduction slides on meteorites and show the images of Barringer crater. Ask students to estimate the size of the object that created this crater.

Run through the answers and get students to reflect on any errors they may have made during their calculation.

A18 PowerPoint



ARMAGEDDON TIME?



MAIN ACTIVITY 1

Explain that Armageddon was a 1998 film where Bruce Willis and his team saved the world from an impact event by an asteroid.

Set out the parameters of the object (as defined by the movie). Students then calculate how much energy the bomb would need to have to blow the asteroid into two halves that will both just miss the Earth. Ask them to state any assumptions that they have made.

Look at their answers and get them to compare this amount of energy to other known amounts (on the slide). On this basis, and by discussing the simplified assumptions that they have made, get them to comment on how realistic the movie was.

ACTIVITY 18.1 ARMAGEDDON TIME?

In the 1998 film Armageddon, Bruce Willis and his team of oil drillers are asked to save the world from a massive asteroid impact by going to the asteroid, drilling down into the asteroid, and placing a nuclear weapon to blow it into two fragments that will miss the Earth.

In this lesson you will learn about asteroids and meteorites, calculate the kinetic energy of a previous Earth impact, and extend these ideas to establishing whether you think the premise of the movie is realistic or not.

ACTIVITY 1: HOW BIG WAS THE BARRINGER CRATER?

Kinetic energy = $2500\text{ kT TNT} = 4.3 \times 10^{12}\text{ J}$
 Entry velocity = 12.8 km/s
 Density of iron meteorite = $7\text{ g/cm}^3 = 7000\text{ kg/m}^3$

Impactor diameter =

ARMAGEDDON TIME?

In the movie, plan a bomb to blow the asteroid apart. You are going to analyse when the asteroid is about 100km from Earth. Explain in terms of the size of the asteroid whether we can truly say that the bomb would be INSIDE the asteroid.

1. Texas has a diameter of about 100km. Explain in terms of the size of the asteroid whether we can truly say that the bomb would be INSIDE the asteroid.

2. The movie states that once the asteroid is less than 3 hours and 56 minutes away from the Earth, it is too late to divert it. Use the information along with the information given below to calculate how much energy would be required to safely split the asteroid in two, and have both pieces miss the Earth, just before this deadline. State any assumptions that you have made.

Minimum energy required:

Diagram showing Earth and asteroid at distance $t = 3\text{h } 56\text{m}$.

Density of an iron asteroid: 8 kg m^{-3}
 Radius of the Earth: 6400 km
 Diameter of asteroid: 1100 km

4. Here are some figures for various energy sources. Compare these to your answer and make a statement about the energy that would be required and the likelihood of this being possible.

Hiroshima nuclear bomb: $6.3 \times 10^{13}\text{ J}$
 Biggest ever nuclear weapon test: $2.092 \times 10^{17}\text{ J}$
 Energy output of the Sun: $3.846 \times 10^{26}\text{ J s}^{-1}$

So what could we do?

Think about, and discuss with your table, what other options there might be open to scientists and engineers when it comes to destroying or deflecting an asteroid that might hit the Earth.

- How could we use lasers?
- How could we use kinetic energy and momentum?
- How could we use gravity to explain how your options would work and how feasible you think they are.

18.1 Armageddon time



MAIN ACTIVITY 2

Ask students what other methods they can think of that can be used to deflect or destroy an asteroid.

Get them to consider, and attempt to explain, the principals behind gravity tractors, laser ablation and kinetic impactors.

You can then use the slides that cover these topics to summarise and reinforce the physics concepts.



PLENARY

If you have the Borrow the Moon loan box, you could use this as an opportunity to get some of the samples out and view them. If not, get students to write a short

piece detailing why it is important to focus on research into protecting our planet from impacts.

They could extend this into a report for the government detailing the physics behind impacts as a homework task.