

Critical Thinking Answer

"An asteroid is on a collision course with Earth, say scientists. Dubbed AB175, the space rock has been measured at 30 kilometers wide and may weigh up to 1 million kilograms. 'Our calculations show that its trajectory will put it within 100,000 kilometers of the Earth in March of 2012,' says Dr. John Smith of the Westville Observatory. Dr. Joe Williams of Easttown University says, 'An asteroid like this one wiped out the dinosaurs millions of years ago. Humanity could be next if we don't do something about it.'"

Run through the checklist, and write down your answers. When you're done, compare your results to those shown below.

- Identify the arguments, the provided data, and the assumed data.

Arguments:

- An asteroid may strike the Earth in 2012 *because* its trajectory will intersect ours.
- The asteroid could wipe out all life on Earth *because* this asteroid is like the one that caused the extinction of the dinosaurs.

Provided Data:

- The asteroid is named AB175
- AB175 is 30 kilometers wide
- AB175 is estimated to weigh 1,000,000 kilograms
- The current trajectory of AB175 will intersect that of Earth in 2012
- John Smith is a PhD who works at Westville Observatory
- Joe Williams is a PhD who works at Easttown University
- An asteroid similar to AB175 caused extinction of the dinosaurs
- What are the sources of the data?

Although it starts the vague identification of "scientists," later it quotes someone who works at an observatory who refers to their calculations. This implies that the primary source is Dr. Smith and his colleagues.

The second quote is more dubious. Even though it is someone who is a doctor and is associated with a university, there is no indication that this person produced any of the data or has even examined it closely. Their field of study may not even have anything to do with astronomy - just because someone is a doctor does not make them an expert on all subjects.

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- Can you verify the data, by checking their sources or by checking an alternate source?

Does Westville Observatory have a web page? If so, they may have posted a press release or an article of their own, with more details on their studies and calculations. For example, the article claims that the asteroid weighs "up to" a million kilograms - this may mean that the scientists estimated between half a million and one million kilos. News articles tend to take the more extreme estimates in order to make the news more exciting.

Have other observatories witnessed the asteroid, and made similar calculations? A web search for the asteroid name might locate this information. If only one group of scientists have come to this conclusion, then it is not as solid as it would be if other groups had independently verified it themselves. As well-intentioned as the original group might be, scientists are human and can make mistakes.

Was the asteroid is comparable to that one which caused the extinction of the dinosaurs, as they say? Although there is much debate as to the size of any such asteroid (or whether it was the cause of the extinction at all), research might turn up estimates for the ancient asteroid's size at 100m in diameter and weight at 200,000 kilograms. So this one is quite a bit smaller, but still comparable in size. The statement that its impact will cause serious damage to life on Earth is not without merit.

- Is the data internally consistent?

One consistency check that suggests itself is whether the asteroid's size make sense for its weight. One notices when comparing against the estimated size of the ancient asteroid above, that this one is much smaller in diameter, but the article lists it as being much heavier. Although not impossible, this seems a bit odd. Since the size of the asteroid is easier to guess than the weight (we can see it, but we can't weigh it), it seems likely that the size is correct and the weight is overestimated.

- Is context provided? If not, do some brief research to create context.

An obvious point of context is: how often do asteroids of this size or larger pass this closely to Earth? It may be that, looking back through past news articles on the same subject, this sorts of collision predicts are announced several times a year. If this many asteroids are in danger of striking Earth, but (to date) life on Earth has only faced serious danger from them on several occasions over the past few hundred million years, then the chances that this one are anything special seem low.

Similar to the point above, what has happened when asteroids of this size have collided with the Earth? Research might show that asteroids lose quite a lot of

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their weight and velocity while entering Earth's atmosphere, and therefore pose less danger when they strike. Moreover, if you can find a specific instance of an asteroid of comparable size striking in recorded history, then you can examine the effects of that collision. For example, if it struck far out in the ocean and did little except produce some minor wave disturbances at distant shores, then this would cause you to consider that asteroid strikes may only have ill effects if they strike near a populated area.

The article implies that concern is warranted because the asteroid will pass within 100,000 kilometers of the Earth. That sounds like plenty of room. Will it really be a close call? For this you need some additional data, such as [the radius of the Earth, which is 6,000 kilometers](#). 100,000 and 6,000 are close enough for us to say that, yes, that sounds like there is a reasonable chance for the asteroid to collide with Earth. In this case a visual representation may help. Draw a circle that is 10 centimeters in radius, then another that is 0.6 centimeters in radius, both with the same centerpoint. (This is the same size ratio as 100,000 and 6,000.) The inner one is the Earth; the other one is the area where the asteroid may pass. Looking at the picture may give you a better sense of the distance involved, and help you imagine the chance for a collision.

- Do their conclusions make sense given the supporting data?

The first conclusion, that the asteroid may strike us, seems solid enough assuming you can verify that the scientists have actually made the observation of the asteroid's size and trajectory, that other scientists have seen the same thing, and that both have run calculations to determine the collision possibility and have gotten the same result.

The second conclusion is much more dubious. Although the asteroid will pass near Earth, its chances of striking it are still fairly low (look back at the picture you drew). If it does strike, its size is much less than that which caused the Cretaceous extinction. For that matter, the extinction being caused by an asteroid strike is still up for debate, so drawing comparisons to it is a bit shaky. Nevertheless, there are many parallels, so this conclusion does have some value.