Crater Lesson for 4th graders

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Understand: the size of a crater is affected by variables such as mass and distance

Know: The more mass of an object the greater the size of the crater and the farther the distance of the projectile, the larger the crater.

Do: Groups will be divided between doing two experiments and then come back together to report their findings.

SOL 4.8

The student will investigate and understand the relationships among Earth, moon, and the sun

SOL 4. 1

The student will plan and conduct investigations in which a) distinctions are made among observations, conclusions, inferences, and predictions; b) hypotheses are formulated based on cause-and-effect relationships; c) variables that must be held constant in an experimental situation are defined; d) appropriate instruments are selected to measure linear distance, volume, mass, and temperature; e) appropriate metric measures are used to collect, record, and report data; f) data are displayed using bar and basic line graphs; g) numerical data that are contradictory or unusual in experimental results are recognized; and h) predictions are made based on data from picture graphs, bar graphs, and basic line graphs.

Time to Complete Lesson: 2 class periods/ 1 hour session

Non technology materials: leveled articles and books on our solar system, moon and craters, Materials needed for lab: marbles, rocks of varying masses, flour, basin, cocoa with holes in top to sprinkle, tape measure in centimeter, small millimeter ruler (copy from kit), newspaper to spread under basin, copies of lab with chart for gathering data and line graph, scale,

Technology materials: Interactive smart board or promethean board, laptops or Ipads.

Teacher preparation prior to lesson to maximize time:

* Have all supplies ready on supply table
* Have the sites for the lesson minimized and ready to show.
* Have a demo of the lab ready to show
* Open the links above: picture of the moon, picture of a crater on Earth, animations of crater formation,

For Day 2, have materials ready for choice boards including ipads, laptops, relevant and leveled books and articles related to craters, Earth, moon and asteroids.

Methods of Assessment

* Formative (preassessment on day 1 and at end of day 1)
* Students will record their data in their science notebook (day 1)
* Students will have differentiated homework to explore more about craters (day 1)
* Choice board (day 2)

Day 1 : Procedures/Activities

Preassessment

As students come in, have up on the smart board a picture of the moon showing craters moon next to a picture of a crater on the Earth. Earth's craters Students are grouped heterogeneously  **(Doubet, Day 1)** by the teacher and sit at tables. Students begin each day in my class with a warm up to either preassess or spiral review. Today, they will have a sheet of paper with True/ False questions.

Teacher: *Hello class. What do you notice about the pictures on the screen?* (Expected response: one is the moon and it has a lot of craters. One looks like Earth and it’s one big crater. Some of the craters on the moon are larger than the other. ) *I want to show you a very cool simulation from NASA on how craters are made. I’m so excited today to not only learn about the formation of craters on the moon that you see on the screen but also to help you discover through a scientific investigation on what factors affect the size of moon craters. On your table is a ½ sheet to see what you may already know about what we are talking about today. Use a read marker to mark your answers and we’ll use a blue one at the end of class to see how much you’ve learned.*

1. The moon has an atmosphere similar to Earth, but most of the craters on Earth are under water.
2. The only reason some craters are bigger than others is because the object that hit them was larger.
3. The closer an object is when it drops to the surface, the bigger the crater will be.

Teacher: *Let’s go over your responses. If you answered True, put thumbs up on your chest. If you answered false, thumbs down on your chest.* Go over the questions to get an idea of where students are, but not correcting or explaining whether they are on target or not.

Explain the procedures for today’s experiment:

*Your team captain today is the student who has the most green on.* **(Strebe Day 4)** *When you have your team captain, raise your hand. Team captains, be prepared to share one idea from your team on what factors affect the size of moon craters.* *Today we are going to test two variables and how they impact the diameter of a crater. The great thing is that we are going to help one another. Three tables will test one variable and three tables will test the other variable.*

*These are the supplies that we are going to use: cocoa, basin of flour, your test variable, newspaper, a tape measure in centimeters and a small tape measure in millimeters. Tables 1, 3, and 5 are going to test speed of their variable by using a marble that has the same mass. How could we test speed? Turn and talk to your elbow partner on how you think we might change the speed.* (change the drop height, the higher the height, the greater the velocity.)

*Tables 2, 4 and 6 are going to test mass by using rocks of varying masses. You will want to number your rocks and then use the digital scale to measure the mass of each. What should you be certain to control? Turn and talk to your elbow partner*. (the drop height).

*Before I finish the directions, talk to the person across from you. Tell them what your table is going to do in this experiment. If you both aren’t sure, raise your hands and I’ll come over and explain.* **(Strebe Day *4)***

*Eyes on me. Both groups will want to do each trial four times. How many times will you do the experiment?* ***(Everyone should say 4 times ...Strebe Day 4)*** *That means that if you are doing a drop height of 50 cm, you will do it four times, record it and average the four. If someone at your table isn’t sure about how to get an average to teach you, then let me know so I can explain. Then you would do 100 cm four times and average the four. If you are doing the other variable, and your first rock weighs 9.5 grams, you would do that four times from the same drop height, measure the crater diameter, record it and average it before you do the next rock. You are expected to have the chart filled out by the time the timer on the smartboard goes off. We will then share our results. Ok. Turn and talk to someone at your table that you haven’t talked to today and summarize what you need to do in the lab today. If you aren’t sure, check in with the other two people at your table. If you still aren’t sure, raise your hands.* Give them time to discuss. *Eyes on me in 3-2 -1. I’m going to demonstrate how this will look. I’m going to show you how to do the speed variable and the mass variable. Demonstrate how to make sure the drop height and the mass experiment should be completed. When you are finished, you will take your supplies back to the supply table, clean up any messes, calculate your averages and record on the big chart on the side board. Any questions? If you are your team’s go-getter this week, meet me at the table to get your supplies.*

After clean-up, and when all tables have recorded their averages, discuss the results of the experiment.

*For the groups that used speed as your variable, what was the relationship between speed/drop height and the diameter of the crater?* (expected answer, the faster the marble, the bigger the crater)

*For the groups that used mass as your variable, what was the relationship between mass and the crater’s diameter?* (the greater the mass, the bigger the crater)

*Do you think there are other factors that impact a crater diameter other than speed and mass?* (Students may or may not come to the expected answer: angle of impact, shape of the asteroid or meteorite)

*Let’s look at our questions we did at the beginning of class. Let’s go through the questions again. Use a blue marker this time to mark your response.* Go through each question and get the students’ responses. *Are there any questions you are uncertain about that our lab didn’t answer?* Expected answer that they don’t know the answer to the first question. *Our homework tonight is going to be shared as a table to see if we can find out more information about craters. I’m going to give each of you at your table a different question to investigate.* (Jigsaw, Collins Day 4) These are the questions to give to different students from highest level to lowest.

1. Investigate how scientists use information on rocks around a crater to know that an asteroid hit.
2. Explain how some craters on Earth aren’t able to be seen. Name one. Give some facts about it.
3. Research why there are more visible craters on the moon than on Earth.
4. What is the name of the biggest crater in the United States? How wide is it?

After giving the questions out, say: *Go around the table and read your research question to the table. Be careful. If you know something about someone’s question, try not to say much other than helping them understand what it is they need to find out tonight. You can always add what you know tomorrow. Are there any questions about what your task is tonight?* Take time to clarify how and where to find the information.

Day 2 : Procedures/Activities

Preassessment

As students come in today, have the clip from Killer Asteroid playing on the smartboard without sound.

Killer Asteroid to generate interest and spark curiosity **(Collins Day 5)**

Warm up questions on the board today **(Deeper Questioning Collins Day 1)**

1. Two objects are dropped from a height of 50 meters above a surface. Object A weighs 200 Kg and the Object B 1,000 kg. Predict which would make the larger crater and support with evidence.
2. Two objects are heading toward a planet. They have equal masses. Object A fell from a higher height than Object B. Which will make the larger crater? Provide evidence. .

*Good morning. Today our goals are again to understand the factors that affect the size of craters, to share what we’ve learned about craters on Earth compared to craters on the moon and to do begin some choice activities to further study craters. Let’s look at our warm up questions today.* Discuss. (Students should provide evidence from the experiments.)

*Each of you is going to share what you learned from your homework question last night. You’ll read the question you had and share what you learned with your group.*

Give time for sharing and then show each question on the smartboard. Have people from different tables share their research and to clarify any misunderstandings.

*After you spent time last night researching and reading, what further questions did you have related to this topic? In other words, what are you still curious about related to craters?*

Take time to list questions students have. It’s expected that there will questions about types of and where craters are on Earth, are there other asteroids headed toward Earth, more on the extinction of dinosaurs and maybe why all animals didn’t become extinct.

Hand out choice board and rubric. *Today we are going to spend our class time on a choice board related to craters.You will select any three of these. It will be due in one week. If you have another idea that isn’t on here or a product that you’d like to make, check in with me and we can discuss it.*

Take the time to read through each choice. Again, reiterate that if students have a different idea on what they’d like to learn or how they’d like to present it that they can meet with you**. (Collins days 1-5, differentiation of content, process and product)**

Give up until 10 minutes to go to walk around, meet with students, ask about their choices, help troubleshoot or clarify.

With ten minutes to go, have students clean up, put away magazines, technology, etc. Place exit tickets on each table.

*To close class today, I’d like you to give me a sense of how you are feeling about your research. Fill out the ticket and hand it to me on the way out today.*

EXIT TICKET

*1. One thing I learned in my research that I didn’t know: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

*2. I have picked out \_\_\_\_\_\_\_\_\_ of my 3 choice activities.*

*3. Do you need one on one time with me to help you with some questions you have on the project? \_\_\_\_\_\_\_\_\_\_\_\_\_*

*4. Questions I have:*

*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**Choice Board**

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| --- | --- | --- |
| *Use the data from our two experiments. What is the best way to graph this data? Create a graph and summarize the results.* | *Research asteroids on different planets and other moons. Compare and contrast them and include pictures of them.* | *Write an apology letter from an asteroid to the moon or Earth.* |
| *More experimenting!*  *Using the same materials that we used, explore the variable of angle of impact. Make sure you keep the mass of the object and the drop height the same in each of three trials. Put the information into a chart and formulate a way to share your results.* | *Play the online video simulation called .* [*Asteroid*](http://www.scigames.org/game.php?id=26)  *The activity you will complete is What if it hit My Town? You will need to have Google Earth loaded on to your computer.*  *Be prepared to share about your experience. You may write a summary of it, do an oral presentation or come up with an idea on how to present.* | *Compare and contrast three of Earth’s largest craters. You may present your information in a poster, chart, triple venn diagram, or come up with your own idea on how to present your discoveries* |
| *Write a short story or script where you are the hero or heroine who saves Earth from a killer asteroid.* | *Research the KT Asteroid theory of how the ancient dinosaurs became extinct. Check the portaportal for resources. Present as much evidence as you can for the KT asteroid.* | *Did you know that NASA has a mission to land on an asteroid in the next decade to keep it from entering our atmosphere. Research NASA’s Redirect Asteroid project.* |

**Rubric for Choice Board**

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| --- | --- | --- | --- | --- |
| **QUALITIES** | **Exceeds Expectations** | **Meets**  **Expectations** | **Fair** | **Attempted** |
| Knowledge of Content | Extensive use of authentic information; showed extra research; details selected to support main idea were very appropriate | Consistent use of authentic information; showed adequate research; details supported the main idea and were accurate | Inconsistent use of information; some information included but not relevant; showed some research; main idea was only partially supported by details | Showed little or no incorporation of authentic information; showed little or no research; main idea was not supported by details; many details were inaccurate |
| Overall Quality of Project/  Presentation | Extremely well organized; striking; communicated information effectively; effort and skill are clearly evident | Clear organization that is focused on main ideas; uncluttered and attractive; effort and skill is apparent | Somewhat organized but ideas are not presented clearly; information could be understood but the product was not attractive; minimal effort | Confusing and poorly organized; messy; information presented could not be understood; little or no effort |
| Creativity | Put a great deal of creative energy into project; very original | Thoughtful format with many creative touches; somewhat original | Some creative touches, but overall little originality | Put little creative energy into project; no originality |
| Mechanics | Flawless; includes very complete key ideas | Few mechanical errors; includes complete ideas | Some errors in spelling, labeling, grammar, or dates; includes some incomplete thoughts | Many errors in spelling, labeling, grammar, or dates; illegible; includes many incomplete thoughts |  |