Investigating Impact Craters Lab Activity

**Background:**

Many objects in the Solar System, such as terrestrial planets, other moons, and asteroids, exhibit impact craters. The object creating the crater is called an impactor. Most impactors are meteoroids, small rocky or metallic objects travelling through space. When a meteoroid enters Earth’s atmosphere it is called a meteor. Meteors often disintegrate as they travel though the Earth’s atmosphere, but a portion of some meteors may strike the surface. Any fragment of a meteor that survives the impact is called a meteorite.   
 Since an impactor travels at a high rate of speed due to the acceleration of gravity, the impact event is usually explosive, which is why most impact craters are circular, no matter the shape of the meteorite. Only impactors that strike the surface at a very low angle form elongate craters. Most of the impactor matter is vaporized by high pressure shock waves. The collision and explosion create a crater in which the target material is compressed, displaced, and ejected.

**Pre-Lab Questions:**

1. What is an impactor?
2. When can you call falling space rock a meteor?
3. What is a meteorite?
4. Why are impact craters always circular?
5. Research: What is the equation for density?

**Data Tables:**

Table A: Density of Impactor

Drop Height cm

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Spheres | | | | Crater Diameter (cm) | | | | Crater Depth (cm) | | | |
| Material | Mass (g) | Volume (mL) | Density (G/mL) | Trial 1 | Trial 2 | Trial 3 | Average | Trial 1 | Trial 2 | Trial 3 | Average |
| White Sphere |  |  |  |  |  |  |  |  |  |  |  |
| Glass |  |  |  |  |  |  |  |  |  |  |  |
| Steel |  |  |  |  |  |  |  |  |  |  |  |

**Data Tables:**

Table B: Velocity of Impactor

Mass g

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Steel Sphere | Crater Diameter (cm) | | | | Crater Depth (cm) | | | |
| Drop Height | Trial 1 | Trial 2 | Trial 3 | Average | Trial 1 | Trial 2 | Trial 3 | Average |
| 30 cm |  |  |  |  |  |  |  |  |
| 45 cm |  |  |  |  |  |  |  |  |
| 60 cm |  |  |  |  |  |  |  |  |

Table C: Surface Material

Mass g

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sphere | Crater Diameter (cm) | | | | Crater Depth (cm) | | | |
| Surface Material | Trial 1 | Trial 2 | Trial 3 | Average | Trial 1 | Trial 2 | Trial 3 | Average |
| Sand |  |  |  |  |  |  |  |  |
| Playdough |  |  |  |  |  |  |  |  |
| Water |  |  |  |  |  |  |  |  |

**Post Lab Questions:**

1. What was the effect of density upon crater size?
2. What was the effect of increasing drop height (velocity) upon crater size?
3. Discuss the effect of changing the surface material upon the presence of remaining impact craters.
4. Compare and Contrast features of experimental impact craters to actual impact craters.

**Station #1: Density’s effect upon crater size and depth**

Procedure:

1. Gently shake the dish back and forth to level the sand. Use the metric ruler provided at you lab table to smooth the sand so it is even with the top of the dish.
2. Have one team member hold a ruler gently so that it touches the top of the sand in the bowl.
3. Obtain the white sphere.
4. Hold the white sphere 30cm from the top of the sand. \*\*\*Measure from the top of the sand NOT the table surface.
5. Drop the sphere onto the sand.
6. Carefully remove the sphere from the sand, taking care to disturb as little sand as possible.
7. Use the small metric ruler to measure the diameter of the crater from the top of the rim on one side to the top of the rim on the other side.
8. Record the diameter of the impact crater in Data Table A.
9. Measure and record the depth of the crater. Make sure the zero mark on the ruler is truly at the bottom of the impact crater.
10. Repeat steps 1-9 for two more trials with the same sphere.
11. Repeat steps 1-9 with the glass sphere.
12. Repeat steps 1-9 with the steel sphere.
13. Take the mass of each sphere from Part A on a balance. Record the mass of each sphere in Data Table A.
14. Record the volume of each sphere using water displacement.
15. Calculate the density of each sphere using your equation from prelab #5.
16. Record the density of each sphere in data table A

**Station #2 : Velocity’s effect upon crater size and depth**

1. Gently shake the dish back and forth to level the sand. Use the metric ruler provided at you lab table to smooth the sand so it is even with the top of the dish.
2. Have one team member hold a ruler gently so that it touches the top of the sand in the bowl.
3. Obtain the steel sphere.
4. Take the mass of the steel sphere using the balance and record the data in grams in Data Table B.
5. Hold the white sphere 30cm from the top of the sand. \*\*\*Measure from the top of the sand NOT the table surface.
6. Drop the sphere onto the sand.
7. Use magnets to carefully remove the sphere from the sand, taking care to disturb the crater as little as possible.
8. Use the small metric ruler to measure the diameter of the crater from the top of the rim on one side to the top of the rim on the other side.
9. Record the diameter of the impact crater in Data Table B.
10. Measure and record the depth of the crater. Make sure the zero mark on the ruler is truly at the bottom of the impact crater.
11. Repeat steps 1-9 for two more trials with the same sphere at the same height of 30cm.
12. Repeat steps 1-9, dropping the same steel sphere from 45cm above the sand.
13. Repeat steps 1-9, dropping the same steel sphere from 60 cm above the sand.

**Station #3: Surface material’s effect upon crater size and depth.**

Procedure:

1. Find the sphere present at this station. Use this sphere to perform all tests on different surface materials.
2. Take the mass of this sphere and record the mass in the blank above Data Table C.
3. Sand Test: Gently shake the dish back and forth to level the sand. Use the metric ruler provided at you lab table to smooth the sand so it is even with the top of the dish.
4. Have one team member hold a ruler gently so that it touches the top of the sand in the bowl.
5. Hold the sphere 30cm from the top of the sand. \*\*\*Measure from the top of the sand NOT the table surface.
6. Drop the sphere onto the sand.
7. Carefully remove the sphere from the sand, taking care to disturb as little sand as possible.
8. Use the small metric ruler to measure the diameter of the crater from the top of the rim on one side to the top of the rim on the other side.
9. Record the diameter of the impact crater in Data Table C.
10. Measure and record the depth of the crater. Make sure the zero mark on the ruler is truly at the bottom of the impact crater.
11. Repeat steps 1-9 for two more trials using the same sphere with the sand.
12. Repeat steps 1-9 using playdough as the surface material.
13. Repeat steps 1-9 using water as the surface material.