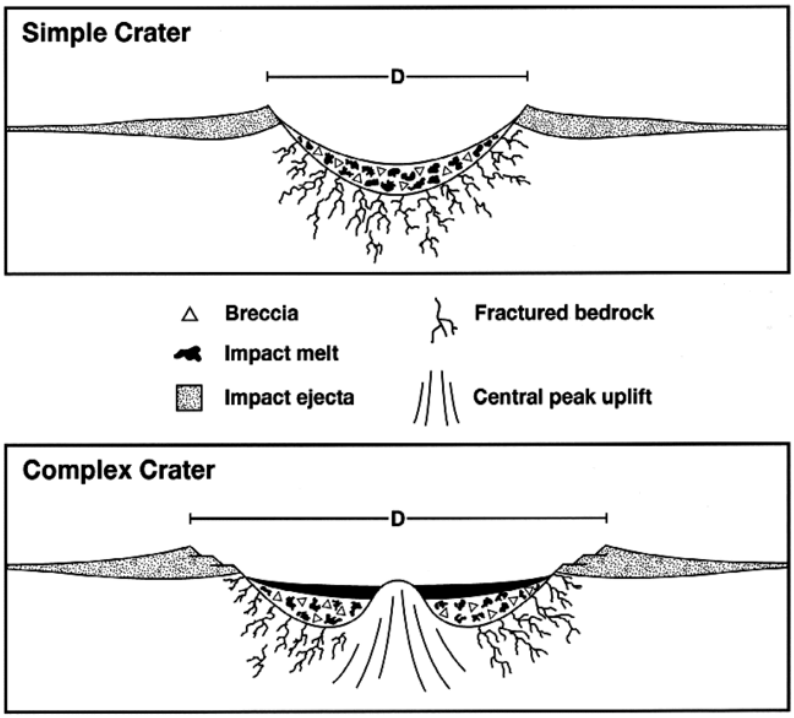
Impact Cratering Lab

Materials: Bin, flour, cocoa powder or paprika in shaker, ruler.

Introduction

One of the many things that we can study about a crater when we find one is its *morphology*, or shape. Study the two diagrams below, which show the difference between simple and complex crater morphologies, before you begin this lab. Note that the diagrams show the craters *in profile*, whereas you will be looking at them from the top down. Given that your "impacts" will be small objects impacting flour with a layer of cocoa or paprika on top, which of the features shown do you think will be observable? Make a prediction below as to how you think the appearance of your craters will changed based on the height, angle, size and density of the object being dropped.

Prediction (at least three sentences):



Drop a single rock into your bin from 10cm above. Draw what you see below both in a top-down view and a side profile view. Use shaded areas to indicate the location of cocoa and white areas to indicate the location of flour. Label the crater rim, ejecta and central peak (if present) in both diagrams.

Part 1: Investigate the effect of height

Now, drop the ball from different heights above your "surface". Each time, make sure that you are dropping it in a flat (uncratered) portion of your bin with a fresh coat of cocoa powder on top (do not apply a fresh coat to the whole bin every time- try to use the whole bin area then smooth the whole thing out and apply more cocoa). When describing the "appearance of the crater", make note the following:

(a) shape of crater (cicular? elliptical?)
(b) shape of ejecta, distance from crater rim
(c) simple or complex (do you see a central peak?)

Height	Depth of Crater	Diameter of Crater	Appearance of Craters
50cm	1. 2. 3. Average:	1. 2. 3. Average:	
100cm	1. 2. 3. Average:	1. 2. 3. Average:	
200cm	1. 2. 3. Average:	1. 2. 3. Average:	
400cm	1. 2. 3. Average:	1. 2. 3. Average:	

Using a sheet of graph paper, plot crater depth and crater size as a function of height *on the same plot*. To do this, make *two* y-axes (one along the righthand side of your plot for crater size and one along the lefthand side for crater depth) and one shared x axis (of height). Plot the two sets of points in two different colors and sketch in a "best-fit" line through each set of points (hint: for a best fit line, half of your data points should lie above it and half below it). Choose the scale of your axes wisely so that you use up the majority of the paper. Make sure to label your axes and title the graph, and to label your two sets of data points and best fit lines with a "legend" in one corner of your graph (see example below).

*	depth data
---	depth best fit line
+	size data
___	size best fit line

Using the data that you collected in table 1 and plotted in your chart, describe how each of the following change with height. **Use specific numbers from your data to justify your claim.**

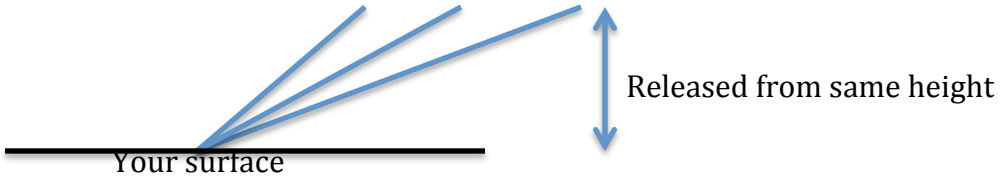
Crater Depth:

Crater Diameter:

Crater Appearance:

Part 2: Investigate the effect of angle

How does angle effect the shape, depth, etc of a crater? Use a "ramp" made of meter sticks and a round meteor (so that it rolls smoothly). In all cases though, make sure that it's being released from the same straight line distance from the ground as in the diagram shown below, and that you use the same object each time.



Angle	Depth of Crater	Diameter of Crater	Appearance of Crater
10 degrees	1. 2. 3. Average:	1. 2. 3. Average:	
45 degrees	1. 2. 3. Average:	1. 2. 3. Average:	
70 degrees	1. 2. 3. Average:	1. 2. 3. Average:	
90 degrees	1. 2. 3. Average:	1. 2. 3. Average:	

Part 3: You Design an Investigation

Question to investigate: Is it the object's size, mass, or both (density) that dictates the size and depth of the crater?

Several tables are given on the next page to help you get started. Examine them and then develop a plan here to describe your experiment. How are you going to measure the relevant values? Describe your procedure in numbered steps below. *Hint: Good experiments change only one variable at a time!*

Now carry out your experiment. Feel free to design your own tables or use the ones below.

Object	Size	Mass	Volume	Density

Object	Depth of Crater	Diameter of Crater	Appearance of Crater
	1. 2. 3. Average:	1. 2. 3. Average:	
	1. 2. 3. Average:	1. 2. 3. Average:	
	1. 2. 3. Average:	1. 2. 3. Average:	
	1. 2. 3. Average:	1. 2. 3. Average:	

Describe your conclusion regarding the question *Is it the object's size, mass, or both (density) that dictates the size and depth of the crater?* below. Use the data that you collected to justify your claim. If your data were inconclusive, describe why you think this is and design a better experiment to test this question and describe it.

Section 4: Discussion/Wrap Up

This experiment was based on the assumption that we are able to mimic the "real world" in a scaled down way. Name at least two other factors that effect how impact cratering works (size, depth, appearance) in the "real world" and how you expect this to change our results (if at all).