

**Grades:** 6-8

**Subjects:** Science

**Concepts:** Understanding mass versus weight; Separation of complex mixtures

**Oregon Science Standards:**

6.1P.1 Describe physical and chemical properties of matter and how they can be measured.

7.1P.1 Explain that all matter is made of atoms, elements are composed of a single kind of atom, and compounds are composed of two or more different elements.

**Materials:**

**Part A**

-(Optional) Computer and projector

**Part B**

-Bowls/cups for each group

-1 pkg. regular M&Ms®; 1 pkg. peanut M&Ms®; 1 pkg. peanut butter M&Ms®; 1pkg. Pretzel M&Ms®; 1 pkg. almond M&Ms®

-(Optional) Simple scale for weighing candies

*Note:* Alternative candies of similar sizes and weights can be substituted, or done with fewer types of candy

*Note:* The candies could be exchanged with colored marbles of different weights/sizes, or any objects that maintain a similar size, but differ in weight.

**Part C**

-(Optional) Computer

**Time Considerations**

*Preparation:* 10 minutes

*Activity:* 30 minutes

**Preparation**

**Part A and C**

**Set-up:** Using a computer hooked up to a projector, navigate to the websites listed

**Part B**

**Set-up:** In a large bowl, mix the 3 packages of candies. Fill smaller bowls/cups with the mixed candies, one bowl per group.

**Activity:** Separate the students into groups of 3 or 4. *Instruct the students not to eat the candies until the activity is finished!*

**Related Activities**

*Mass spectrometry activity*

# Chemical Conundrum

Mass is a measurement that may be used to separate individual chemicals out of a complex mixture. In this activity, students will explore different methods of separating out a complex mixture, and explore the difference between mass and weight.

## Objectives

1. To understand the scale/concept of a chemical
2. To understand how mass/weight can be used to identify chemicals
3. To understand the difference between mass and weight

## Background

Why could you live on roots and berries, but not off of the ground they grow in? Why could you stay warm by burning wood, but not rocks? Why might water pipes burst in the winter? The answers can be found in the composition of these materials as well as the properties of the chemicals that make up these different substances. We could guess why all of these things occur, but by measuring those chemical properties, we can find out the answers to our questions, and may even predict what may happen under different conditions.

Therefore, the study of chemicals and their properties, and how we might measure those properties can be important to everyone. Essentially chemistry can be thought of as using knowledge of how matter is put together and its interactions with other matter to solve confusing problems.

## Part A – What is a chemical?

A chemical is any substance with a specific molecular composition either used or created by an exchange of energy. Chemicals are found throughout the Earth, both created naturally and by humans. A large combination of chemicals are used to make pesticides. Scientists are currently trying to figure out what chemicals are in pesticides, and determine whether they are safe. So how big is a chemical?

A chemical is made up of atoms. Atoms are very, very small – smaller even than the dot made by the point of a pencil. Therefore, chemicals are very small as well, making it difficult to “see” them. Therefore, scientists must come up with ways to “see” their chemicals.

(Optional) To understand how small an atom really is, use the demonstration provided by the University of Utah. Chemicals can be thousands of times smaller than even a grain of rice!

*Website:*

<http://learn.genetics.utah.edu/content/begin/cells/scale/>

*Guiding Questions:* If atoms make up chemicals, and chemicals make up pesticides, what might be a way to find out what chemicals are in pesticides?

## Part B – Separation

Scientists are often tasked with identifying unknown chemicals in a mixture. For example, a scientist may be given a sample of river water, and then asked to identify the chemicals in the sample. They often identify the chemicals by separating the mixture.

Using M&Ms®, ask the students to separate the candies different ways. They may use color, size or shape as ways to separate the candies. However, all the candies are slightly different in weight. The peanut M&Ms® will weigh more than the peanut butter M&Ms®, which will weigh more than the regular M&Ms®.

Using the weight of the candies to separate them is similar to how scientists identify chemicals. Using a machine called a mass spectrometer, chemists can separate chemicals based on their mass. Thus, in a sample of river water, a scientist could more easily identify a pesticide by searching for chemicals in the mixture that had the same specific mass of the pesticide they were searching for.

(Optional) Use a scale to measure 5-10 of each candy, to determine the weight of each group. Which group weighs more?

*Guiding Questions:* What are some chemicals that could be found in river water? What are ways you can separate the M'n'Ms(or other alternative) into different groups? Do they weigh the same? Could you use the difference in weight to separate out the candies?

## Part C – Understanding Mass

While our mass stays constant, our weight changes as gravity changes. For example, on the moon, a person who weighs 100 pounds on Earth will weigh 16 pounds on the moon!

(Optional) The calculator provided by the Exploratorium allows students to calculate their weight on any of the planets, and the moons of Jupiter.

*Website:*

<http://www.exploratorium.edu/ronh/weight/index.html>

*Guiding Questions:* If a person weighs 140 pounds on the Earth, will they weigh more or less on Jupiter? Hint: Jupiter has a heavier gravitational field.

