

## Cool Science Lessons for Different Ages and Stages

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### Elementary: Potions!

Do ahead: Cut up a purple cabbage. Throw the leaves in a blender with 2 cups water. Blend 30 seconds. Pour out the juice. This is your “Foundation Potion.” It will be good for a week or two in the refrigerator.

On the day of: Explain to your kids that you are going to be doing Potions for science today. Explain that pH is the measure of how acidic or basic something is. Many liquids have extra H<sup>+</sup> ions—this means that they are Acidic. They might taste sour (but you don’t necessarily eat all acids, so don’t try this out!). Other liquids might have a high concentration of OH<sup>-</sup> ions—this means that they are Basic. Many cleaners are basic. In this experiment, we are going to decide whether different things are Acidic or Basic.

Pour the cabbage juice into clear glasses or test tubes. Try adding things such as baking soda, lemon juice, bleach, vinegar, liquid soap, fruit juice, and other things that the kids think up. Acids will turn the cabbage juice purple and pink. Bases will turn it blue, green, and yellow. You can make a chart to record your results:

Liquid added:	Color:	Acidic or Basic:
Vinegar		
Baking soda		
Liquid soap		
Juice		

Let the kids experiment for as long as they want. Try adding baking soda to the vinegar one and see what happens to the color. Try other combinations.

### Middle: Aristotle vs. Galileo

Part 1--Aristotle: Aristotle was a Greek philosopher who lived around 350 B.C. [Dress student in toga.] He believed that the earth was the center of the universe. He also believed that the world was composed of four elements: earth, water, air, and fire. Earth was the heaviest and fire was the lightest. He believed that if anything got out of order, they would do their best to return to the original position.

Let’s do an experiment to see if this is true. [Mix dirt and water. Dirt will sink to bottom.] See, it’s true.

He also believed that heavier objects will fall faster than lighter objects. Let’s see if this is true. [Drop rock and feather from high place.] Yep, that is true, too.

People believed Aristotle’s teachings for 2000 years. Then someone else came along who had some questions...

Part 2—Galileo: Galileo was born in 1564 in Pisa, Italy. [Have a student be Galileo—put on beret and whatever other props you may have.] In 1610, he built a telescope that was one of the best of his time. He started looking at stars and planets. He decided that Aristotle was wrong—the earth was not the center of the universe! This got him in quite a bit of trouble at the time. How could Aristotle be wrong? Heresy!

But Galileo was already looking at some of Aristotle’s other philosophies and wondering if they were true. For example, does a ten-pound rock fall ten times faster than a one-pound rock? Let’s test it. [Drop big and little rock from high place. Drop other objects. Play with this. Who was right—Galileo or Aristotle?]



## High School: Natural Selection

Living things that are well adapted to their environment survive and reproduce. Those that are not well adapted don't survive and reproduce. An adaptation is any characteristic that increases fitness, which is defined as the ability to survive and reproduce.

A characteristic which is influenced by genes and passed from parents to offspring is called heritable. Over many generations heritable adaptive characteristics become more common in a population. This process is called evolution by natural selection. Evolution by natural selection takes place over many, many generations. A heritable characteristic that helps an animal or plant to have more offspring which survive to reproduce will tend to become more common in a population as a result of evolution by natural selection.

This simulation involves pom-poms that can reproduce. These pom-poms live out their lives on a Black Forest or Red Grassland habitat. The only concern our pom-pom creatures have is the presence of ravenous hunters. All we need is a system that has three necessary conditions for evolution by natural selection.

1. Variation in characteristics: For natural selection to occur, different individuals in a population must have different characteristics. In our simulation, pom-poms vary in color; they are black, red, and white. The hunters vary as well; hunters have three distinct types of feeding structures: forks, knives, and spoons.

2. Differences in fitness: For natural selection to occur, the different characteristics of different individuals must contribute to differences in fitness (i.e. differences in ability to survive and reproduce). For example, variation in pom-pom color may influence the probability that a pom-pom is snatched up by a hungry hunter. Also, different feeding types

may vary in their success in capturing pom-poms. These differences contribute to survival and therefore success in reproducing.

3. Heritability of characteristics: For natural selection to occur, the characteristics that affect fitness must be heritable (i.e. passed by genes from one generation to the next). In our simulation, a pom-pom that is born into the pom-pom population is the same color as its parent and a hunter that is born into the hunter population has the same feeding structure as its parent.

Instructions:

1. Record the initial numbers of each type of pom-pom and each type of hunter in each habitat.
2. At the signal, start feeding. However, once a pom-pom is in a cup it is off limits. When time is called, STOP feeding.
3. Now count how many pom-poms you have eaten. Only the top half of the hunters will survive and reproduce. Those who die will be reborn as the children of the survivors and will have the same type of feeding structure as their parents had.
4. For each of the pom-poms that survived, they will be given 2 new offspring.
5. Run through the simulation two to three times.

Did evolution by natural selection occur in each pom-pom population? In other words, did one pom-pom color become more common over time while the other colors became less common? What traits contributed to the survival of pom-poms that survived to reproduce? For each population of hunters, did one feeding type become more common while other feeding types became less common? What traits contributed to the survival of hunters that survived to reproduce?



Potions lab:

[www.Chem4Kids.com/files/react\\_acidbase.html](http://www.Chem4Kids.com/files/react_acidbase.html)

[www.KhanAcademy.org/science/biology/water-acids-and-bases/acids-bases-and-ph/a/acids-bases-ph-and-buffers](http://www.KhanAcademy.org/science/biology/water-acids-and-bases/acids-bases-and-ph/a/acids-bases-ph-and-buffers)

[www.SteveSpanglerScience.com/lab/experiments/red-cabbage-chemistry/](http://www.SteveSpanglerScience.com/lab/experiments/red-cabbage-chemistry/)

Aristotle/Galileo:

[www.YouTube.com/watch?v=SyfgsqBM1Ng](http://www.YouTube.com/watch?v=SyfgsqBM1Ng)

[www.Tes.com/teaching-resource/is-galileo-or-aristotle-right-7020898](http://www.Tes.com/teaching-resource/is-galileo-or-aristotle-right-7020898)

Pom-Pom Lab:

[www.Dentonisd.org/cms/lib/TX21000245/Centricity/Domain/917/Lab-%20Natural%20Selection%20Lab%20new.pdf](http://www.Dentonisd.org/cms/lib/TX21000245/Centricity/Domain/917/Lab-%20Natural%20Selection%20Lab%20new.pdf)

[Employee.Heartland.edu/hfei/Labs/NaturalSelectionProtocol.pdf](http://Employee.Heartland.edu/hfei/Labs/NaturalSelectionProtocol.pdf)

Elementary Science Links

[AmblesideOnline.org/](http://AmblesideOnline.org/): Free Charlotte Mason style curriculum with great “living” science book suggestions

[www.EEqualsMCQ.com/](http://www.EEqualsMCQ.com/): Downloadable elementary and middle school curriculum. The life science one is free.

[TheHappyScientist.com/](http://TheHappyScientist.com/): Robert Krampf has lots of fun experiments. There is a fee for accessing all of the content, but there is a section of free goodies.

[www.Carolina.com/](http://www.Carolina.com/),  
[www.HomeScienceTools.com/](http://www.HomeScienceTools.com/): science supplies

[www.HomeschoolShare.com/](http://www.HomeschoolShare.com/): List of science picture books & lapbooking resources

[www.Neok12.com/](http://www.Neok12.com/): Short video snippets

Middle School

[MiddleSchoolScience.com/](http://MiddleSchoolScience.com/): Science resources

[ScienceSpot.net/](http://ScienceSpot.net/): Lessons and activities

[www.OnlyPassionateCuriosity.com/free-homeschool-list/](http://www.OnlyPassionateCuriosity.com/free-homeschool-list/): lots of great free science resources here

[www.ScienceBuddies.org/](http://www.ScienceBuddies.org/): Lots of experiments and science fair project ideas

High School

[www.Hippocampus.org/](http://www.Hippocampus.org/): science videos and other resources

[www.UCScout.org/](http://www.UCScout.org/): open access courses

[SerendipStudio.org/sci\\_edu/waldron/](http://SerendipStudio.org/sci_edu/waldron/): great biology labs

[Learn.Genetics.Utah.edu/](http://Learn.Genetics.Utah.edu/): University of Utah free online genetics curriculum

[QuarksAndQuirks.wordpress.com/biology-hs-level/](http://QuarksAndQuirks.wordpress.com/biology-hs-level/): Outline for a high school biology course

[www.ChemGuide.co.uk/](http://www.ChemGuide.co.uk/): chemistry tutorials from the UK

[GoAndDoSchool.weebly.com/](http://GoAndDoSchool.weebly.com/): Weekly outlines for homeschool high school and middle school chemistry class

[www.PhysicsClassroom.com/](http://www.PhysicsClassroom.com/): online physics curriculum

