Physical Changes: Cornstarch and Water

Summary
Explore the properties of cornstarch, water, and what happens when the two are added to one another. Physical changes occur and are all reversible.

Main Core Tie
Science - 5th Grade
Standard 1 Objective 2

Time Frame
1 class periods of 45 minutes each

Group Size
Small Groups

Life Skills
Thinking & Reasoning

Materials
- cornstarch (maybe 0.5 cup per group)
- water (use cold water)
- small bowls (microwave safe)
- stirring utensils (fingers work too)
- measuring cups and spoons (or scales and graduated cylinders)
- sink (it will be messy)
- food coloring (optional)

Background for Teachers
The addition of cornstarch and water produces a suspension with non-Newtonian properties: the more force is applied, the less strain (deformation) is observed). This is similar to quicksand. Be aware that the addition of hot water to cornstarch will cause the cornstarch to denature resulting in a more gelatinous solid.

Student Prior Knowledge
Students should understand the basics of physical changes and how they differ from chemical changes (i.e. chemical changes are irreversible (for grade school intents and purposes) and physical change are reversible and do not result in a new substance).

Intended Learning Outcomes
1. Use Science Process and Thinking Skills
   a. Observe simple objects, patterns, and events and report their observations.
   h. Predict results of investigations based on prior data.
   i. Use observations to construct a reasonable explanation.

Instructional Procedures
As a group, discuss with the students about physical changes and states of matter. Ask the
students to think of examples of physical changes (adding salt to water, crushing a can, folding
a sheet of paper).

Break into small groups giving each group a bowl, stirring utensil, water, cornstarch, and
measuring devices. Ask the students to describe the physical properties of water (clear liquid),
cornstarch (white powdery solid). Also ask them what they think will happen when the two are
added together, a chemical or physical change? A worksheet could be used to record
observations.

Place all of the cornstarch in the bowl and add water bit by bit. Ask the students to describe the
changes they see. The mixture should be crumbly and uninteresting. Students may note that it is
difficult to stir, but advise them to not add too much water. When a critical level of saturation
occurs, ask the students to describe the properties of the new concoction. Tell them to poke it,
pour it, and get their hands in it. The students will see that when they apply a force to the
mixture, it solidifies but quickly runs as they lessen the force.

Ask the students what their observations (what phenomenon did they observe?) are and
whether this is a physical change or a chemical change. Is the product a solid or a liquid or
something else? (The substance does not resemble water and does not resemble cornstarch
but is a suspension of corn starch in water. Applying force causes individual molecules to line
up, preventing movement. Removing that force allows the molecules to flow past one another)
Show the students dried out pieces of the suspension. The water is gone and all that remains is
cornstarch in block form (this is the same as adding salt to water and allowing the water to
evaporate to form larger salt crystals). The cornstarch can be re-powdered and has the same
properties described earlier.

More physical changes can be observed with this suspension. Take the bowls of cornstarch and
water to the microwave and heat for 10-30 seconds depending on the microwave. The
cornstarch will denature forming a clear gel. AFTER THE MIXTURE COOLS, let the students
play with it to determine the properties. This transformation is not reversible but technically no
new substance is formed. Therefore this is a physical change.
Clean up. If disposable bowls were used, the whole mess can be tossed, otherwise the mixture
can be scraped into the garbage.

Extensions
Cornstarch and water is similar to sand and water (quicksand!). With small toys (cars, army men),
watch them sink into the mixture, possible timing how fast they sink and what speed different objects
sink). Is it difficult to pull the objects back out? What if you pull slowly? If you were stuck in quicksand,
how would you get out?

For the chemistry inclined:
Demonstrate what starch is composed of. Atoms make up molecules; take many of those molecules
and string them together and we get polymers. Demonstrate with paperclip chains and that as the
cornstarch is heated, the paperclips unwind and create a big net of stringy polymers. The students
can then build their own complex polymers out of paperclips.

Authors
Andrew Basinski
Dina Freedman
Holly Godsey
Erin Moulding
Edwin Opperman
Steven Pinta