

# PSI:

## PHYSICAL SCIENCE INVESTIGATION



### Teacher's Lesson Description

Title	<b>Fill 'er Up!</b>
Brief Description of the Videos	Dante asks students to consider the particle nature of matter, differences between physical and chemical changes, and how conservation of mass doesn't mean that volume is conserved.
Time Needed	1 Class Period
Ohio Science Benchmarks and Indicators Addressed in This Activity	Grades 6-8 Physical Science Benchmark A Grades 6-8 Scientific Inquiry Benchmark A
Ohio Grade Level Indicators Addressed in This Activity	Grade 6, Physical Science Indicators 1, 3, and 4 Grade 7 Scientific Inquiry Indicators 1, 3, and 4
Concepts Developed	When combining two or more elements or compounds as part of a chemical change, mass is conserved. Volume is not necessarily conserved. Some chemicals can mix and the resulting volume is less than the sum of the two initial volumes. A common misconception is that if equal volumes of different substances are combined, the resulting volume will be twice that of its components. While there is conservation of mass, resulting volumes rely on the chemical properties and physical sizes of the molecular particles that comprise the materials.
Lesson Rationale	This demonstration was selected as a way to pique students' curiosity and challenge the idea that generalizations or inferences drawn from observations are always scientific ways of thinking. The lesson also creates an opportunity for teachers to investigate the particle nature of matter with students. The particle model is a good way to develop simple conceptual representations of complex physical and chemical phenomena that can occur later in students' studies of science.

Background Knowledge for Teachers	Review the teacher segment for “Fill ‘er Up!” In this segment, Dante explains how the student segments can be used and models effective questioning techniques that promote inquiry in the classroom.
Classroom Procedures	After viewing the student segments and conducting classroom discussions, you can provide students with an opportunity to see how “packing” different volumes can result in “negative” volume results – a mixture that does not have a final volume equal to the sum of the component volumes. The important thing is to have some materials (particles) that can nestle in between the other materials in the mixture. Sometimes shaking, or “mixing” the materials will provide an even more dramatic reduction in volume. You will see Dante demonstrate something similar to this when he mixes marbles and salt during his office explanation. Have students predict (and give reasons for their predictions) what the resulting volume might be. After the materials have been mixed, have students consider different ways that the resulting volume can be measured (either by volume formulas based on linear measurements, or by “pouring” the mixture back out into containers of known volume). Does the size of “what goes in” equal the size of “what comes out?” Here is a very simple demonstration of the decrease in volume when salt crystals are dissolved in water: <a href="http://www.practicalphysics.org/go/Experiment_174.html">http://www.practicalphysics.org/go/Experiment_174.html</a>
Materials Needed	A collection of physical objects of varying size: marbles, sand, table salt, “sea salt” or “Kosher” salt of larger particle size, dry rice, dry beans, BBs, etc; transparent plastic or glass beakers, 500 ml or 1000 ml., or large glass or plastic jars for “mixing.” Pickle jars and pretzel jars are excellent mixing containers. It also is useful to have a classroom balance or electronic scale so that students can be convinced that overall mass has not changed, but the resulting volume may have changed.
Science Connections	These activities are connected to discussions and demonstrations that consider the outcomes of physical change and chemical change. While difficult in complex mixtures, scientific techniques have been developed, along with chemical equations, that allow scientists to account for the conservation of mass and the conservation of energy by examining the dynamics and components of a chemical reaction, but scientists still debate about the actual dynamics that take place when negative volume mixing occurs.

Additional Web Resources	American Chemical Society's Inquiry Activities with Liquids <a href="http://www.inquiryinaction.org/Inv3.html">http://www.inquiryinaction.org/Inv3.html</a> Annenberg's Essential Physical Science for Teachers Professional Development Videos <a href="http://www.learner.org/resources/series200.html">http://www.learner.org/resources/series200.html</a> Practical Physics Site with Investigations of Physical Quantities <a href="http://www.practicalphysics.org/go/Topic_42.html?topic_id=42">http://www.practicalphysics.org/go/Topic_42.html?topic_id=42</a>
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Ohio Science Standards Abbreviations:

ES – Earth/Space Science

SI – Scientific Inquiry

LS – Life Sciences

ST – Science and Technology

PS – Physical Sciences

SW – Scientific Ways of Knowing

