



Fluidized Bed



COLLEGE OF
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Overview

When teaching, we tend to give fairly clear-cut definitions of solids and liquids; the line between them seems well-defined. However, as is often the case in science, reality is less easily categorized and more interesting. The fluidized bed in the Solids & Liquids kit is one excellent case study.

Theory

An individual grain of sand is clearly solid: it will not take the shape of its container, nor will it flow. A whole lot of grains of sand in aggregate do act somewhat like a liquid — together, they can often take the shape of their container, and flow under the influence of gravity. However, the basis of the observed behavior lies in the movement of small-but-macroscopic particles past one another, not sliding around and transient bonding of individual molecules (as would be the case in a liquid). Adding fast-moving air, though, makes the sand act a lot more liquid-y: it creates a fluidized bed.

Now, we need to have brief talk about terminology. Air, as you and your students probably know, is a gas. However, for certain purposes, physicists lump gases and liquids (and plasmas, but we won't get into that here) together under the umbrella term fluids, since they are distinct from solids in flowing when acted upon by a force. Adding a flowing fluid (air) to the sand makes the sand act distinctly fluid-y. The movement of the individual sand grains in the fluidized bed is a decent basic model for the motion of molecules in a liquid.

Doing the activity

If you have the fluidized bed setup from the Solids & Liquids kit, setup should be fairly seamless. (If you'd like to build a device like the one in the kit, please feel free to get in touch with us — you can find our contact information [here](#).)

SAFETY NOTE: *The compressors in the Solids & Liquids kit are pretty powerful, and can overheat if they're left on for too long. Only run the compressor for about 5 minutes at a time; let it cool between runs.*

1. Use the tubing to connect the air compressor to the airstone, and plug in the compressor (but don't turn it on yet).
2. If possible, let students play with the sand before turning on the compressor, so they can see that there's nothing particularly special about it. If this isn't possible, take a moment to demonstrate the normal-ness of the sand. It's nice to have a few items in the fluidized bed that can help illustrate the change that's about to take place — aim for a mix of high- (e.g., marbles) and low-density (e.g., rubber ducks) items.
3. Explain to students that the air compressor will make fast air flow all throughout the sand. Tell them that you'd like them to observe how this makes the sand change (and warn them that the compressor will be quite noisy).
4. Ensure all seals (one at each end of the tubing, and one all around the base of the bucket, where it's attached to the airstone) are tight, and turn on the compressor. If possible, allow students to

Necessary materials:

- large clear bucket, sealed over a...
- large airstone (aquarium bubbler)
- small air compressor
- section of tubing
- kid-safe play sand*
- items to "float" in the fluidized bed (marbles, rubber ducks, etc.)

***Not all play sand is kid-safe! Ensure you're using a brand that won't create potentially harmful particulates in the air. The sand in the LSOP kit is safe.**

make a tactile exploration of the change that occurs. Encourage them to observe what happens to the objects in the sand.

5. After turning off the compressor, ask students to discuss what may have caused the new behavior of both the sand and the objects within it.

Summing up

Making connections between micro- and macro-scale phenomena is a perennial challenge. Experiments with and observations of the fluidized bed can help students make sense of the micro- and macroscopic differences between solids and liquids in an intriguing and engaging way.

For more information

Little Shop of Physics: <https://www.lsop.colostate.edu>

Colorado State University College of Natural Sciences: <https://www.natsci.colostate.edu>