

Diagnosing When You Need a RECAST Activity

DENSITY

Think about the source of the students' difficulties. Ask yourself, "Does it have to do with causal structure or other factors?" Here are some possibilities:

IN THESE CASES, YOU DO NOT NEED A RECAST ACTIVITY:

Misinformation or misunderstanding NOT related to causality:

Some confusions or misunderstandings are not related to causality.

Examples:

- Thinking that high density means less crowded and low density means more crowded.
- Thinking that all wood floats.
- Thinking that the spaces between atoms and molecules are always air so density is a measure of how much air there is.
- Believing that gases are not matter, don't take up space, and do not have mass.
- Thinking that gas molecules bunch up in a corner of a flask, affecting the density, rather than spreading out in the available space.
- Believing that objects that float always have more air in them.

Cognitive challenges NOT related to causality:

Some concepts give students difficulty due to the nature of the thinking challenge.

Examples:

- Trying to hold information in your head such as coordinating the relationship between mass and volume in to consider what happens to density.
- Visualizing information that is dynamic, such as imagining how density changes if you heat a metal up.

IN THESE CASES, YOU DO NEED A RECAST ACTIVITY:

A simpler causal structure is substituted for a more complex one:

The student has reduced the phenomenon to a simpler causal structure than the scientifically accepted explanation.

Examples:

- In a simple linear way, the weight of the object causes it to sink.
- Not viewing density as a relationship and the related idea that you can manipulate mass and not affect volume or vice versa.
- Focusing on "material kinds" instead of the relationship of mass to volume inherent in particular kinds of materials.

Missing information or misunderstanding a fact that is related to causality:

Misinterpreting a concept related to causality such that it reinforces simplistic models.

Example:

- Thinking that because density is a standard, it doesn't change. So students don't realize that if you change the temperature or pressure, the relationship between mass and volume will change and thus the density will change.



RECAST ACTIVITY REQUIRED CONTINUED

Non-obvious variable(s) contribute to a simpler model:

There are non-obvious variables that the student fails to notice and so he/she applies a simpler causal model.

Examples:

- Not attending to the liquid when analyzing why something sinks or floats.
- Reasoning about density as weight because you can perceive weight, but not density (a non-obvious, intensive quantity) and reducing the problem to one variable as opposed to the relationship between two variables. This can result in thinking that if you cut an object in half, it will have only half the density.
- Atomic mass and atomic and molecular bonds contribute to differences in density but you can't see them so students reduce it to differences in weight.

Not recognizing multiple possible causes:

Being efficient in searching out causes and stopping after finding one when there may be multiple possible causes, any one of which is sufficient for causing the outcome or two or more causes might work together.

Example:

- Differences in density could be due to differences in atomic mass and/or differences in atomic or molecular structure and/or instances of mixed density.