**Explore Causality**

***Step 4: Why is it Hard to Realize That Density Doesn’t Change with Size or Shape?***

Ask students to think about how volume, mass and weight can be measured, and

point out that different sized pieces of the same kind of material will have

different volumes and masses. Compare this to the density of a pure substance,

which is the same no matter what size the piece is (at stable pressure and

temperature). The density is not affected by the size or shape of the object.

While it is possible to logically reason that taking half of the cylinder again and

again until you have a tiny fragment would result in a piece with the same density,

this is still counterintuitive for most of us. Ask the students, “Why do you think it

is hard for people to realize that cutting the cylinder in half does not change its

density?” Gather their ideas.

There are at least two reasons that have to do with how we reason about causality:

One has to do with Relational Causality. It is hard to focus on the

relationship of mass to volume, which stays the same. It is generally

harder to hold two things in your mind and think about the relationship

between them then it is to just focus on one variable.

The other has to do with the non-obviousness of density. It is much easier

to focus on the more obvious features of weight and size. After all, you

can see and feel those!

Causal Patterns in Density:

Defining Density as a Relationship

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**Review, Extend, Apply**

***Step 5: Introducing the Densities of Common Substances***

Put up the overhead of the *Densities of Common Substances Under Standard*

*Conditions* Table (p. 81). Explain that scientists assign certain numbers to the

densities of different substances. Each substance has its own number. In order to

get these numbers, scientists test the substances under standard conditions. This

means that they keep the temperature and the amount of pressure the same.

Explain to the students that they will revisit this concept a little later in the

module.

***Step 6: Making Connections: “The Case of the Missing Crown”***

Pass out the sheet entitled, *Archimedes and the Golden Crown* (p. 82). Have

students read it and answer the question. The sheet asks them to make the

connection between a certain substance having a certain density and the ability to

identify that substance.

Invite students to share their solutions with the class. Try to get a sampling of

different kinds of responses. Tell the students to compare the different solutions

that they came up with and think about which they think would work the best.

Guide the inquiry by asking questions that get to the issues in the story and

support the following understandings:

Density is a property of a certain kind of material.

We find the density by measuring the relationship between the mass and

the volume of an object made of that material.

Comparing the density of the material a crown is made of to the density of

gold will tell us what kind of material the crown is made of. The density of

gold can be found by finding the relationship between the mass and

volume of a known piece of gold.