**Supporting Argumentation through Student Talk**

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The most central element of all of the new standards – the Next Generation Science Standards, the Common Core Math standards and the Common Core English Language Arts standards – is that students are making sense of the world through argumentation. Let’s explore how student talk can support development of students’ argumentation skills in a classroom setting.

Mrs. Ramierez’s fifth grade class has been working on understanding the particle model of matter for two weeks. First they explored sugar – sugar cubes, granulated sugar, powdered sugar – and concluded that bigger things can be made of much smaller things. They investigated the conservation of matter by mixing baking soda and vinegar in a bottle on a digital scale. When the bottle was open to the air, the mixture lost mass. When the bottle was closed, the mass stayed the same. From this result the class deduced that there must have been some invisible mass that went into the air when the bottle was open, but was captured in the system when the bottle was closed. They agreed to call the very tiny invisible bits of matter particles.

Now the class is ready to think about how particles move. Each group of students is given a beaker of ice-cold water, a beaker of room temperature water, and a beaker of very hot water. Mrs. Ramierez instructs the students to put one drop of food coloring in the three beakers at the same time and observe what happens over the next five minutes. Each group of students has a large whiteboard to work on. Their task is to record their observations in words and pictures on one half of the whiteboard. The recorder for each group draws the three beakers down one edge of the whiteboard, and the students prepare to observe.

Mrs. Ramierez gives the signal to start, and excited murmurs rise around the room as the students watch the food coloring. In the beaker of hot water, the color immediately begins to swirl through the mixture. In a few minutes, the liquid in the beaker is a uniform color. In the room temperature beaker, the food coloring sinks to the bottom, slowly spreads across the bottom and gradually starts to mix with the cool water above it. At the end of five minutes there is more intense color toward the bottom of the beaker, and lighter color toward the top. In the beaker of ice-cold water, the food coloring drops to the bottom and sits in a well-defined pile for almost all of the five minutes, with only a tiny bit of color spreading into the surrounding water.

Mrs. Ramierez calls the class to attention. The reporter for each group describes what their group observed, and Mrs. Ramierez records the observations on a piece of poster paper. “Children, now it is your job to explain why you saw different things in different cups. Why did the color mix completely in the hot water, partially in the cool water, and not at all in the ice-cold water? Use the other half of your whiteboard to show your explanation in words and pictures. Your explanation must include these two words: particles and motion. How do you think the motion of the particles is different in each of the cups? Get started!”

The room fills with the buzz of student talk. In each group, students share ideas about what they think is happening, and their recorder puts their ideas on the whiteboard. As Mrs. Ramierez walks through the room, she sees that while each group represents their ideas in a similar way, they are all converging on the same idea – that the particles in the hot water must be moving faster than the particles in the cool water, and the particles in the ice-cold water are moving even slower. She reminds herself to have the students record their current thinking in their science notebook in their own words.

Mrs. Ramierez’s lesson is a lovely example of putting student talk and argumentation at the center of science education. Students have science experiences that they are invited to make sense of. Through discussion with each other, the students are able to try out ideas and rehearse constructing explanations in a safe setting. All students are drawn into the process of building explanations, instead of the few students that might participate in a whole class discussion. Students are connecting their new science experience to the particle model they have been building in previous activities. They are using evidence to support their ideas, getting them ready to construct formal arguments.

The next step for Mrs. Ramierez’s students is to turn their informal oral and diagramed explanations into written formal arguments. An argument has three parts:

* **Claim** – usually a prediction, conclusion or generalization.
* **Evidence**. – usually drawn from experience or from text.
* **Reasoning/Explanation** – a statement of how the evidence supports the claim.

**Figure 1: Relationship between Claim, Evidence and Reasoning/Explanation**

Claim:

Prediction conclusion

Evidence:

Science experience

Text

Reasoning/Explanation:

Links the evidence to the claim

What argument can we build from the observation of the colored water? Here is the argument structured in the graphic organizer:

Claim:

Particles with higher temperature move faster

Evidence:

Food coloring in the hot water mixed through the cup quickly.

Food coloring in the ice water never mixed, but sat on the

bottom of the cup in a pile.

Reasoning/Explanation:

The fast-moving particles in the hot water collided with the food coloring particles and made them move fast around the cup, mixing the color everywhere.

The slow-moving particles in the ice-cold water gained some energy from the particles of the food coloring, but it was not enough energy to make the particles of food coloring mix through the cup.

**Figure 2: Claim, Evidence and Reasoning/Explanation for the colored water experiment.**

Mrs. Ramierez’s students are now well-prepared to turn their explanations into a written argument through the use of well-scaffolded instruction:

* Solid preparation in developing a model
* A carefully-chosen science experience that lends itself to student explanations.
* Small group discussion to foster participation in a safe setting and allow rehearsal of ideas, coupled with representation of the ideas in words and pictures.
* Informal writing in the science notebook to help solidify ideas.
* Explicitly detailing claim, evidence and reasoning using the graphic organizer.
* Transforming the text in the graphic organizer into paragraph form.

Providing students with opportunities to construct arguments to explain interesting phenomena is the essence of NGSS and the scientific enterprise itself. Careful scaffolding ensures that all students can achieve the goals of our new science standards.