

***Science Instruction at Brooke***

We believe that all students come into the classroom with ideas about how the world works. Often, the conceptual models they come in with are different from the scientifically accepted models. In a science class, students get evidence from a variety of experiences and get feedback about their ideas from their teammates. Thinking logically about what they are seeing and hearing in class helps students to refine their conceptual models though out the course of a unit.

With this focus on students’ ideas, it is imperative that teachers know what students are thinking. In many science classrooms, students memorize vocabulary and answer teacher questions with single words. We do not think that this helps teachers know much about their students understanding of the world. When a student says a particular vocabulary word, they may be visualizing something completely different than what the teacher is visualizing when they use that same word. Therefore, we spend a lot of time trying to elicit student thinking. We often present students with a phenomenon and then ask them to draw a model that explains how that phenomenon happened. They are also asked to explain these models orally or in writing using paragraphs, not sentences, to explain their thinking thoroughly. A single vocabulary word can never substitute for a long explanation. When students speak, we often ask them to tell us more, and they almost always have more to say. In order to refine their thinking, students need get feedback on their ideas from their peers. Students must use logical reasoning and evidence to support or refute each other’s ideas. Students draw evidence from experiments, observations, models, readings, videos and lectures. Their job is to form a coherent understanding by integrating information from these various sources. By the end of class, it is important for students to notice that their ideas have changed and to articulate why their ideas have changed.

We balance the science practices from the Next Generation Science Standards and content acquisition and application. On unit plans, each day has a science practice and content point. These components of our units are mutually reinforcing.

* PRACTICES: Science practices help students to learn the skills that scientists use in their jobs. We do not have a separate unit on the scientific practices. Instead, the practices are integrated with content. Sometimes practices are used to discover a science concept. Sometimes, practices are used to solidify students’ understanding through explaining and communicating ideas. And scientific knowledge is needed in order to fully engage in practices. A student needs some scientific understanding in order to ask good questions, deeply analyze data, design models and write clear explanations. It would be impossible to teach the practices in isolation. Most units also include an engineering project that takes several days and requires students to use their understanding of a science concept to build something that solves a problem. They get experience with the engineering practices while solidifying and broadening their science knowledge.
* CONTENT: We teach critical science concepts that transcend more than one lesson. Students and teachers should be seeing and articulating how content from different strands of science and different grade levels is connected. They should also be able to apply their understanding to situations in novel contexts. The content point for each day includes not only what students need to know by the end of the day, but an application question that students should be able to solve by the end of the day. There are also whole days dedicated to more complicated application questions. These are sprinkled throughout the unit and provide an opportunity for students to use their understanding of science in a new context, which helps them generalize and deepen their understanding. Application of content also happens through engineering design projects.

At Brooke, rigor in science does not come from teaching more content, but from using the practices to have students make discoveries, requiring thorough explanations of ideas and applying content knowledge to novel situations. All of these are the things that real scientists do.

Unit plans are written by the Science Department Chair, who then leads a unit launch to make sure that all teachers understand the content and the possible misconceptions students will have. Teachers design the lessons to implement that plan and meet with school leaders weekly to talk through lesson plans. Lower elementary students have four 30-minute science lessons per week. Upper elementary students have three 50-minute science lessons per week. Middle schoolers have five 50-minute lessons per week. High school students have five 55-minute lessons per week.