By Caitlin Fine and Margaret Conover

Ch-Ch-Ch-Chia

SEED SCIENCE

"Oh! We drink that at home all the time! We call it 'chan.' It's delicious!" exclaimed one of our students of Mexican descent upon seeing a photo of a beverage made from chia seeds and lemonade. In planning our second grade unit about plant life cycles, plant needs, and plant products, we expected that many students would be familiar with Chia Pets from daytime television ads. But, we never imagined that some would also be familiar with chia as a food and could teach us all something about chia from their cultural traditions.

Students explore the chia seed's nutritional value and the growth requirements for its sprouts.

Finding common interests with which to engage learners from different cultural backgrounds can be a challenge in any classroom. It is particularly so in our urban, English/Spanish dual-language immersion school, which draws a socioeconomically and linguistically diverse population of students from a wide geographic area. The curriculum design in our school emphasizes building background knowledge through real-life experiences using the Sheltered Instruction Observational Protocol (SIOP) (Short, Vogt, and Echevarria 2011). SIOP was developed to make content

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material comprehensible for English language learners and includes an emphasis on key vocabulary, frequent interactions between students, hands-on activities, and language objectives in addition to content objectives.

Requirements for plant growth are included in national, state, and local standards. This activity was planned to address the *Next Generation Science Standards (NGSS)* performance expectation 2-LS2-1: Plan and conduct an investigation to determine if plants need sunlight and water to grow (NGSS Lead States 2013, p. 18; see Connecting to the Standards). The idea that plants depend on water and light to grow is a focus of this activity and part of *NGSS* disciplinary core idea LS2.A: Interdependent Relationships in Ecosystem. We further sought to provide our students with the opportunity to plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question (*NGSS* science and engineering practice Planning and Carrying Out Investigations). While we conducted this unit in second-grade science classes, it could be expanded or simplified to fit a plant unit in any elementary-level class.

We chose chia seeds as the basis for our plant science unit for several reasons. Chia seeds are available in many grocery stores and are not known to cause allergic reactions. However, the teacher should check with parents to determine if any students have allergies to the plant. Since they will sprout on almost any moist surface and respond quickly to environmental variables, they have been used in controlled experiments in middle school classrooms (Conover 2011). The nutritional value and rich cultural history of chia offer interdisciplinary extensions to build upon the existing knowledge and interests of our students from culturally diverse backgrounds.

Engage

We first assessed students' prior knowledge and engaged them with a think-pair-share activity about the traditional Native American "three sister" crops (corn, beans, and squash), a topic covered earlier in the social studies curriculum. Then we used a brief slide show to introduce chia as another Native American crop. Students were excited to examine small containers of chia seeds. Chia has been grown in Mexico and Central America for at least 3,000 years. Chia was an important part of the Aztec diet and has been recently recognized as a health food in the United States. Today, sprouted chia seed displays are featured in spring celebrations in parts of Mexico and Central America.

Explore

Students then wanted to know: *Can you eat it? Can you grow it? How does a seed provide nutrition for the growing plant? Is that what makes it good for me? Will a chia seed grow inside me if I eat it?* Students in an urban environment don't often encounter the living version of the food they eat, so they were eager to explore these mysteries.

Eating Chia Seeds

Students compared the nutritional value of chia and the "three sisters." They examined nutrition labels of commercially packaged corn, beans, squash, and chia seeds (see NSTA Connection for labels) and recorded their observations on blank nutrition labels (see NSTA Connection for the recording sheet). Chia is high in fiber, protein, and healthy omega-3 fat (see Figure 1), so the students concluded that chia is nutritious. We also provided extra blank nutrition labels so that students could work with their parents to evaluate other food products at home (see NSTA Connection).

Chia seeds have a mild nutty flavor that we expected the children to enjoy. We obtained samples of chia products (free of gluten, nuts, and lactose) for sampling: plain whole chia seeds, chia pudding, a chia-based energy bar, and chan. Tasting food products should not be conducted in a laboratory but rather in a cafeteria.

Students ranked each sample by appearance, aroma, and flavor using a scale of "yuck to yum" on a data sheet we provided (see NSTA Connection). The students compared their notes and agreed that chia tastes delicious. We sent them home with a letter that provided information about chia, some recipes, and links to some family-friendly websites (see NSTA Connection). The following day, several students were eager to share their family experiences eating chia.

Growing Chia Seeds

We prepared chia seeds for sprouting on a Chia Pet by making a "chia gel" (1 part chia seeds to 3 parts water) that we applied to the outside of the figurine. For our class investigation, we placed one Chia Pet in a dark closet and one under a grow lamp. Seedlings appeared within three days, allowing the class to observe the growth process. Seeds in this crowded environment usually survive about two weeks.

As the seeds sprouted, we used an inexpensive digital microscope to better observe the tiny seeds, roots, sprouts, and emerging leaves. We compared the growth of the Chia Pet in the closet with the Chia Pet under the lamp and discussed why the former was white and the latter green. We measured the individual parts of the sprouts in mil-

FIGURE 1.

Chia nutrition facts.

Nutrition Facts

Serving Size 1 ounce 28g (1 ounce (28g))

Amount Per Serving	
Calories 137	Calories from Fat 72
	% Daily Value*
Total Fat 9g	13%
Saturated Fat 1g	4%
Trans Fat	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 12g	4%
Dietary Fiber 11g	42%
Sugars	
Protein 4g	
Vitamin A 0% • Vitamin C	0%
Calcium 18% • Iron	0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

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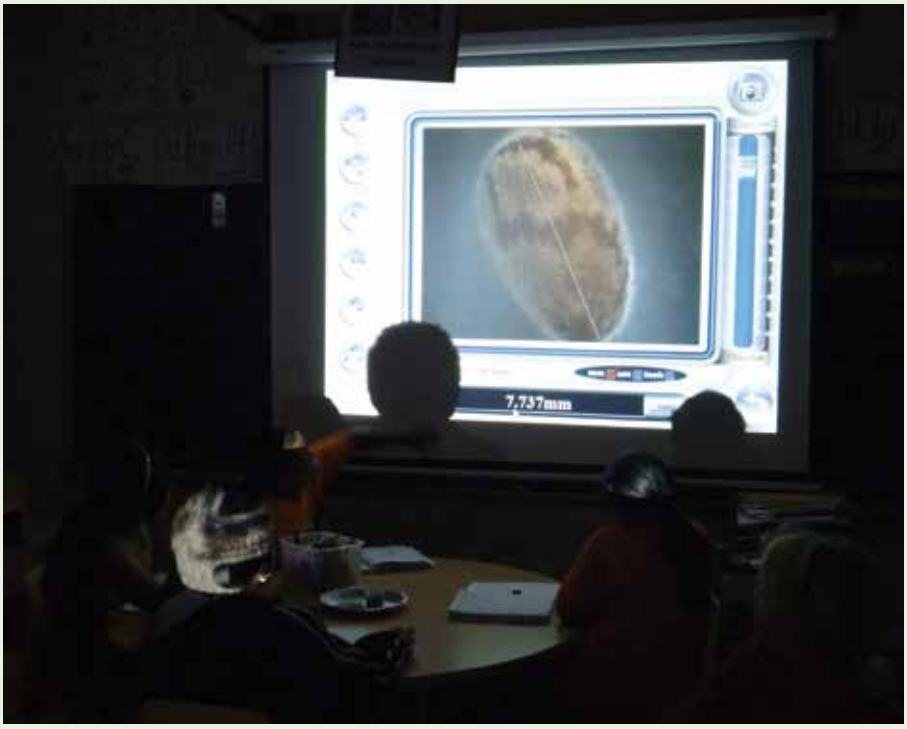
FIGURE 2.

Observing chia sprouts with a digital microscope.



limeters using digital microscope software (see Figure 2). Students were amazed to magnify something so small and see in such fine detail. They were fascinated with the tools, the images, and videos we captured and the measurements we took.

Art With Chia Seeds

Students used colored markers to draw a design on a paper towel. They then placed seeds on their design with chia gel from a plastic pipette (see Figure 3). Finally, they moistened the paper towel, sealed it inside a plastic sandwich bag, and took the project home to observe.

This art project allowed children to practice sprouting chia seeds and also served as a catalyst for students to share science curriculum with their families. Many students returned to class energized and excited about the discussions they had with their parents. One girl explained, "My mom sometimes eats chia in her smoothies or oatmeal, but she didn't know that you could also grow plants from the grocery store–bought seeds!"

Although students were encouraged to place the chia art in a well-lit room, some placed their art in varying conditions. All students were surprised that the chia seeds could sprout simply on a moist paper towel without soil. This provided a rich discussion about independent variables and conditions for seed germination that extended beyond the school walls.

These activities allowed our diverse students to build upon common interests and deepen background knowledge about chia seeds, through a fun hands-on inquiry approach (Fathman and Crowther 2006). This set the stage for the science learning activity to follow: designing and conducting original investigations using chia seeds.

A Fair Test

Within the context of the classroom, students conducted investigations in groups of four or five over a two-week period to determine how a variable of their choice affected the growth of their chia seeds. Before beginning, students reviewed first-grade science concepts with a discussion about plant life cycles and basic needs. Students then brainstormed different variables that could affect the growth of plants, for example temperature, amount of water, soil, and container type. Students considered that they could test seed growth with no light, natural sunlight, classroom fluorescent lights, or growth lamps. Students also discussed how elevation could change the growth of plants. For example, we could hang the plants

from the ceiling, put them on the floor, or leave them on a table in the classroom. Each group selected one variable to investigate.

Students observed their plants and recorded findings every other day over a two-week period. In addition to noting their own free-form observations and drawings, students counted the number of seeds that had sprouted, measured the length of the emerging roots and stems, counted the number of leaves, and observed the color of the plant parts. Students compared their results to the class control, which consisted of 10 seeds planted on a water-soaked paper towel in a resealable plastic sandwich bag under a growth lamp at 70°F. They also worked together to infer why their results turned out the way they did. We discussed with students that the sprouting that we observed was fueled by the energy contained inside the seeds, the same energy that makes chia a healthy and nutritious food.

FIGURE 3.

A student uses a pipette to create chia art.

Explain

We asked each group to create a poster outlining the important components of their investigation. Each poster included the title, question, hypothesis, materials, procedure, observations, and inferences. We provided sentence starters for students to help scaffold for our English language learners and students with special needs (see NSTA Connection). Student posters demonstrated that in the germination and growth of chia seeds, events have causes that generate observable patterns, which relates to the *Next Generation Science Standards* crosscutting concept Cause and Effect (NGSS Lead States 2013, p. 18).

Since each group of students conducted a different investigation, the class organized a gallery walk. Students rotated clockwise around the room and spent five minutes at each table. They really enjoyed this part because they were able to use their five senses to observe differences, similarities and other patterns between the groups' results. One student remarked, "I really thought that the seeds would not sprout floating in water. It was a surprise to see green stems and leaves!"

Students recorded each group's results on a worksheet using their own words. They then worked together to draw inferences about the effect of each independent variable on the growth of the seeds. For example, one group explained: "We predicted that the seeds would not sprout after we put them in the microwave and we were right." This activity gave students practice with drawing

FIGURE 4.

A corn, beans, and squash garden.

inferences, observing patterns, and developing explanations—skills that many students struggle with. Finally, we gathered as a group to share and, when necessary, discuss differences.

Elaborate

Having observed the early sprouting phase of chia, students wondered how a chia plant might grow in a garden. Our school yard includes an organic "three sisters" garden (see Figure 4). At the students' suggestion, we invited parents to help supervise a planting of chia seeds there. (Note: Chia is native to the subtropics. It grows quickly to up to 6 ft. tall, but will not flower before the end of the growing season in the northeast.) The students taught parents what they had learned about chia seeds, chia nutrition, and the importance of chia to the Aztecs. This activity enabled them to engage their five senses outdoors and showcase their new knowledge. Many students count this activity as one of their favorites. Before planting, check for the use of herbicides and pesticides and the presence of poison ivy or insect problems in the area selected to plant. Adequate adult supervision is always necessary and the use of gloves is recommended.

CAUTION

In art class, students applied knowledge about the cultural context of chia for the ancient Aztecs. They each designed and constructed their own chia pet from clay. After the pets were fired in the kiln, students planted chia seeds on them in science class and took them home to observe the growth (see Figure 5). One student remarked, "I liked making the chia pets because I grew mine at home and it grew pretty well."

Evaluate

We assessed student learning throughout all phases of the unit. In the engage phase, we noted the background knowledge that students brought to the lesson. During the explore phase, we interacted with and questioned students as they observed and recorded the growth of their chia plants during the investigations. The explain phase allowed us to gather information from student posters about the growth of their chia plants, including their predictions, observations and inferences. We also assessed the explanations they drew after observing their classmates' investigations. Although there was some disagreement about the effects of some of the variables, all students agreed that these seedlings need water and light to live and grow. During the elaborate phase, we evaluated students' ability to apply what they had learned about chia to the planting of chia in the school yard and to the creation and preparation of their chia

Connecting to the Standards

Standard 2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Performance Expectation:
2-LS2-1 Plan and conduct an investigation to determine if plants need sunlight and water to grow

Science and Engineering Practice:
Planning and Carrying Out Investigations

Diciplinary Core Idea:
LS2.A Interdependent Relationships in Ecosystems

Crosscutting Concept:
Cause and Effect

NGSS Table: 2-LS2 Ecosystems: Interactions, Energy, and Dynamics
www.nextgenscience.org/2ls2-ecosystems-interactions-energy-dynamics

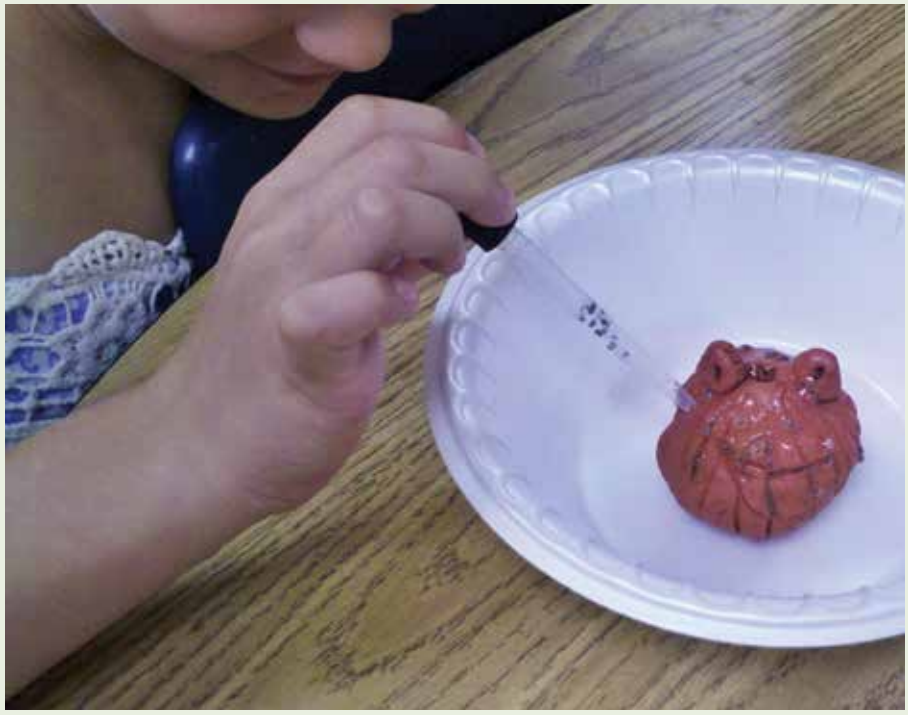
pet. Finally, we gave all students a summative assessment to determine how much students learned from the other groups' investigations (see NSTA Connection).

Conclusion

All students need experiences with school science that connect to their everyday lives in familiar ways (Brown and Abell, 2007) and draw upon their personal interests. In this unit, chia seeds became a common interest among students from different cultural and linguistic backgrounds and helped us foster a classroom environment where students developed deeper understanding about plant products and life cycles through hands-on inquiry-based activities. Students engaged in cross-curricular, inquiry-based activities that encouraged them to work as a collective to communicate, plan, observe, infer, and share their results. Throughout the month long unit, students not only explored nutrition, Aztec art, science practices and our school yard habitat, but also connected to each other through the cultural traditions that they bring to the classroom. ■

FIGURE 5.

A chia pet made in art class.



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Internet Resources

Chia Power website
www.chiativity.org

Sheltered Instruction Observational Protocol (SIOP) website
www.cal.org/siop

NSTA Connection

Visit *www.nsta.org/SC1312* for this article's supporting resources.