NARRATOR: This third-grade sound energy example will show how students created and refined models over time, which supported their ability to write scientific explanations. We used a vocal phenomenon in order to anchor the unit around an underlying big question that students could pick apart and wrestle with throughout the unit. The big question for this unit was why can a singer shatter a glass with his voice. Students saw two video clips about this phenomenon. Then, talked to each other right after watching, already curious about what was happening.

STUDENT: And then it gets so whistley.

STUDENT: Yeah, the bottom is moving.

[INTERPOSING VOICES]

STUDENT: Oh, look at that!

TEACHER: OK. So I'd like you to pair-- are you guys next to your pair?

[INTERPOSING VOICES]

TEACHER: Oh. If you don't have a buddy, can you join a buddy, another buddy, and buddy up? And I want you to talk to your buddy about what you see happening and take turns, all right?

STUDENT: I think it's vibrating and maybe shaking because the bottom-- I think she's going toward the bottom, and it's kind of circling around the glass, which is making it not fall and like shaking it, but then it just gets so shaken that it just causes it to break.

STUDENT: Yeah.

STUDENT: We're wondering why--

STUDENT: So I think it's going back and forth like this so much. But it's supposed to be stiff and not break because what it's for is for putting water in and not moving back and forth and not breaking with your voice, so it's shaking so much, and it's so hard that it shatters.

NARRATOR: Using a model scaffold provided a structured space for students to diagram and outline their initial ideas. They had time to talk with others about their initial ideas and add or change their models. Here are some examples of students' initial ideas about the big question why can a singer shatter the glass.

During the unit, students made sense of various activities and demonstrations as they layered on knowledge about how our bodies produce sound, how we hear sound, the force and energy of vibrations, how sound travels through different media, and a bit about resonance. Students revisited their initial ideas a little over halfway through the unit. We also talked about diagram norms and focusing on only including details, labels, arrows, and explanations that were about our science ideas. From this model, we could see gaps in student understanding and made instructional decisions on the activities in coming lessons. Students use these conversations to further develop their model and explanation.

STUDENT: I agree with you because I think sound waves are like invisible waves that are made out of sound, and that's how--

STUDENT: Like sound waves, I'm making sound waves. This is vibration.

STUDENT: But I'm still making a noise, and it's still traveling. So, why is it not the same as sound waves?

STUDENT: But what if the sound waves had something different?

STUDENT: I know, but sound is still traveling.

NARRATOR: Finally, students worked in small groups to make a consensus model that would explain how the singer was able to shatter the glass using evidence to support their ideas. Students had resources to help them in this process by using their initial model and midpoint model, as well as access the readings and diagrams we have used in class.

STUDENT: What we figured out is that I put my ear to a table and then we just gently knocked on it. And then I pulled my ear back, and I knocked the same force, and it was actually quieter. So, we figured out that sound travels through things.

STUDENT: That it can travel from--

STUDENT: It expands the farther it goes. So, we were in the hallway, and I talked to Emma way up close, really close to me--

TEACHER: Like that?

[LAUGHTER]

STUDENT: --like that and said "hello," and then we went really far away and then--

STUDENT: I literally went to the second floor.

TEACHER: Oh, did a little experimenting.

STUDENT: And then, I couldn't hear her. So we figured out that if the sound wave travels like really far it kind of builds off some of the sound, and so then it's only small, less. Yeah. It expands all over.

STUDENT: So, it only comes with a certain amount of force.

NARRATOR: After presenting their small group models to the class, students gave each group feedback about their ideas. This feedback would help groups clarify their diagrams as well as help focus their writing. To help scaffold their writings, students had pink sentence starters that were about ideas and green sentence starters that referenced activities to help students bridge what they learned in the activity and use it as evidence for their ideas.

STUDENT: One thing. The singer doesn't have enough force to break it until they take longer to break.

STUDENT: Wait. Forced to break.

STUDENT: We need to write an evidence. We need evidence.

STUDENT: How about you--

STUDENT: You don't need to use the green evidence.

STUDENT: How about you just write some evidence?

STUDENT: What I wrote about is the singer can make sounds because the diaphragm squeezes the lungs, which pushes air through the vocal cords. The vocal cords vibrate the air that makes the sound waves.

STUDENT: I've got one question.

STUDENT: Yeah?

STUDENT: You forgot the diaphragm.

STUDENT: Diaphragm.

STUDENT: Right?

STUDENT: The diaphragm?

STUDENT: Yeah.

STUDENT: So, I have to draw a muscle?

STUDENT: Well, technically, the diaphragm helps the air come out, right?

STUDENT: Yeah, I know. It explains it. The diaphragm squeezes the lungs, which pushes the air through the vocal cords.

STUDENT: Oh, I wasn't listening correctly because I didn't hear them like that.

STUDENT: You need hearing aids.

[LAUGHTER]

NARRATOR: Throughout the unit, taking time for students to refine their models of this science phenomenon and communicate their ideas with others provided them with the resources needed in order to craft a full scientific explanation about a sound energy phenomenon.