CREATIVE SOUND DRAMATICS

DRAMATIC MODELS OF SOUND TRAVEL EXTEND INQUIRY LEARNING FOR FOURTH GRADERS.

By Rebecca Hendrix and Charles Eick

"I feel like real particles and not dots in a book!"

Sound propagation is not easy for children to understand because of its abstract nature, often best represented by models such as wave drawings and particle dots. We wondered how science inquiry, when combined with an unlikely discipline like drama, could produce a better understanding among our fourth-grade students of how a sound wave travels through matter. Creative dramatics uses children's imagination, emotions, and movement to act through improvisation to learn academic material in the classroom. Creative dramatics helps children both retain academic ideas and learn them more deeply (Johnson 1998). We used creative dramatics as extensions in support of our children's ongoing inquiries in the Full Option Science Study (FOSS) module on the physics of sound (see Internet Resource). We found that children performed better on end-of-unit module tests when performing these extension activities integrated into their inquiry studies (Hendrix, Eick, and Shannon 2012). We used an adaptation of the Glasson Learning Cycle Model (Glasson 1993) to plan our sequence of drama activities for maximum effect into four phases or steps: Preliminary, Focus, Challenge, and Application. These steps mirror the 5E Learning Cycle steps of Engage, Explore, Explain, and Elaborate but with an emphasis on student dialogue on new learning in each phase. We will describe a series of creative drama activities that we used with the module section How Sound Travels, including how the teacher facilitates the process (see Table 1).

Preliminary Stage: Exploring Sound Travel

Before beginning the drama activities, students conduct a practice exercise that helps them learn how to feel comfortable with their bodies and use their bodies appropriately (see Figure 1 for tips for keeping students on task). This practice exercise helps to reduce the initial novelty of drama and related off-task behavior and silliness that can interfere with the learning experience. In the preliminary phase of the drama integration, we begin with a 15-minute body warm-up in which the teacher leads the children to imagine, invent, and mimic the movement of a sound vibration traveling through matter. The children are aware of sound vibrations and the nature of sound waves after completing the the first three modules in their FOSS curriculum. In previous investigations on how sound travels, students develop the concept that the energy of a vibrating sound wave can move from one place to another because it travels through a medium. The teacher provides the science setting: That sound is energy in the form of a vibration that travels through all matter. The teacher also coaches with prompts such as, "Pretend you are an air particle too small to be seen near the sound source of a plucked string of a violin. How would you move?" and "How would you cause the other particles to vibrate?" The activity gives children permission to enact and experience a model of a sound vibration as they conceive it. We use the music of Vivaldi's "Four Seasons" to help motivate and encourage individual body movement as a sound wave or vibration. Varying the genres of music used can add a more multicultural emphasis in the lessons. Children use the movement of their bodies to suggest the back-and-forth movement of a vibration coming from a sound source. They imagine they are sound waves traveling through the medium of matter. They use their head, arms, torso, and legs to model the wavelike motions of a moving sound wave. For example, they wave their arms and bodies away from the sound source to bump into another particle (student) who continues the motion.

The preliminary phase activity is a motivational and thought-provoking activity because children must get out of their seats and engage in initially thinking about the science that they are learning through movement. After the drama experience, children write and draw in their science journals their understanding of how air particles vibrate. Their initial ideas inform us of their understanding of the cause-and-effect nature of vibrating particles traveling through matter. With this initial understanding, we are

FIGURE 1.

Drama practice exercise and behavior management.

We use stop and start signals for the dramatic action. Children are asked to imagine that they have a bubble surrounding them. If they get too close to another person and into their space, then that bubble will burst. Then, playing some slow music, children move around the room to the music. The slow music is followed by another tune with a more rapid beat. These short experiences with movement help set the tone for expectations in the upcoming lessons. Any behavior problems that arise in this initial exercise are addressed with the children. In particular, we explicitly address the issue of respecting other children's physical bodies by not crashing into them or using limbs to accidently hit them. Running is also forbidden. While carrying out drama, we provide an adequate playing place or area in the classroom by moving the desks to the side. This rearrangement opens up the area in a classroom and sets the perimeters for the playing space to be used for about 15 children. Teachers with larger numbers of children and/or smaller classrooms can use the space in a cafeteria, gymnasium, or outdoor playground (with a whistle). Children are instructed not to run or inappropriately touch or push each other in their dramas.

TABLE 1.

Adapted Glasson learning cycle for creative drama activities for the FOSS module's section on "How Sound Travels."

	Teacher Activity	Student Activity
Preliminary	Explores student views on how sound is produced through creative dramas. Provides the motivational experience of integrating music and creative body movement to science concepts. Coaches children to visualize the rapid back-and-forth movement of a sound vibration.	Engages in creative movement activity to mimic the wave motion of a sound vibration. Values music and movement to learn about air particles, sound vibration, sound transfer, and sound mediums.
Focus	Teaches the tools of creative drama to act out scientific models of molecular motion. Guides children by asking open-ended questions of the effect sound vibrations have on particles.	Uses improvisation and pantomime to explore molecular motion. Uses literary personification to understand molecular motion. Records ideas in science journal.
Challenge	Introduces Compression and Rarefaction Guides the exchanges of views. Checks to ensure that all views are considered about air particles in a sound wave. Keeps discussion open. Presents the evidence from the accepted science point of view.	Seeks validity of concepts of how sound travels through additional reading in the science text about compression and rarefaction in a sound wave. Compares the accepted science view with the view of other children. Evaluates own view. Cites evidence of view based on science readings.
Application	Assists children to clarify views and to understand concepts from reading and investigations. Help children to apply the science concepts to build accurate models of sound science through dramatic improvisation, pantomime and literary personification.	Discusses and debates the best approach to present the group model of compression and rarefaction. Solves problems in model construction with collaboration of peers. Presents solutions as to the best way to construct the science model of compression and rarefaction in a sound wave. Presents models to the class. Engages in evaluation of models.

ready to introduce the tools of creative drama in the Focus Phase in order to construct still deeper understandings of how a sound source affects particles in different mediums as it travels.

Focus Phase: Building Models With the Tools of Creative Drama

In the focus phase, we begin with the concept of how a vibration from a sound source affects particles in different mediums: solids, liquids, and gases. In Module 3, students compare and record how a sound wave moves through different mediums, including solids, liquids, and gases. This is the phase where we first introduce, explain, and use the creative drama tools of improvisation, pantomime, and literary personification (Table 2). Before students can use these tools on their own, the teacher first leads the children through whole-class and small-group exercises where they learn through practice how to use each drama tool. We place the names of each drama tool on our word bank of terms that we keep from our previous FOSS lessons. The word bank is particularly important for our English language learning children. We use the tools in practice to communicate our notions of the vibrating motion of air particles previously explored.

We then seek to further combine language with the pantomime to understand sound travel through the invention of drama scenarios. The teacher introduces the drama scenarios for the class based on the targeted science concepts learned from the FOSS inquiries. Children working in groups of four to six write out their dialogue for their dramas to perform before the class. The prior introduction to the tools of creative drama serves as a catalyst for their use in planning and acting out models of understanding (see Table 3). In this way, children are meeting the scientific practice of Developing and Using Models to represent events (NGSS Lead States 2013). As groups plan

TABLE 2.

Creative drama tools used with practice examples.

Creative Drama Tool	Definition/Description	Activity examples
Improvisation	The art of creating dialogue on the spot through group interaction in order to create a sense of story or character without the use of a scripted play. (Can be applied to both animate and inanimate objects in science.)	**Improvisation Circle Activity** Children form a circle. Teacher guides an improvisation on moving particles in air through "I" statements that are completed by each child around the circle: Example: Teacher: I am a very small air particle and ... Child 1: I can cause other particles to vibrate and ... Child 2: I pass my energy of motion on and ...
Pantomime	The art of conveying ideas without words in which the body engages in physical movement much like dance to challenge the imagination and sharpen the senses. Note: Pantomime for science concepts is also the art of making the invisible seen through movement and invention.	**What Are You Activity** Children select action slips from the pantomime box for miming the physical action to the class individually or in small groups for others to guess: Example: Pretending to be a vibrating air particle striking a nearby still air particle
Personification	Giving human characteristics to animate or inanimate objects.	**If I Could Talk Activity** Children write first-person "I" statements in science journals about what an object [or concept?] (e.g., particle, vibration) might say if it could talk as a monologue. The activity is extended to include a dialogue between particles.

their dramas, the teacher listens closely to each group and facilitates thinking in helping link their dramas to the science concepts learned in the corresponding FOSS activity.

As groups perform, the class also listens to each group's thinking and construction of events in the scenario to assess elements of sound travel through the mediums of air, liquids, and solids. Some examples of children's performance statements include, "Spread out men! Let's move to the ear! Get ready go!" and "Excuse me fellow gas molecules but you need to vibrate!" The expectation in performance and class dialogue is that a new idea or expression of science meaning will occur from prior knowledge in the settings we have created. Our purpose is to interact, assess, and exchange dialogue with the children about how sound travels through all matter.

Challenge Phase: Introducing Compression and Rarefaction

The Glasson Learning Cycle stresses the exchange of ideas in science discourse and the importance of oral language in framing conceptions. In the Challenge Phase, we decide to dig deeper in learning about particle movement and sound vibrations by reading about compression and rarefaction in our science text. In this phase, children use informational text as evidence to support their thinking in linking learning from the science investigations and creative drama activities. In using these multiple modes of learning, the children also meet the following language literacy standards from the Common Core (NGAC and CCSSO 2010):

- ELA-Literacy RI.4.1 – Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- ELA-Literacy RI.4.9 – Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.
- ELA-Literacy SL.4.5 – Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

The teacher poses the question: "What has to happen to particles to make sound travel to sound receivers in a medium like air?" We ask the children to particularly analyze the textbook picture diagram of compression and

TABLE 3.

Drama scenarios for enacting targeted science concepts in small groups with student examples.

Drama Scenario	FOSS Science Concept	Example Student Dramas
A mixture of air particles are gathered together when suddenly the music of a violin causes a stir of vibrating particles.	Sound vibrations travel through the gases in the air to a sound receiver.	Group invents the pantomime by swaying back and forth to mimic movement of air particles in vibration. Invents what the air gas particles would say: "I am an oxygen particle causing other particles to vibrate on the way to the sound receiver."
A group of submarine captains are traveling on a secret mission underwater to find the lost city of Atlantis. Suddenly, there is a sense of danger as the sub's crew hears the sonar ping of a distant submarine.	Sound vibrations travel through water.	Group invents the pantomime by traveling in two submarines underwater. Enemy submarine sends out a sound wave to the other submarine. Invents dialogue: "I hear the sonar ping, Captain! There is another ship." The submarine hearing the sonar ping sends back two pings to the enemy ship.
A group of solid particles make up the surface of a marching bass drum.	Sound vibrations travel through solids.	Children use classroom drum to march as particles of a solid that make up the surface of the drum. The striking of a classroom drum becomes the inspiration for moving particles that vibrate the drum's surface. Moving outward, the children pretend to make nearby air particles also vibrate through the air in all directions.

rarefaction. They learn from the informational science text how air particles are initially compressed nearest the sound source and then relaxed in rarefaction through oscillations that then travel in a sound wave away from the sound source through the nearby air particles.

The teacher encourages all the children to participate in expressing their views in a class discussion based on evidence from the text on how the particles in compression and rarefaction are arranged in a sound wave. They evaluate the accuracy of each other's thinking by comparing what is stated and the picture diagram in the science text. They try to evaluate their thinking in light of the ideas and model described in the text and whether their views make sense based on the given scientific knowledge. In this way, they use the textbook along with previous FOSS activities as evidence to support their thinking. The teacher guides the children to consider the accepted view of compression and rarefaction that is described in the text. We then write agreed-upon student statements about compression and rarefaction on large sheets of white paper tacked to the wall (see NSTA Connection). These sheets of paper provide a visual representation of statements for everyone to see as well as scaffolding for the next part of the lesson. The children will return to these statements to use as cited evidence in the Application Phase. This is particularly helpful for our English language learners. As a class we collaborate to compare and synthesize thinking through this phase in order to build (and later revise) a model of compression and rarefaction that can be acted out through drama in the next phase activity. In this portion of their learning, students are utilizing multiple scientific practices of: (1) engaging in argument from evidence as they communicate with one another and (2) developing and using models as they construct explanations (NGSS Lead States 2013).

Application Phase: Creating Compression and Rarefaction Models

In the Application Phase, children apply their refined understanding of sound travel by working in groups to create their own sound models using creative drama. We direct the children to collaborate with their group partners to develop a model of compression and rarefaction to perform for the class. The teacher instructs groups to use the agreed-upon ideas from the wall charts from the previous lesson in developing their models for greater accuracy. Groups also receive a rubric of essential components to include in their dramas and that will be used for peer evaluation of performances (see NSTA Connection). The teacher circulates, observes, and acts as the science and drama coach to facilitate group thinking on the science learned and its application to the dramas. After drafting and practicing their created drama models, student groups perform the models for the class to observe. The use of videotaping for each performance is helpful in allowing the class to review each performance for deeper analysis, discussion, and learning purposes.

FIGURE 2.

Creative drama group in their orange stretchy costumes.

Groups come up with many different creative ways to use the drama tools that they have learned to more accurately model the compression and rarefaction principles of sound travel. In one drama, a group of children led a particle conga line adapting the conga song rhythm to show particles vibrating and traveling in compression and rarefaction to the point of slowly fading out. Pretending to be vibrating air particles of oxygen, nitrogen, and water vapor, the children sang, "Everybody Conga," followed by a pause to drop the head, while pulling inward their arms and hands to shape the body as an air particle in compression, followed by saying "compression." The children follow this same method for the second verse but in this instance the chest lifted and expanded as particles spacing apart in rarefaction followed by saying "rarefaction."

The arms and fingers were spread out as far as the body would allow for a model of rarefaction in a sound wave.

In another drama, the children decided to use orange stretchy "particle" costumes available in our science classroom (see Figure 2). The children bunched together to mimic the compression of air particles and then spread apart to mimic the rarefaction in a sound wave. Their movements were set to their favorite songs that served as a sound source. Decision making and collaboration were evident as the children explored the best way to communicate their model and maneuver the orange material. Although costumes are not necessary to implement creative drama, their use provides our children with an additional motivation and excitement in their dramas.

Using the drama model rubric (see NSTA Connection), all children assess if each creative drama model implementing improvisation, pantomime, and literary personification is in keeping with accepted science views of compression and rarefaction. We discuss their assessments as a class. For example, in assessing the conga line drama, we discussed how the model was weaker on science accuracy because the performing group had the same particles traveling through space. The open-ended questions at the end of the rubric provide further self-reflection about sound from each performance. We observe that the rubric helps to sharpen their thinking on the accuracy of the science model created when compared with accepted science thought. For grading purposes, rubric scores are collected and averaged for half of the grade given for each group's work, with the other half being the teacher's rubric score.

Conclusion

Children enjoy getting out of their seats to learn science. Children greatly enjoy movement and action as they learn across academic disciplines through the use of creative dramatics. To the teacher of science, this simply means that children improvise science models through movement of the body that mimics accurately the science concept. Creative drama performs well as an extension to the abstract nature of concepts in sound travel. In addition, moving electrons or the biology of circulating red blood cells all become inspiration for building models of understanding through creative drama to make difficult concepts more concrete. This metacognitive strategy provides a great extension to inquiry-based science learning for concepts that are too small or not possible to see! ■

***Rebecca Hendrix** (rebecca.hendrix@opelikaschools.org) is a teacher in Opelika City Schools in Opelika, Alabama. **Charles Eick** (eickcha@auburn.edu) is an associate professor of curriculum and teaching at Auburn University in Auburn, Alabama.*

References

Glasson, G. 1993. Reinterpreting the learning cycle from a social constructivist perspective: A qualitative study of teachers' belief and practice. *Journal of Research in Science Teaching* 30 (2): 187–207.

Hendrix, R., C. Eick, and D. Shannon. 2012. The integration of creative drama in an inquiry-based elementary program: The effect on student attitude and conceptual learning. *Journal of Science Teacher Education* 23 (7): 823–846.

Johnson, A.P. 1998. How to use creative dramatics in the classroom. *Childhood Education* 75 (1): 2–6.

National Governors Association Center for Best Practices and Council of Chief State School Officers (NGAC and CCSSO). 2010. *Common core state standards.* Washington, DC: NGAC and CCSSO.

NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states.* Washington, DC: National Academies Press.

Internet Resource

Full Option Science System (FOSS) *Physics of Sound*
www.deltaeducation.com/productdetail.aspx?Collection=Y&prodID=1074&menuID=

Connecting to the Standards

Standard 4-PS4 Waves and Their Applications in Technologies for Information Transfer

Performance Expectation:
4-PS4-1 Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Science and Engineering Practice:
Developing and Using Models

Disciplinary Core Idea:
PS4A Wave Properties

Crosscutting Concept:
Patterns

NGSS Table: 4-PS4-1 Waves and Their Applications in Technologies for Information Transfer
www.nextgenscience.org/4ps4-waves-applications-technologies-information-transfer

NSTA Connection

Download a model evaluation rubric and see student statements at *www.nsta.org/SC1402*.