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Fusion Science Theater

Using Theater to Teach Science Concepts, Content, and Methods

by Marcy Weiland and Holly Walter Kerby

We founded Fusion Science Theater in 2006. Holly was an instructor of chemistry and playwriting at Madison College, a two-year institution in Madison, Wisconsin. Marcy was an actor, artistic director of a community theater company, and an employee of Attainment, a company that creates educational products for people with disabilities. Our mission is to invent and produce forms of theater that engage children in science learning.

Using theater to promote science is not a new idea. Spurred on by a national call to increase the quantity and quality of students pursuing careers in science, elements and forms of theater have been used to engage children in science for decades. Examples include stage plays about scientists or their discoveries; chemical and physical demonstration shows that wow audiences with performances of spectacular science phenomenon; and physical dramatization or “Creative Dramatics” that invite children to play a role in the science-related scenario. These forms of theater are practiced in classrooms, museums, outreach shows, and clubs. They are not only fun and exciting, but have also been shown to increase interest and appreciation in science. What more did we want?

To Inspire and to Teach

Increasing children’s interest, excitement, and appreciation of science is the first step toward getting them to study and choose careers in science; we wanted to go further. We felt that the best way to inspire children to future science learning was to provide them with a rich, rewarding learning experience. We founded Fusion Science Theater to explore ways to use theater to actually teach science concepts, content, and even scientific methodology. Our question, of course, was—could it be done? And if so, how? We found the answers by identifying and combining playwriting techniques and best practices in teaching science.

Playwrights use a combination of elements to make the audience care about what will happen next, wrestle with weighty issues, think in new ways, and reach their own conclusions. We identified and adapted the following elements of playwriting to motivate and catalyze science learning in our first outreach show:

1. Tell a story through Questions—Plays work by planting a question in the minds of the audience early in the story. For example, the question planted in Romeo and Juliet is, “Will Romeo and Juliet beat the odds and live happily ever after?” The audience becomes engaged in the play because they want to learn the answer. This device, known by playwrights as the “dramatic question,” sparks curiosity, elicits attention, and motivates the audience to wrestle with the problems presented as the play unfolds. A well-crafted dramatic question provides context and urgency to the many smaller questions that are posed, answered, and linked together to form the plot.

2. Plot—The plot or story of the show is what happens in the play to answer the dramatic question.
3. *Engage the audience through Characters*—Audience members invest themselves in a play because they identify with the characters and care about their well-being. This emotional connection makes the problems and concepts of a play more personal and compelling.

4. *Make Metaphor concrete*—Well-written plays convey metaphor in concrete terms (sets, props, masks, or choreography) to engage multi-modal learning and deepen understanding. This tool, drawn from Creative Dramatics, is used in many elementary school classrooms.

5. *Provide a framework through Genre*—Playwrights choose to write in a familiar genre because it provides a framework that allows the audience to engage and interact with the content of a play.

6. *Make an impression through Spectacle*—Playwrights employ spectacle to draw the attention of the audience to information important to the plot. Exciting and arresting displays of lighting, sound, sets, or costumes heighten awareness through the element of surprise. Demonstration shows use this principle to engage children in science.

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**Questions Lead to Learning Objectives**

We applied these elements to the traditional science demonstration shows and created a form we call “Science Investigation Shows.” We begin the development of a show by deciding on a single age-appropriate learning outcome. The next step is to formulate a primary question whose answer is the learning objective. This is the crucial ingredient in engaging curiosity. Simply put, the mere act of asking a question makes people want to figure out the answer. We structure each show as an investigation that proceeds through the steps of a scientific method (observations, questions, hypotheses, experiments, interpretation, modeling, conclusion). All demonstration experiments are chosen to provide clues needed to answer the investigation question.

Presenters use techniques like Q&A, open discussion, and call and response to involve children in the investigation. Towards the end of the show, children are invited to the stage to act as atoms and molecules in a kinesthetic dramatization of the concept under investigation.

*The Boiling Point* is one of our Science Investigation Shows. *The Boiling Point* poses the investigation question, “What happens to water when it boils?” It uses signs to introduce vocabulary words, chemistry demonstrations to provide clues, hand motions and Q&A to involve the audience, and features an “Act-It-Out” segment where children don “I”s and “O”s and dance to the Blue Danube to model boiling water molecules. We assessed learning by having the children vote for their favorite hypothesis at the beginning and the end of the show. The data confirmed that kids not only learned the correct answer, but also improved their own opinion of their ability to do science.

Since *The Boiling Point*, we have created several more Science Investigation Shows:

1. *The Burning Question*, about combustion;
2. *The Circuit Game*, about serial and parallel circuits;
3. *The Way the Ball Bounces*, about the relationship between polymer structure and its “bounceability”;
4. *Race to the Glow*, about the influence of temperature on the the brightness and longevity of Glo-Sticks;

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**Involving Teachers and Undergraduates**

Because these shows target children 5–10 years, we consulted with several elementary school teachers during the development of the shows. Most shows were then piloted in elementary
school classrooms, family science nights, children’s museums, and after-school science clubs. We’ve also coordinated follow-up sessions with select elementary classes and teachers to assess whether children retain what they learned a week or two after the show.

The most exciting development for us is that we have trained two local undergraduate groups to perform Science Investigation Shows: SPICE (Students Participating in Chemical Education) at the University of Wisconsin-Madison, and PAL (Performing Arts Leadership) at the Madison College. Not only does this vastly broaden the scope of our child audience, but we found that the students performing the shows were profoundly affected by the experience. They reported that they were much better able to explain scientific concepts, and some started to consider teaching as a career for the first time. This has launched our first long-range goal, to enable science outreach groups all over the country to perform our shows. Our partner in this is the American Chemical Society, which hosts undergraduate student chapters. We conduct training sessions at ACS national meetings, and ultimately intend to put training “kits” online.

Outreach and Sharing

Our focus to date has been on Informal Science Education (or “Science Education Outreach”), but elementary school teachers have a natural understanding and affinity for what we do and how we do it. We’d love to work with elementary teachers to develop shows and activities that fit into and enhance their science curriculum. It would also be exciting to work with teachers to develop shows that their students could perform for their parents and/or younger children. We think our first step down this road is to connect with fellow travelers—in this case, elementary teachers who are interested in using theater to teach science. To this end, we are presently creating the “Science Education through Theater Network” (or SET NET), a Facebook social network where educators can talk to each other, offer advice, post activities, and ask questions. It will be up and running after March 9, 2011. Anyone who is interested can check it out and join. We believe that the power of an investigation question, combined with intriguing demonstrations, call and response, and modeling concepts via creative dramatics, has the potential to spark and support learning in a whole new generation of science students.

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Passages in this article were drawn from the following previously published papers:
