Drama in the Science Classroom:
Teaching Science in the New Millenium

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To my loving husband, Jason, who has more patience than anyone I know.
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Introduction
In the fall of 1998, I decided to take my required fine arts education class; I had several to choose from, but none seemed to catch my fancy. I finally decided upon Children's Theatre. As a science person, I prefer facts and numbers and hard evidence; theatre is not my game. As a teacher, though, I was mildly curious to see what I could gain from the experience. Still, I had visions of costumes and lighting, sets and scripts and all the other things that people often think of when the word "theatre" pops up. I was not really looking forward to this class, especially since I am not any kind of artist or actress. As the semester wore on, however, I found that this class was giving me one of the most valuable tools that any teacher could have – a teaching method that can not only motivate students to participate, but one that gets them to think and problem solve as well. It comes built in with alternative evaluation methods; it can help you get to know your students and help your students get to know each other. This extraordinary teaching method has a very ordinary name: drama.

My purpose in writing this paper is to share with others what I have learned in my explorations of drama in education. I needed a new way to teach science to middle school students and high school students that would get their attention – I was looking for a way to dispel all the stereotypes that surround science education today. More often than not, students think that their science classes will be hard or boring; very few students seem to enjoy this subject. However, using drama as a teaching tool, science comes alive as a
real adventure that students can take with them – a thought-provoking event that the students can relive. It is no longer just words in a textbook or chemicals in a laboratory – it is a part of the student’s experience. This part, that in the beginning seems so small, can help them in many ways later in life. I believe that it can be one of the first steps to an open mind for many students. Through drama, even in a science classroom, you inevitably touch an issues of importance such as multicultural diversity (i.e., women and minorities in science), accepting and validating others people’s opinions and emotions (especially in group discussions), teamwork (group projects), and self-esteem (courage and comfortableness to participate). These are just a few of the extremely valuable lessons that students learn.

“For its part, science education...should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and face life head on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent and vital. America’s future – it’s ability to create a truly just society, to sustain its economic vitality, and to remain secure in a world torn by hostilities – depends more than ever on the character and quality of the education that the nation provides for all of its children” (The Need for Science Literacy, 1).

I believe that drama in education used across disciplines, but especially in science, helps to build that character and quality in our educational system. It
does so because it allows students to practice those essential lessons and skills in a safe learning environment.

"A child’s years in elementary school span a period of dramatic physical, mental, and emotional growth. The teacher’s primary role is often seen as increasing student’s knowledge, but the most effective teachers also play an important role in promoting growth of their students’ independent, responsible thinking and actions...Children need to know that they can think for themselves and that their own thoughts are worthwhile and valuable to themselves, their classmates, and their teacher" (Howe, iii).

It is my goal to be an effective science teacher and I believe that using drama in my classroom will help me to achieve that goal.
Part I
Why Drama Works

"Imagine that learning is a magnificent journey full of wondrous adventures. Myriad routes can be followed leading to the same destination. . . Students become explorers, traveling interconnecting pathways of human experience. As they take their intellectual and creative excursion into the unknown, students will be guided by teachers who help develop a learning map – a curriculum which will be guided to their final destination – knowledge, insight and understanding" (Kase-Polisini & Scott-Kassner, 3).

This quote fairly leaps off the page in the book "Interconnecting Pathways to Human Experience"; right away, the reader gets a glimpse of the wonderful possibilities that drama seems to promise. It speaks of the kinesthetic interaction; thinking of learning as a journey brings a physical picture to mind. It tells of an "intellectual and creative excursion" where higher-order thinking skills are developed. It also hints at the interesting approach in which students help direct their own learning – the teacher acts as a guide. Finally, and most importantly, it tells of a "final destination" – one which we can never fully reach, but must always strain toward. It is the ultimate goal of education itself. We must strive to develop our knowledge, understanding and insight of the world around us.

How does drama drive us toward this goal of knowledge and understanding? Several reasons are immediately apparent: drama is process-
centered, student-oriented and interactive; it can also be very motivational and can help the teacher activate the students' prior knowledge.

A. Drama as a Process

The form of drama that will be discussed in the following pages is "process"-centered drama rather than "product"-centered. "Process usually indicates an ongoing event, unlike product, a term that implies conclusion, completion, a finished object" (O'Neill, xv). Cecily O'Neill further explains the concept of process by saying that

"the primary purpose of process drama is to establish an imagined world, a dramatic ‘elsewhere,’ created by the participants as they discover, articulate and sustain fictional roles and situations. As it unfolds, the process will contain powerful elements of composition and contemplation while remaining at the heart of the event as the source of much of its dramatic power" (O'Neill, xvi).

Because the actual focus of the drama exercises is the process of creating the drama, there is a sense of no right or wrong actions or answers. It is very much like an experiment: just because it is not what you expected does not mean that it is in any way wrong or incorrect. And, like in an experiment, it is important to do it more than once. Judith Kase-Polisini points out the significance of rehearsal in The Creative Drama Book: Three Approaches. First, the group must plan their scene, with emphasis on what will happen, not how it will come about. Next, the group plays out the scene and then they evaluate it. After each evaluation, there is another planning period followed by another
playing period. The cycle of “plan-play-evaluate” continues until the group is content with the product (Kase-Polisini, 85-88). It is through this cycle that ideas are considered and discussed, misconceptions are cleared up and new understandings are created.

B. Drama as Interaction

The interaction that occurs when a group engages in a creative drama exercise is three-fold. They interact with each other, with the facilitator or teacher, and with the text or material that they are studying. The interaction with the teacher/facilitator in drama transforms the classroom from the stereotypical classroom where teachers use “the ‘3 T’s’ – teacher, talk and textbook” (Kase-Polisini and Spector, 15) to a classroom where bi-directional and student-directed learning takes place. Brian Edmiston accentuates this point when he describes the teacher’s role in drama.

“Teacher-student interaction is crucial in drama. Although drama work follows student’s interests and suggestions, the teacher is responsible for sequencing tasks and shaping the drama. Even though students will often work in small groups, it is in the teachers’ interactions with the students where ideas are most likely to be clarified, shaped, extended and revised” (Wilhelm and Edmiston, 5). In order to use drama effectively in the classroom, then, the teacher must be willing to learn just as much from the students as the students learn from the teacher. It is the bi-directional learning that makes the difference. Edmiston also says that before he began using drama in his classroom, he, like many
other teachers, “assumed that education was individual ‘instruction’ believing that students were learning if [he] gave them information or directed them to resources. . .” (Wilhelm and Edmiston, 13). He realized that “[he] had done little either to assist students in the performance of their knowledge or to ensure that they would encounter alternative viewpoints that would challenge their thinking and provoke their creation of new understandings” (Wilhelm, 13). What stands out the most, though, is the emphasis that he places on his realization of the importance that bi-directional learning represents:

“Most significantly, I had regarded the interrelationships among students, subject matter, the world, and the teacher, as peripheral rather than central to learning – both theirs and mine. . .My students learned information but my classroom work did not create self-motivated learners. Drama never became powerful for me until I constructed understandings with the students” (Wilhelm and Edmiston, 13, 18).

There is an old adage in education that says “I hear and I forget; I see and I remember; I do and I understand.” This simple proverb explains quite well how students learn through drama. Students actually take on the roles that they are discussing; i.e., they do what they are learning. The interaction that they experience with the material cannot be gained any other way. The students must shift their paradigms and become part of what they are studying in order to understand it. They must assume the perspective of someone, something or somewhere else in order to examine the material more carefully,
thus acquiring an intimate knowledge of what is being studied. Also, Edmiston says that by taking on perspectives of others,

“[students] encounter situations and points of view – represented by other students, texts, and by the teacher – that challenge and change them and their view of whatever they are studying. . .In this drama space, their understandings change if they begin to relate: what is to what might be, the here and now to then and there, and the self to the other” (Wilhelm and Edmiston, 6).

What Edmiston is saying is that not only do students begin to make connections in the material being studied through drama, but they also begin to connect with other people through drama. Students can begin to see other people's points of view while at the same time as they their own. Mikhail Bikhtin, a Russian theorist, says that we can only form new understandings when our point of view is doubled – when we experience two or more views at the same time (Wilhelm and Edmiston, 6). This doubled point of view helps the students gain an appreciation for other people's feelings and opinions. The students thus learn the importance of respecting and validating the feelings of others. This ability to validate others improves students' social skills and promotes empathy – consequently improving social interactions.
Multiple Intelligences: Something for Everyone

In 1983, Howard Gardner, a graduate psychology professor at Harvard University, published his book *Frames of Mind*. It was intended as an introduction to his theory of Multiple Intelligences. He received quite a bit of positive reaction among educators – his theory caught on quite well. We have always known that everyone is better at some things than at others; this is what helps to define us as individuals. Gardner’s concept of Multiple Intelligences (MI) put this common knowledge into a precise theory that is easily and productively applied in real classrooms. One of the reasons that the Multiple Intelligences theory has attracted so much attention from educators is that it endorses the fact that not everyone is the same. Education works better for individuals if the educational experience is personalized by taking into account, instead of ignoring, differences in intellect and strengths. (Gardner, Myths and Messages, 1, 6).

Gardner defines intelligence as the “human ability to solve problems or to make something that is valued in one or more culture” (Checkley, 8). He goes on to say that the ability must have a particular representation in the brain; there must be populations that are very talented in or especially impaired in that ability; and there must be an evolutionary history of that intelligence seen in animals other than humans (Checkley, 8). In *Frames of Mind*, Gardner listed seven intelligences: linguistic, logical-mathematical, spatial, bodily kinesthetic, musical, interpersonal and intrapersonal.
“Linguistic intelligence is the kind of ability exhibited in its fullest form, perhaps, by poets. Logical-mathematical intelligence, as the name implies, is logical and mathematical ability. . . Spatial intelligence is the ability to form a mental model of a spatial world and be able to maneuver and operate using that model. Sailors, engineers, surgeons, sculptors, and painters, to name just a few examples, all have highly developed spatial intelligence. Musical intelligence is the fourth category of ability that we have identified: Leonard Bernstein had lots of it; Mozart, presumably, had even more. Bodily-kinesthetic intelligence is the ability to solve problems or to fashion products using one’s whole body, or parts of the body. Dancers, athletes, surgeons, and craftspeople all exhibit highly developed bodily-kinesthetic intelligence.

Finally, I propose two forms of personal intelligence. . . Interpersonal intelligence is the ability to understand other people: what motivates them, how they work, how to work cooperatively with them. Successful salespeople, politicians, teachers, clinicians, and religious leaders are all likely to be individuals with high degrees of interpersonal intelligence. Intrapersonal intelligence, a seventh kind of intelligence, is a correlative ability, turned inward. It is a capacity to form an accurate, veridical model of oneself and to be able to use that model to operate effectively in life” (Gardner, *Theory in Practice*, 8-9).

Recently, Gardner added an eighth intelligence, the naturalist intelligence, to the list. “Naturalist intelligence designates the human ability to discriminate
among living things (plans, animals) as well as sensitivity to other features of
the natural world (clouds, rock configurations)” (Checkley, 12).

When asked how he thought educators should implement the theory of
multiple intelligences, Gardner answered that “it is very important that a
teacher take individual differences among kids very seriously. You cannot be a
good MI teacher if you do not know each child and try to gear how you teach
and how you evaluate to that particular child” (Checkley, 11). Gardner also
promotes the concept of “education for understanding” – meaning that
students are able to apply knowledge to new situations. He also believes that
“school matters, but only in so far as it can yield something that can be used
once the students leave school” (Checkley, 12). Using creative drama in the
classroom promotes both of these concepts – knowing your students and
application of knowledge outside of the classroom – as pointed out by
Edmiston. In fact, drama and Multiple Intelligences go hand-in-hand. Almost
all drama exercises involve some kind of kinesthetic activity; they promote
social skills and interactions (intrapersonal intelligence); they scenes in creative
drama must follow a logical, rationale sequence in order to make sense –
mathematical-logical intelligent people would make good planners. The scenes
must be communicated in a clear, well-thought out manner (linguistic
intelligence); music, rhythms, songs or sound-effects can be added to make the
scene more effective (musical intelligence); and finally, the scene must take
place within a set area (classrooms are only so big), so the spatial intelligent
people can visualize how the scene should be placed and moved about. By
using creative drama, all of the intelligences can be utilized. This will give students an opportunity to shine in their greatest abilities and help them to work on the ones that they have trouble with.
Drama and Whole Child Development – Cognitive, Social, Emotional and Physical Development

“Everyone comes to school with the skills needed to create drama. It is one of the principle methods that children [use to] learn about life, by acting out or rehearsing situations for greater understanding” (Kase-Polisini and Scot-Kassner, 95). Dramatic play has long been known to be a “major means through which children extend their cognitive skills” (Berk, 251). This significant method of learning begins in early childhood; it emerges at about 18 months, and increases as the child matures. In fact, the older a child gets, the more complex his/her play becomes. For example,

“toddler use only realistic objects – . . . a toy telephone to talk into or a cup to drink from. Around age two, they use less realistic toys, such as a block for a telephone receiver, more frequently. . .Between 3 and 5 years, children become better at imagining objects and events without any support from the real world” (Berk, 227).

This shift toward more imaginative drama indicates the cognitive development taking place; by using different objects to represent the object in question (props), children are demonstrating their growing representational abilities.

“This indicates that their representations are becoming more flexible, since a play symbol no longer has to resemble the object it denotes” (Berk, 227). The more symbolically a child can think, the better they are with figurative representations, the less they use real objects and the more they use their growing imagination. “Research indicates that play not only reflects, but
contributes to children’s cognitive skills” (Berk, 227); this reinforces the theory that children gain knowledge and skills through drama. Research also shows that when compared to “non-pretend” activities, children engage in dramatic play sustain interactions longer, show more involvement, are more helpful, and draw more children into the activity. Preschoolers who spend more time in dramatic play are advanced in intellectual development, have a better understanding of other people’s feelings, and are considered more socially advanced by their teachers. Dramatic play also seems to strengthen other areas in cognitive development including memory, language, logical reasoning, and creativity (Berk, 227).

Besides helping children develop their cognitive functions and abilities, dramatic play also helps them develop socially and emotionally. According to Russian psychologist Lev Semenovich Vygotsky's sociocultural theory of child development, “make-believe [play]...provides crucial preparation for cooperative and productive participation in social life” (Berk, 249). Vygotsky believed that dramatic play directs social development forward in two ways.

“First, as children create imaginary situations in play, they learn to act in accord with internal ideas, not just in response to external stimuli. Gradually they begin to see that thinking (or the meaning of words) is separate from the actions and objects for which it stands and that ideas can be used to guide behavior” (Berk, 249).

Again, this is demonstrated by the use of objects to represent other objects. Children learn that you can change the meaning of an object. “When a child
uses a...folded blanket to represent a sleeping baby, they change the object's usual meaning” (Berk 249). Second, the rule-based nature of make-believe play

“strengthens children’s capacity to think before they act. . .It constantly demands that children act against their immediate impulses because they must follow social rules to execute the play scene. . .As children enact rule in make-believe, they come to better understand social norms and expectations and strive to behave in ways to uphold them” (Berk, 249).

Children often play out gender roles that are emphasized in their cultures as well; in the United States, young girls often play “house” – they take care of their dolls by washing them, feeding them and changing their diapers, they pretend to make food, wash clothes, etc. All of these activities fit into the stereotyped role of females. Dramatic play also allows children to become familiar with social roles and career possibilities. Laura Berk points out several examples:

“In cultures around the world, young children act out family scenes and highly visible occupations – police officer, doctor and nurse in Western nations; rabbit hunter and potter among the Hopi Indians; and hut builder and spear maker among the Baka of West Africa” (Berk, 227).

By practicing these skills, children are readying themselves for social interaction and are learning about profound activities in their culture.
There is also an important emotional element in dramatic play. “An anxiety-provoking event, such as a visit to the doctor’s office or discipline by a parent, is likely to be revisited in the young child’s play, but with roles reversed so that the child is in command and compensates for the unpleasant experience” (Berk, 227). By revisiting the event and placing themselves in control of the situation, children learn how the better manage their own negative emotions and come to better understand the feelings of others. Judith Kase-Polisini says that “drama offers a healthy release of emotions. . .We develop an awareness of our relationship with others and learn ways of functioning in society” (Kase-Polisini, 113). Also, engagement in dramatic play, especially with siblings, is linked to advanced emotional understanding. The complex nature of sibling relationships, coupled with the “frequent acting out of feelings”, makes dramatic play an excellent setting for learning about emotions (Berk, 394).

While there is more emphasis placed on the importance of dramatic play in cognitive and social development, it plays a part in the physical development of a child as well. Children practice fine motor skills when they “feed” their dolls or build “forts” from blocks. Since they are only pretending, using their toys, they are free to practice such skills without the fear of making a mess or breaking something that would be considered valuable. Hand-eye coordination is refined and more skilled movements are developed as children practiced these movements again and again when they play. Drama enhances “kinesthetic sensitivity and body awareness” and “physical poise and grace may
be fine-tuned through experience in drama" (Kase-Polisini, 112). Dramatic play may also involve gross motor skills such as running (i.e., when playing “Cowboys and Indians” or “Cops and Robbers”).

It is clear that dramatic play in young children advances every part of their development. What is not clear, however, is why educators cease to utilize this natural form of learning as the child grows older. We know that “theatre is a way to practice social customs and manners, build self-confidence. . . develop group and individual problem solving skills. . . synthesize information from a variety of sources, evaluate what has been learned. . . [and] explore career choices” (Kase-Polisini & Scott-Kassner, 95). Creative drama is a natural extension of dramatic play. Therefore, we can effectively use drama to instill and enhance these skills and attributes in our students just as they used dramatic play in their early childhood to foster their own development.
Neuroscientists are making leaps and bounds in what we know about the brain. Because of their research, we now have a basic understanding of how the brain functions and what learning is in a neurological context.

Neurons are the cells in the brain that control neural functions such as thinking and learning. Neurons are composed of a cell's body (called the soma), dendrites (the parts of the neuron that receive messages) and axons (the part of the neuron that send messages). Every neuron has many dendrites, but only one axon. The axon branches out and at the end of each branch is a synapse – the gap between two neurons (see Fig. 1). Neurons connect axon to dendrite; dendrites almost never connect to each other. Messages are carried down the axons in the form of electrical impulses; when the signal reaches the synaptic gap, it is converted to a chemical message (these chemicals are referred to as neurotransmitters). This message then crosses the synapse to the dendrite of the next neuron (Jensen, *Teaching with the Brain in Mind*, 11-13).

“Learning is a critical function of neurons that cannot be accomplished individually – it requires groups of neurons. . .Learning changes the brain because [the brain] can rewire itself with each new stimulation, experience and behavior” (Jensen, *Teaching with the Brain in Mind*, 13). For several decades,
scientists thought that the brain that you got when you were born was the brain you had for the rest of your life. Now, however, we know that experience plays a large role in the way that your brain develops over time. Researchers have found that "the brain changes physiologically as a result of experience. The environment in which brain operates determines to a large degree the functioning ability of that brain" (Wolfe and Brandt, 10). The concept of neural plasticity (the brain’s ability to change physiologically in response to experience) has revolutionized what we know about learning. "The environment affects how genes work, and genes determine how the environment is interpreted. . .So our environment, including the classroom environment, is not a neutral place. . .The trick is to determine what constitutes an enriched environment" (Wolfe and Brandt, 10-11). So how do we determine what an enriched environment is?

In their article, Pat Wolfe and Ron Brandt list four facts about the brain's natural inclinations:

"1. The brain has not evolved to its present condition by taking in meaningless data; an enriched environment gives students the opportunity to make sense out of what they are learning, what some call the opportunity to 'make meaning'" (Wolfe and Brandt, 11).

Vygotsky outlined this in his theory of zone of proximal development. Learning must be challenging but not too much so or the students will give up. If it is not challenging enough, they will get bored. Using developmentally appropriate lessons for each student deals with this zone for each individual child.
“2. The brain develops in an integrated fashion over time. An enriched environment addresses multiple aspects of development simultaneously” (Wolfe and Brandt, 11).

All aspects of the child’s development must be acknowledged and fostered. Each part is intertwined so intricately with the others that they all must be addressed in order to truly further the child’s learning.

“3. The brain is essentially curious, and it must be to survive. It constantly seeks connections between the new and the known. Learning is the process of active construction by the learner, and an enriched environment gives the students the opportunity to relate what they are learning to what they already know…” (Wolfe and Brandt, 11).

The brain is constantly recognizing relationships between what the person already knows and the new understandings that they are creating. How well a student learns and the quality of the constructions that they make depend on how efficiently the brain is able to organize and store these relationships.

“4. The brain is innately social and collaborative. Although the processing takes place in our students’ individual brains, their learning is enhanced when the environment provides them with the opportunity to discuss their thinking our loud, to bounce their ideas off their peers, and to produce collaborative work” (Wolfe and Brandt, 11).

Social interaction in the classroom, especially when guided by the teacher, is much more than just social interaction; it is a wonderful chance for students to practice collaborative learning.
Marian Diamond, a neuroscience researcher at the University of California at Berkeley, says that

“an enriched environment for children:
Includes a steady source of positive emotional support; . . . Stimulates all the senses (but not necessarily all at once!); has an atmosphere free of undue pressure and stress but suffused with a degree of pleasurable intensity; . . . Allows social interaction for a significant percentage of activities; promotes the development of a broad range of skills and interests that are mental, physical, aesthetic, social, emotional; gives the child an opportunity to choose many of his or her efforts and to modify them; provides an enjoyable atmosphere that promotes exploration and the fun of learning; [and] allows the child to be an active participant rather than a passive observer” (Wolfe and Brandt, 11).

The above description of an enriched classroom immediately brings to mind the image of a classroom where drama is created. Drama allows children to learn in a manner that is natural to them; it enhances their development, it provides them with an enriched environment, and it teaches them to learn things in such a way that they will be able to apply them in real situations. Edmiston points out that

“our notions of how students learn significantly affect what students learn... Using drama is a way for students to be motivated to use what they know, to learn new information real purposes, and to create new understanding and theories of the world as they transform
and apply this knowledge in new situations. In this way, drama guides students in learning how to learn” (Wilhelm and Edmiston, 18).
Drama to the Rescue: Trouble in Our Schools

(State-mandated Curriculum and Testing Methods)

In the article that she wrote with Barbara Spector, Judith Kase-Polisini spells out what may be causing educators to overlook drama as a teaching tool.

“Typical instructional strategies used by science teachers in schools were the ‘3 T’s’ – teacher, talk and textbook – with cookbook laboratory experiences interspersed once in a great while in natural science classes. As a result of the proliferation of state mandates for teaching math and science, and calls for teaching thinking skills in all disciplines, many science teachers felt pressured to teach ‘just the facts’ as quickly as possible in order to ‘cover the material’ for which students would be tested. As they got caught up in meeting the science mandates, creative thinking inherent in the scientific enterprise was ignored” (Kase-Polisini & Spector, 15).

Texas, like most others states in the U.S., has its own mandates and methods to evaluate students on how well they are learning these objectives. State-mandated testing for Texas these days is the Texas Assessment of Academics Skills (TAAS) test. The test is given at various grade levels; the most emphasized tests are at the third grade, eighth grade, and tenth grade levels. However, there is a common observation even among students studying to be teachers: Once it is time for the TAAS test here in Texas, everything stops so that the TAAS tutorials can begin. The students seem to do nothing but worksheets in the weeks before, so that the teachers can be sure that every
objective has been covered in class. The children are “bribed” and “coerced” with parties and other rewards to do well on the exam. If the situation is extreme enough, teachers may even fear losing their jobs if scores are not satisfactory. These attitudes are not only harmful to the students learning and development, but they are also utterly ridiculous! These tests should only be used an evaluation of the child’s progress and not an evaluation of the entire school district as a whole. (Child-development specialists have been telling educators and administrators for years that developmentally appropriate lesson plans, teaching methods and testing are needed in order to truly measure a child’s progress and development.) Furthermore, if we can teach a child to use critical thinking skills, higher-order thinking skills, and creativity when answering a problem (as many drama exercises do), then it is not necessary to drill them on specific skills, and then test them on those skills – especially in science. Drama presents a wonderful, but alternative, form of evaluation. For example, the scientific method is always taught in a science classroom. The students are required to know the exact steps that it involves: observation, inference, hypothesis, experimentation, and conclusion. However, “all problems cannot be solved by beginning with a generalization and analyzing it deductively, which is the traditional representation of science in a textbook. Students also need to be able to identify and gather relevant data and induce a generalization from that data” (Kase-Polisini & Spector, 15). While it may be important for the student to be able to list the exact steps in the scientific method, it should be more important that they be able to apply to a situation.
For instance, a teacher might go over the steps of the process in class by defining them and discussing the order of in which they arranged. The teacher could also set up a "mystery" for the students to investigate and have them label the parts of the investigation according to the steps of the scientific method. After they have solved the mystery, the students can discuss the application of the scientific method in the activity and how useful it is (or is not). The students will no only have learned the scientific method, but also how to apply it in a "real" situation and what problems may occur when using it. The teacher will be able to deduce how well the class learned the subject from the discussion portion. The teacher might also ask a few questions and have the students write down their answers on note cards so that he/she can evaluate the children on an individual basis. In this case, drama is an easy and effective way to teach an objective that is often covered on the TAAS test and it made it interesting and useful to the students.

Another problem with state mandates and required curriculum is that it often overloads teachers with too much information to teach in one year.

"The present curricula in science and mathematics are overstuffed and undernourished. Over the decades, they have grown with little restraint, thereby overwhelming teachers and students and making it difficult for them to keep track of what science, mathematics and technology is truly essential. Some topics are taught over and over again in needless detail; some that are of equal or greater importance to science literacy – often from the physical and social sciences and from technology – are absent
from the curriculum or are reserved for only a few students" (Science Education in America, 1).

Drama is an educational approach that promotes "education for understanding," which means that students are able to take what they learn and apply it to new situations – they are not just memorizing facts and objectives. Howard Gardner says that "the greatest enemy of understanding is coverage. If we try to cover everything, by the end of the day people will have learned very little and understood nothing" (Gardner, Keynote Speech, 1).

While it is important to meet the mandated objectives in any classroom, coverage is not everything. Teachers often get so caught up in just covering the objectives that teachable moments – moments where students exhibit a natural curiosity or a false or incomplete conception of an idea – slip by unidentified. When using drama in a science classroom though, those teachable moments are more easily identified. In their article, Kase-Polisini and Spector wrote about a program in Florida called World of Water (WOW) where this notion was found to be true. The participants in the program were middle school students that demonstrated a high level of achievement in science and math; they attend the program for two weeks. This program was the first anywhere to use drama as an evaluation method for science (Kase-Polisini and Spector, 16).

"Initially, creative drama was intended as an evaluation tool to test whether or not students had synthesized and internalized their experiences. As the creative drama process unfolded, the science staff discovered the process to be a dynamic diagnostic tool for identifying
student's incomplete conceptions and a vehicle enabling students to revise their conceptions to fit with currently accepted scientific knowledge” (Kase-Polisini and Spector, 16).

Not only was the WOW staff able to identify those moments, but they were able to correct the misconceptions quickly and efficiently. Teachers who participated in the WOW program found creative drama to be such an effective method of teaching science that they began to use it in their regular classrooms to help their students learn. These teachers, just like Brian Edmiston (see pg. 5-6), found that drama was a very potent and effectual tool that they could use to teach science.

Drama also fosters the natural curiosity that is so often absent in today's classrooms. “Drama harnesses students’ imagination to breathe life into the concepts and content of the curriculum” (Wilhelm and Edmiston, 4). Since the students create the drama and the teacher just guides them, their educational experience is what they make of it. Because they have choices about how they learn, they are more conscious of what is being taught. The students ask more questions, produce more feedback for the teacher to evaluate and they help the teacher in assessing them because they have to assess themselves. Also, by putting themselves in someone (or something) else's shoes, begin to get into character. The students want to think like their character, so that they can accurately portray their character. For example:

“'I've been asking lots of questions. Asking what might people have been
doing, thinking and feeling because they were here [in the castle]. I wondered a lot too. I wondered what their lives were like and why people were here and what might have happened to them if they were outside...’

– Jessica, grade 6” (Wilhelm and Edmiston, 1)

This student demonstrated the that is imperative in education. “Asking ‘What if...?’ is not an optional question in the curriculum – imagining possibilities is at the core of understanding other people, other times, other places.

Imagination is an integrative force in the curriculum as students wonder: What if...” (Wilhelm and Edmiston, 4).

Drama also brings social and emotional development to the attention of teachers. If a student’s self-esteem is not as well developed as it should be, it will show during activities. If the student’s social skills are underdeveloped, it will show. Often times, especially in middle school and high school, students who are quiet or shy and some who cannot communicate well or whose social skills are lacking often slip in and out of classrooms without being noticed. Vital parts of their development are overlooked because the students themselves are overlooked. Not only will drama activities help to identify those students, they will also help to build self-esteem and nourish social and communication skills.

Drama used across disciplines as a teaching tool is by no means a method that will fix everything that is wrong with school systems today. It will, however, help teachers to reach more students than they could reach with traditional teaching methods. It makes them more aware of themselves, of
their relationships with others and of the world. It encourages every part of
their development from physical to social to cognitive development. It causes
students to think about what they are learning, instead of just taking in
information. Most importantly, drama helps them prepare for life better than
any textbook they will ever pick up or any exam that they will ever take
because it gives them experiences that they can apply to real life situations.
Part II
Practical Applications of Drama in a Science Classroom:

5 Lesson Plans

The previous pages have emphasized the importance, efficacy, and powerfulness of the effects of drama as a teaching tool across disciplines. Unfortunately, it does not always have these effects in the real world. Often times, the activities that have the potential to transform a lesson into a true learning experience are used solely as "fun" activities; they have little or no value as true creative drama. Teachers use them because they are interesting and provide a break from routine teaching. The activities can and often do take away from the material that is being taught because they are not facilitated from a drama perspective. Students often become wrapped up the actual activity and lose site of what they are supposed to be learning.

The following pages include five different lesson plans from four different individuals. Each one is a life-science lesson geared toward middle school or elementary students. While they seem like good activities that would no doubt be fun, they exhibit more potential for creative drama than actual value as creative drama. Most "drama" that is used in subjects such as science and history is used because of the uniqueness of it. Again, it provides a break from routine. Until educators shift their paradigms to include drama as an outstandingly effective teaching tool in almost all subjects, it will be the novelty of such lessons that attracts teachers' attention to them instead of their true educational value.
Using Imagery to Introduce the Endocrine System

Courtesy of:
Janet Weaver
Rosary School, Oklahoma City, OK

Description:
This experience uses the students' imagination to make their body's protective systems go into action, thereby giving an actual experience of what the Endocrine System can do.

Purpose:
To introduce the Endocrine System to the students.
To involve all the students' senses, including their imagination, in the experience.
To introduce the Endocrine System vocabulary.

Objectives:
Students will identify body reactions associated with adrenaline.
Students will define Endocrine System and functions.
Students will define glands and hormones.
Provide a basis for: comparing the endocrine system to other body systems and exploring connections between endocrine system and other body systems.

Activities and Procedures:
Ask the students to get into a comfortable position in their chairs. Turn off the lights (close shades if possible). Tell the students that when you begin they will be told to close their eyes. They are to keep them closed until told otherwise. They are only to listen and use their imagination.

Say (pausing after each suggestion):
Close your eyes...Relax your feet...Relax your knees... Relax your thighs...Relax your stomach...Relax your hands...Relax your shoulders...Relax your chest...Relax your forehead...
Imagine yourself in the middle of a beautiful field of flowers...The smell is sweet...the colors are all your favorites...there is no pollen to irritate you...you are perfectly relaxed...the sky is blue, with only small puffs of white clouds...

You look around and see a small dirt road leading into the most beautiful grove of trees...you decide to follow the road into the trees...As you walk on the road, the temperature gets cooler...there are still flowers among the trees...

You see the road makes a sharp turn ahead, and as you walk around the turn you notice a house at the end of the road...It is not large, but it is not small, either...The house is not well kept, but it is not falling down, either...you can tell someone lives there...

You decide to go up to the house to see if anyone there could give you a drink of water...You walk up to the house and up the three broken steps to the front door...The door is standing open a little as you knock...No one answers your knock, so you knock again, this time a little louder...Now you hear a muffled sound coming from far inside the house...You look into the front room of the house and see clothes laying around...a half full glass of milk...and a kitchen in the back...

In the kitchen you notice a door, half open leading into blackness...you open the door and see steps leading down...you hear the muffled sound a little louder now coming from beneath the stairs...

You begin walking down the stairs, into the darkness...your hand brushes up against the cool wall...At the bottom of the stairs you hear the muffled sound coming from your right, and as you turn towards it you hand feels a wetness on the walls...You walk very slowly towards the sound...in the darkness...then AAAAAAAAAAAAAAAAAAAA!!! (The teacher screams as loudly as possible.)

Open your eyes. What is your body doing right now?

Begin a list of body reactions on the board (shaking hand, moving out of seat, screams, fast heart rate, pounding head, etc.)

Listen to what was going on with the students.

Identify the systems of the body at work on the list of reactions.

Then ask: Why do you think your body was doing this? (List answers.)

Introduce the Endocrine System and beginning vocabulary – glands, hormones, adrenaline.
Explain how the Endocrine system works to protect you in an emergency.

If time remains, ask: What other ways could you need protection? (If they don’t come up with needing to have timing for cycles to happen (growth and sexual cycles) mention them also. Then the rest of the explanation of the endocrine system can be done.

**Tying it all together:**

Begin a discussion comparing how the endocrine system works with how the nervous system works, and how all the other systems work. Discuss how the different systems work together. Ask students to decide on which system of the body is the most important and give reasons for their decision. (Don’t let them off the hook by saying they are all important and that none of them can work without the other – though that should be the conclusion they will come to.)

Available at: http://explorer.scrtec.org/explorer-db/rsrch/783750969-447DED81.1.htm
Circulatory System of the Body
A Science Role Playing Activity

Courtesy of:
Janet Weaver
Rosary School, Oklahoma City, OK

Description:
Small groups of students use their imagination in cooperative efforts to role-play processes in Science. Each student in the group 'plays' the 'part' of one part of the process. The other groups watch as each group acts out their version of the process.

Purpose:
To reinforce knowledge level information on processes in Science, several times for each child and in a 3-D format.
To encourage creative thinking.
To encourage cooperative efforts between students.
To engage the students in whole body learning, using all their senses and imagination, in order to better integrate into themselves.

Objectives:
The students will be able to demonstrate the scientific process studied.
The students will be able to identify the different parts of the process and the correct order of each of those parts in the process.
The students will be able to work cooperatively with other students.
The students will be able to create a new way of looking at a scientific process.
THE STUDENTS WILL ENJOY LEARNING!

Activities and Procedures:
For use only after the basic process has been explained, read, or in some way studied.

Divide the class into groups. Groups should be small enough so that each student can be an important part of the process, but large enough so that the process can be complete. Tell them to create a creative and entertaining way to show the process just studied using everyone in the group.

Set a time limit (8-10 minutes) for the groups to 'get it together', then have each group perform for the rest of the class.
Sample Process:

Cast of Characters:
Blood (carries two wads of paper to represent the blood cell and carbon dioxide)
Toe
2 Capillaries
Vein (use arms or extra student as one-way valves)
4 Chambers of the heart (use arms or extra student as one-way valves)
Vessel from Heart to Lungs
Lung (with wad of paper to represent Oxygen)
Vessel from Lungs to Heart
Artery

Begin with Blood inside Capillary which is inside Toe (students can stand close
together with Vessel's arms around blood)
Blood moves into Vein, through one-way valve up to Heart Atrium.
Blood then goes through one-way valve to Heart Ventricle and out through
Vessel
from Heart to Lungs.
When in Lung, the Blood goes into a capillary and gives the Lung the Carbon
Dioxide paper wad and the Lung gives the Blood the Oxygen paper wad –
this is all done through the wall of the capillary.
Blood then moves into the Vessel From Lungs to Heart and goes into other
Heart Atrium, through the one-way valve to the Heart Ventricle. The
Ventricle then pushes the blood back down to the Capillary in the Toe,
where the process begins again.

Tying it all together:

Discussion following the performances centers on completeness of the process
shown, and the creativity displayed in showing the processed. After the
performances, ask the students to draw or diagram the process in their notes,
labeling each part.

Available at: http://explorer.scrtec.org/explorer/explorer-db/rsrk/783750917-447DED81.1.htm
CRAZY BONES

Courtesy of:

Mary Hanson
Lake Junior High School
Woodbury, Minnesota

Description:

This lesson involves locating and naming the major bones in the human skeletal system, and rewording a common song to make it biologically accurate.

Materials:

a class skeleton
cassette recorder
bone name labels
copy of the song titled "Dry Bones"
tape (masking)

Procedures and Activities:

The teacher holds the bone labels. Ask the students to request a bone name, give them the appropriate label, and one at a time, have the students go to the front of the room and tape the label on the appropriate bone. I used the 23 major bones, and made labels on my computer in the size of 1 inch X 3 inches, and had them laminated for future use.

Next, tell the students that you have had many conversations with the skeleton, and have found out about some music he likes. Mention music types such as: country, jazz, rock, etc. and add that you did find out that there is one song that the skeleton is a little disappointed in. Ask the students if they want to hear it, and play the song "Dry Bones" for them. When the song is done, or part way through, ask the students why the skeleton doesn't like that song. (They should say that it is because the bone names were common names and not biologically accurate names, and that not all of the major bones were named.)

Put the students in cooperative groups with the task of rewording the "Dry Bones" song to make it biologically accurate. For example when the song says "The hip bone's connected to the back bone," have the students write The pelvic bone's connected to the vertebrae. Allow about 10-15 minutes for this activity. When groups appear ready, have them perform their newly written song, with or without the tape, for the rest of the class. This lesson took 50 minutes from
start to finish, and with two minutes remaining, we had a whole class sing-a-long, which was really fun!!!

Available at: http://www.pacificnet.net/~mandel/Science.html
How We Move

Courtesy of:

Rebecca Curlett
University of North Texas, Denton, Texas

Description:

Through movement exercises, students will observe how muscles and the skeletal system work to move our bodies.

Purpose:

To introduce the skeletal system and the different types of muscles to the students.
To introduce the muscle and skeletal system vocabulary.
To demonstrate how each kind of muscle works (concentrating mostly on skeletal muscle movement).
To demonstrate how each kind of joint works.

Objectives:

Students will identify the different types of muscles and the organs/areas of the body that they are associated with.
Students will identify bones in the skeletal system.
Students will identify and define the types of joints in the body.
Students will define the types of muscle and their functions.
Students will have a basic understanding of the different types of movement in the body (i.e., movement of appendages, movement of food through digestive system, movement of blood through cardiovascular system).

Materials Needed:

A cassette tape or CD with a collection of different types of music on it (everything from classical to country to jazz to oldies – sound effects and music with other sounds in the background – like birds or rain – are great too) – should be 10-15 minutes long

Procedures and Activities:

(Before the students get to class, position the desks or chairs in a circle around the edge of the room.)
Have students sit in their chairs in a relaxed position. Tell them to close their eyes and take deep breaths; every time they exhale, they should relax a part of their body. They should start with their feet and work their way up to the top of their heads. Have them think about each part of their body. How does it move? What makes it move a particular way?

After a few minutes, have the students open their eyes and get up. Lead them in stretching exercises. Ask them, How does it feel to stretch? Why do you think that is?

Tell the student to pick a spot in the room, making sure that they are at least an arm’s length away from everyone else. Instruct them to move to the music, however they are comfortable. If they hear animals in the background, it is great to move like that animal. If they want to do the Twist when an oldies tune comes on, wonderful! The point is to explore movement.

When the tape is done, have the students sit back in their chairs and discuss what they observed about movement. Guide the discussion into a lesson on muscles, joints, and bones.
The Human Body Corporation

Description:

As a body organ you are an employee of the Human Body Corporation. Due to recent cost increases, the Human Body is having to fire workers. You need to write a letter to the Human Body Corporation defending your position in the company. In your letter, you need to describe to the corporation the following characteristics of your organ and explain why you are important to the Human Body Corporation.

1. Tell what the name of your organ is and where you are located.
2. Identify what systems of the body you work with.
3. Describe how you work with these systems.
4. List the other organs that work with you in your system(s).
5. Describe your main functions your main functions as a Human Body Organ.
6. Tell the Corporation how you perform these functions.
7. Tell the Corporation why you are important and why they should not fire you.
8. Explain what might happen to the Human Body Corporation if they fired you.

You will read your letter to the Human Body Downsizing Committee (the rest of the class). Along with your letter, you will need to have a photograph (labeled drawing) of your organ to use as a visual aid.

Conclusion
"Most Americans are not science-literate. . ." (International Comparisons, 1). Why is that? One would think that with all the technological advances that our society is making that our citizens would try to keep up. Instead, they are falling far behind. As a future science teacher, it will be my job to help catch them up.

With all that I have learned this semester in my classes, at conferences, and researching material for this paper, the one thing that has grabbed my attention the most is that very few people are discontent enough with our school system to try to change it. Science teachers are content to teach their classes the same way that they were taught science. They do not seem to mind if their students are uninterested or are gaining lots of interesting but almost useless facts. As long as the state-mandated test scores are acceptable, as long as no one tries interfere with their classroom, teachers are content to teach things the way they have always been taught – virtually ineffectively. For me, using drama in my science classroom is as much for my fellow teachers as it is for my students. During a presentation in an education class, one of my classmates made the statement, “You can’t let kids get comfortable in what they are learning – you have to keep them on their toes and challenge them all the time.” I believe that the same is true for teachers. The changes that are needed in our education system must begin with the teachers. The teachers need to look for more effective ways of teaching their disciplines, whether it is by using drama or something else. Administrators and legislators are often too
far removed from the classroom to truly know what is best for our students. Textbook writers are as well. In fact,

"the present science textbooks and methods of instruction, far from helping, often actually impede progress toward science literacy. They emphasize the learning of answers more than the exploration of questions, memory at the expense of critical though, bits and pieces of information instead of understandings in context, recitation over argument, reading in lieu of doing. They fail to encourage students to work together, to share ideas and information freely with each other, or to use modern instruments to extend their intellectual capabilities"

(Science Education in America, 1).

It is my firm belief, after researching the reasons that drama works, that it is a method completely opposite of the above description. It is by no means a "cure-all" prescription for problems in science education, but I think that it is an awesome start.
Afterword
Drama in any classroom can serve as a useful tool. It can be used for motivational purposes or to access a student's prior knowledge of a subject. It is also a great way for the students to express themselves and make connections – with the teacher, with each other and within themselves!

"Drama harnesses student's imagination to breathe life into the concepts and content across the curriculum" (Wilhelm & Edminston, 4). Using drama as an educational instrument in other disciplines opens up a child's mind to many things; because it utilizes kinesthetics, higher-order thinking skills, and the creativity that everyone has, it gives students the comfort and freedom to put off the real world and explore the question "What if...?"

"Asking 'What if...?' is not an optional question in the curriculum – imagining possibilities is at the core of understanding other people, other times, other places. Imagination is an integrative force in the curriculum..." (Wilhelm & Edminston, 3-4).

Creative drama is as simple as role playing a history story or pretending to be astronauts on the way to Mars. You don't need props or scenery or anything fancy – just an open and willingly mind and a little imagination!

Some excellent books on this subject are:

*Interconnecting Pathways in Human Experience* – Judith Kase-Polisini
Available through Arts for a Complete Education and the Florida Alliance for the Arts in Education (http://www.pegasus.cc.ucf.edu/~faae/)

*Imagining to Learn: Inquiry, Ethics, and Integration Through Drama.* – Jeffrey Wilhelm & Brian Edminston
Available at Willis Library, UNT

*Education and Dramatic Art* – David Hornbrook
Available at Willis Library, UNT

Any one interested in discussing the topic further can give me a call or e-mail me any time! Rebecca Curlett: (940)891-3639 & rcurlett@hotmail.com
Creative drama works because:

It is...

**Interactive** – there is more movement, more discussion, more bi-directional learning than traditional teaching styles; this is a great way to activate and assess prior knowledge.

**A Meaning Maker** – helps students make connections and construct meaning in the text and across disciplines and curriculum. Students will learn a lot and have fun, too!

**Student-Oriented** – meaning that the point is not instruction (giving the information and letting the student figure it out); it is teaching (assisting the student in learning how to think by presenting the information and guiding the student through it); it’s very motivational because the students help direct their learning.

**Process-Centered** – meaning that there are no “right” or “wrong” answers; it’s like an experiment – just because you don’t get it the first time, doesn’t mean you won’t get it. By doing it over and over again, the focus sharpens and the students really examine the material. Replay and revise the situation, your thinking and the outcome – shift those paradigms!

And it...

**Uses Multiple Intelligences** – everyone is smart in different ways; creative drama lets you shine doing what you are best at and helps you sharpen those things that aren’t so great

**Fosters Whole-Child Development** – the parts of whole-child development: physical, intellectual, emotional and social, which are ALL big parts of creative drama.

Possible problems:

**Students willingness to participate** – they must be comfortable enough to express themselves and get involved

**Activities can take away from material being taught** – if the focus is wrong, students will lose site of the purpose. There is a fine balance between having fun and having too much fun

**Standardized and state-mandated testing** – TAAS, PSAT, SAT, ACT, and end-of-course exams – is it possible to use this method and still take care of those?

**Teacher personality** – 95% of teaching is presentation – you MUST be able to pull it off!!!
Bibliography


