MOVING MOUNTAINS, RUNNING RIVERS:
A Kinesthetic Approach to Teaching Science
By Susan Griss

Children are naturally scientists. Without any prompting, they ask questions about the world around them: Why do stars shine? Where do babies come from? Does the color red look the same to me as it does to you? They constantly investigate the physical world, poking, dissecting, pouring, mixing, and more. Yet somehow, the curiosity and creativity that accompanies their younger years dissipates for many in school, and science becomes intimidating or dry.

If you think of science as the study of the physical world, and you know that the physical world is in constant motion — from the orbit of electrons to the spin of the planets — then it's an easy step to seeing the value of studying science *through* motion. Exploring science through kinesthetic activities and creative movement offers students a concrete and accessible way to understand complex and seemingly abstract phenomena. In addition, learning through movement is engaging, enlightening, social, and fun. As a movement specialist for over twenty-five years, I have used kinesthetic activities and creative movement to teach across the curriculum. Science is a perfect fit.

Imagine students enacting the circulatory system by traveling around the room in a figure 8 pathway. Filled with oxygen, they use high level/high energy movements as they leave the lungs (two areas marked out in the room) and then enter and leave the heart (also demarcated). After traveling along chosen arterial pathways, they exchange the oxygen for carbon dioxide in the capillaries and return with low level/sluggish movements, first to the heart and then to the lungs. With a loud exhale the carbon dioxide is released, followed by a deep inhale as they stand tall, arms raised overhead, full of oxygen and ready to begin the journey again. This general structure can be embellished in terms of scientific detail (chambers of the heart, terminology, volume of blood) and artistic expression (creative movements, colorful fabrics, music).

In a lesson on the speed of sound, students can discover through which medium sound travels fastest: solid, water or air. Lining up for a relay race in three teams of equal numbers, the “solid molecules” will be closest together, the “air molecules” furthest apart. Passing a “sound wave” (shoulder tap) down each line, students will *experience and understand* why sound waves travel fastest through solid. This kind of learning is not the memorization of facts, forgotten two days after the final test. This learning is internalized and meaningful.

Other examples abound. Students can create a simple dance showing the flow of precipitation, accumulation, evaporation and condensation in the water cycle. Groups of students can work together to create frozen group sculptures (tableaux) that combine interesting body shapes on multiple levels to show the stages of metamorphosis of a butterfly or frog, or the life cycle of a plant. By standing closer to or farther from each other, students can show the difference between low and high air pressure, and using colored scarves to identify water molecules, they can demonstrate why low pressure allows for high humidity. Older students can differentiate between ionization and covalent bonding as they enact the movement of electrons in pairs of atoms. Neurobiology students can exaggerate details in a study of action potential — for instance, sliding through a membrane (represented by other students) and changing the electronic charge of a chemical in a cell of the nervous system. Students from elementary through high school, and even college, can have a firmer grasp of the physical world by learning kinesthetically, using their bodies and interacting with their classmates.

For the past ten years I have shared movement strategies with K-12 teachers in graduate programs throughout the country. Consistently, I hear stories about dramatic improvements in remembering facts and understanding concepts when students learn through movement. It's not uncommon to find that the *only* question answered correctly by every single student on a test is the one they learned through their bodies. Especially for those who fall through the cracks with traditional textbook/lecture-style teaching, for those who have trouble focusing while in their seats for an extended period of time, or for kinesthetic learners in general, learning through movement can make the difference between failure and success, confusion and clarity.

There is an old Chinese proverb that sums up the power of learning through movement: "I hear and I forget. I see and I remember. I do and I understand."
If teachers can structure movement activities through which students *do* or *experience* scientific concepts and processes, science will be more accessible and meaningful.

For some teachers, kinesthetic teaching is natural. For others it is a new way of thinking. Like a new language with its own vocabulary, the more you use it, the easier it becomes. A good way to begin is to look for the movement potential of a particular topic. Does it involve motion? a structural design? change over time? If any of the elements of movement are essential to the central understanding of your lesson, your topic is appropriate for a kinesthetic lesson. These elements include shape (design and level), space (how far apart the bodies are, on what pathway, and in what direction they move), energy (the force of motion), and time (speed or duration of movement). These are some of the very attributes that scientists observe and analyze in describing how the physical world works. Teachers can choose which element/s of movement to use as the basis for a lesson based on the scientific principles at work.

A study of cloud formations could highlight shape, as students shape their bodies individually or in groups to portray the types of clouds. A lesson about electric circuits or the arrangement of the solar system could involve space, as students journey on a series or parallel circuit, or re-create the order of the planets as they orbit the sun. Experiments with Newton's laws could center around the use of energy, as students play on swings and slides in a playground, or throw balls of different masses. Oftentimes, if you can imagine a "moving diagram" that represents a principle, the class can recreate the diagram on a human scale using students as all the parts.

Think of the refraction of light, the division of cells, the life cycle of a plant, the causes of a tornado. Students can enact each of these processes, individually, with a small group, or with the whole class. "Being" an electron, "being" an air molecule, "being" a cell, makes learning much more personal and meaningful, and therefore memorable to students.

Kinesthetic lessons are not meant to replace, but to complement other forms of teaching. Through them students can:

be **introduced** to a new topic — through creative movement improvisation to a story like *The Tiny Seed* by Eric Carle, or by physically portraying the different forms of natural water.

discover a concept — by linking together as ice molecules to see why ice has more volume than water.

explore a principle — by role playing the way water molecules create surface tension.

learn facts — by enacting characteristics of the different planets.

acquire vocabulary — by creating physical definitions of sedimentary, igneous, metamorphic, and conglomerate rocks.

review processes — by choreographing the life cycle of a star, or the stages of a volcano.

Most of my work has focused on the elementary level, but having worked with middle and high school students and teachers, I know that once they get over the shock of being asked to get out of their seats and learn through their bodies, their learning is magnified. The following are four reasons why this method works:

- **Engagement**

  When students are physically and socially involved in the discovery or reconstruction of a scientific process, their level of participation is higher. When they work with peers on an interactive activity that is creative and dramatic, they are more engaged, and less likely to lose focus and daydream, as they might while sitting at a desk listening, Teachers report that students who often do not raise their hands to participate in verbal lessons will voluntarily participate more in classroom discussions after they experience a lesson concretely through their bodies. This is particularly true for students whose first language is not English.

• **Clarity**

Many students have trouble with visualization. When they hear that something is higher or lower, more or less dense, faster or slower, larger or smaller, they do not necessarily envision the meaning of the abstract words. Getting students out of their seats to embody these relationships helps make the words more tangible. The physical enactment of the functions of a system, or the transformation of stages in a cycle, can clarify details, sequence, and relationships.

• **Feedback**

One of the greatest advantages when teachers use kinesthetic lessons is the immediacy of feedback. This takes place on three levels. First, the teachers can see in students' physical responses whether they are *getting* the right information. If you ask students *to show* whether warm air rises or sinks, you can see the answers of the entire class simultaneously, as opposed to calling on a few students who raise their hands.

Second, the teacher can, in response, give immediate feedback to the students to correct misinformation and help students understand a scientific principle. It makes a lot more sense to catch these misconceptions immediately, rather than wait for the results of a worksheet or test to get the corrections days later. (Final tests will probably reflect better scores when preceded by kinesthetic lessons.)

Which leads to the third level — peer feedback. Students will see how all the other students answer the question, and self-correct. Rather than being viewed as cheating, this can be seen as cooperative learning. After all, scientists never work alone; they always get feedback from their team. When students learn from each other, and not just from the authority, they may feel more safety and claim more ownership of the learning.

• **Brain-based learning**

According to neurophysiologist Dr. Carla Hannaford, "Movement is an indispensable part of learning and thinking…. Movement anchors thought." (Hannaford, 1995). When we learn through a physical language, cognitive, emotional, and motor information are being stored together in the brain, providing multiple associations and contexts for learning (Jensen, 2000).

In addition, on a simple level, movement increases the oxygen flow in the brain. Teachers are often nervous that students will be unable to concentrate after doing a physical activity. But many teachers report that students have a longer attention span, and increased focus after a kinesthetic lesson.

On a more complex level, creative movement and the choreography of shape and motion involve students in problem-solving, decision-making and aesthetics. By including movement in differentiated instruction, we can provide a more stimulating environment for learning. Dr. Howard Gardner, who originated the theory of multiple intelligences, writes: "I believe in action and activity. The brain learns best and retains most when the organism is actively involved in exploring physical sites and materials and asking questions to which

> it actually craves answers. Merely passive experiences tend to attenuate and have little lasting impact." (Jensen, 2000).

Scientists are curious and imaginative, work in teams, and enjoy problem-solving. All of these attributes are nurtured when students work together creatively to engage science through movement.

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