How to Teach Science Which Engenders Awe

Teaching tips for lessons that are both fun and full of wonder.

BY **JOHN BICKART** | SEPTEMBER 9, 2023

Wonder and Awe

In 1971, I went to India where I was meditating for 25 days in an ashram in Haridwar, right at the base of the Himalayas on the Ganges River. It was a beautiful place. I would meditate every day for hours. Studies suggest that you can increase positive emotions, reduce anxiety, improve well-being, and even prevent headaches from meditating. In these last 52 years, I would add from my own experience that meditation makes me feel wonder and awe - as if I were a small child being held and hugged by very large arms. In the hug, I stop trying to understand how this could be and give myself to the feeling of a presence that is holding me. Dacher Keltner, faculty director of GGSC, explains in an interview about his wonderful book, *Awe: The New Science of Everyday Wonder and How It Can Transform Your Life*, that "Being in the presence of something vast that transcends your current understanding of the world" engenders awe. So, meditation can engender awe. In a science class, pure observation is a form of meditation. And pure observation - giving loving attention - may be one of the most wonderful

things a human can do - it is like making friends with new parts of the world you meet. Let's explore how some ways of being an observant scientist can engender awe; and look at how awe might be brought into a science lesson.

Five Sources of Awe for the Science Teacher

If we want to teach a science lesson which engenders awe, one way is to search our content - or the way students might engage with the content - to find where things get *vast* and *transcend understanding*. How and where should we look?

1. Expand the lesson to include ***bigger questions***.
2. Do natural science ***hands-on demonstrations*** of everyday phenomena.
3. Balance and integrate ***achieving*** and ***awakening***.
4. Point out the ***moral feelings*** we share with others.
5. Watch for moments of ***emotional contagion*** of classmates (and the teacher).

1. Bigger Questions

A simple example of expanding a lesson can be seen in a recent study, published in 2023 by a group of ingenious Turkish educators in the *International Journal of Curriculum and Instruction*. It explained how having students handle Aquaponics systems - that means water, plants, and fish thriving in a local ecosystem - can be used as an educational tool. First, they expanded the linear thinking of hydroponics -

growing plants in water only - to the systems thinking that includes the fish who are part of the ecosystem of the water and plants. Then they published educational benefits of both aquaponics and systems thinking, recommending that their "Research suggests introducing students to systems thinking in early years such as elementary education." They asserted that when STEM (science, technology, engineering, and mathematics) teachers looked for the bigger picture "STEM education promotes collaboration, learning is socially constructed as well."

So, to engender awe with our lesson we can use systems thinking to an expanded view of the larger system or context of some specific phenomenon to ever more inclusive frameworks. This way, we can deal with questions of meaning to our existence as well as the lives of other beings to "bring the bigger questions of life into the classroom", as Vicki Zakrzewski, education director of the Greater Good Science Center prescribes in Three Ways to Help Your Students Cultivate Their Inner Lives.

2. Hands-on Demonstrations

Students love to physically engage with natural materials. Let's say that we start a hands-on demonstration of how water meanders by running it down a flat surface. To engender awe, you might begin by saying, "It fascinates me how water winds from left to right with no apparent coaxing from the surface itself. Look at this aerial view of mountain ravines. See that water meanders in our classroom, but also in the great rivers and huge mountains."

To engender awe, suspend the analysis. Asking why water meanders is not necessary - at least not while observing that water does this. The chance to let wonder and awe sink in can be given the respect of a moment's time without commentary.

Even when you are observing the simplest things, you be the model. Show them how to give undivided attention. Demonstrate by your own example that there is a time to intuitively observe, without yet forming any conclusions. During this time, let the phenomenon speak, and keep your role as listener or observer, only. Then, after a time, you may analyze and form conclusions. If we have truly heard, then theory should arise from observation, from 'reading' the phenomenon, not speculating about it. As Goethe advocated, "Let us not seek for something behind the phenomena - they themselves are the theory." And through this selfless act of giving oneself to the phenomena, the hands-on observer has the chance of being transformed and enlarged by the experience.

*3. **Achieving*** and ***Awakening***

In science lessons, we often rush to the left brain activities of naming, labeling and analyzing. We observe an experience, then immediately ask how it happens - what the mechanism is - why it occurs - how to use this natural process. These are all ***achieving*** questions. They are good to do. But if we look at them exclusively, we may pass by the act of ***awakening*** to the wonder and awe of life. Lisa Miller in her book, *The Awakened Brain: The New Science of Spirituality and Our Quest for an Inspired Life*, says that there are two modes in which we go

about life, achieving and awakened. Your achieving mode might tend to look at problems as something to get around. But awakened mode might look at those same problems as lessons. In awakened mode, you might look at a problem as presenting an existential question – a chance to change your existence – make a learning experience from something that is a little bit annoying to you.

In a science lesson, a teacher has the awesome chance to entertain parallels of how nature solves problems and relate them to the students' lives. These chances are golden. They can orient students' views of life to what Miller describes as a 'quest'. “Quest orientation is characterized by a tendency to journey in life: to search for answers to meaningful personal decisions and big existential questions; to perceive doubt as positive; and to be open to change, or more accurately, open to perceiving with fresh eyes, and then using new experience to fuel change. In quest, we open ourselves to the messages from life, take seriously this discovery, and then actively use learning to shape our decisions and actions—our personal operating manual.”

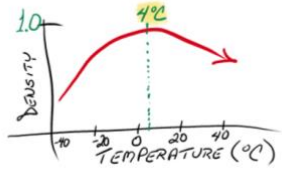
4. Moral Feelings

Nature abounds in examples of one hand helping the other. Everywhere she exhibits collaboration. This is wonderful to point out to students as they are taught the facts of science. it allows their hearts to swell with admiration and inspires moral feelings of characteristics they may wish to emulate. Summer Allen writes in the Does Feeling Awe Make Us Follow the Crowd?, "Awe appears to act as a lever that decenters our own

opinions, encouraging us to go along to get along, so to speak, and to focus on our shared humanity."

For example, in teaching about the *specific density* - heaviness - of water you can point out that water acts in a way that is almost as if it had moral feelings.

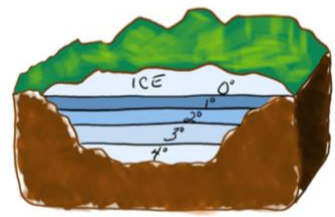
Specific Density



Water begins to expand as its temperature cools from 4° down to 0° Celsius (freezing). This is why ice cubes float.

Therefore, as a pond drops its temperature blow 5°, the densest, heaviest water is 4°, so that sinks to the bottom of the pond. The next layer up is 3°, then 2°, then 1°. The ice, at 0° is on top, which expands so much that it leaves a layer of air. The ice and air layers on top insulate the water below so that any pond or lake that does not completely freeze stays relatively warm below the ice, even if the air temperature gets quite cold. This provides a haven for aquaponic life.

The Frozen Pond



But there is more ...

The night a pond approaches freezing, the water gives up 1 calorie for every gram that drops 1 degree Celsius. But it gives up 79.7 calories - nearly 80 times as much - as it turns into ice. What this means is that the night the pond formed an ice layer

on top, it gave a great amount of heat to the surrounding animals and plants, just at the time they needed it.

5. Emotional Contagion

A science lesson - or any lesson for that matter - can move past being exciting or mildly interesting to cause real emotion in the other students if the teacher mines the rich vein of that one student who starts to see something through a lens of real wonder and awe. Once you notice students stepping outside of themselves and being taken aback, you can call attention to it. "Well, I see that Millie is really taking this in. She just sat back and seemed to see something. Millie, do you want to share the lens you are looking through - what you see?"

Teaching a science lesson, you might find that the language of hard science constantly bumps into the language of wonder and awe. Teaching science is almost like teaching two different languages at once. On the one hand, you must be objective and look for hard evidence. On the other hand, you need to look up to include larger and larger systems and ask questions like, "What does this have to do with me?" or "What could be the purpose or meaning of this scientific property being in the world?" It's like looking through different lenses and seeing the same thing from different angles. Here's the point: you should be objective if you are a scientist, but not make *that* your objective. A scientist's objective is good OBSERVATION - and she aims for this with an unbiased pursuit of the truth and an unrelenting search for purpose and meaning.

#138 The Lens

There once lived an entire family in a tiny house at the base of a lighthouse. In the lighthouse was a great, bright light. Surrounding the light was a wonderful set of glasses, called LENSES - as big as windows and as thick as your arm. Each glass had the special property of being able to focus the lighthouse light and send it out into the ocean very far as a beam. Ships could see this beam and know that they were near land, so that they should take care not to crash into the rocks at the edge of the land.

There was a boy named Henry who lived with the family in the lighthouse. One day, Henry invited his friend, Jack, to come and stay for the week. Henry was quite excited because he and his family lived alone at the edge of the land and sea and he loved to have friends over. Jack was excited to visit a real lighthouse and to see the mighty light and the magical lenses. When Jack arrived, Henry ran out to greet him, and of course you know what they did first. Henry got permission from his parents, then took Jack right to the top of the lighthouse. Up 69 steps and there it was! The light was bigger than Jack, himself! When he

saw the lenses, he said they looked like great windows. The boys played in the lighthouse, then they played in the yard, then they went into the house to play a bit more before dinner.

After dinner, Henry's father and mother introduced Jack to a very different game they loved to play. They pretended to put glasses on. They pretended the glasses had a magical LENS like the ones in the lighthouse. Then, they would look around and try to shine some light on something new and wonderful. Henry's mother took the first turn. "Ok, I'll look at the water that is all round us. An ordinary way to view water is to say that we see it every day and drink it and wash with it and swim in it. But to look through the LENS, I observe that water MEANDERS! That's right, it winds back and forth as it runs. It goes in twisting, curving paths." Henry's mother jumped up and poured water down a tilted plate. It meandered left and right. His mother continued, "Rain twists. Rivers and streams and waterfalls meander. And if you observe water carefully, you can see that the meandering and twisting are always the beginnings of circles." Now she jumped up and ran to the window, "Come and look at the sea with your magic lens! Look at the circles! The ocean waves are coming into the shore with a curling motion that is always starting a circle, then crashing on the rocks!"

Next, it was Henry's turn. He thought for a few moments, then jumped into the game saying, "I've got one. Although water is soft, it can crash on the rocks outside and make them smooth!" That's a good one!" said Henry's mother. "And, I'll add that if water gets in the cracks of rocks and freezes, it is strong enough to break them apart," joined in father. All this time, Jack was listening. Now, he spoke up, "I think I have a way to see water through the magic lens that my mother told me once. She said that I was born after she carried me in water in her womb when she was pregnant. She said it was like magic that it was water that kept me warm, protected my body, and carried all the food

and drink I needed." Henry and his father and especially his mother sat back in appreciation. "Jack," Henry's mother said in a soft voice, "even though you just learned our lens game, you have touched our hearts, tonight."

WHAT LENS ARE YOU LOOKING THROUGH?

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To Engender Awe - Be the Best Observer You Can Be

Purely observing - giving loving attention - is good science. It is also the way to be a good friend. As Emerson recommends, "the only way to have a friend is to be one." So, we can treat every scientific fact like a person you just met, or perhaps one that you have just read about admiringly in the news. Dacher Keltner portrays the most common source of awe as "other people's courage, kindness, strength, or overcoming—actions of strangers, roommates, teachers, colleagues at work, people in the news, characters on podcasts, and our neighbors and family members."

About the Author

John Bickart

John Bickart, Ph.D., likes to work in the background and let good ideas speak for themselves. He believes that children, and sometimes adults, know what they want and that they empower themselves when they listen to their hearts.