Zooming Into Matter

Goals/Content Objectives

- Atoms, which make up all matter, are very, very SMALL.
- Our idea of the atom has changed over time as technology has improved.

Performance Objectives

SWBAT connect scientific concepts of the atom to an understanding of matter's behavior in all its forms.

Evaluation/Assessment Techniques

Formative Assessment & Gallery Walk (Pennies)
Hands-on Activities & Reflection (Atomic Carnival)
Lab Exploration (Balloon Lab- Using Indirect Evidence)
Traditional Quiz (Atomic Theory Quiz)

Activities

Zooming into Matter web-tool : clickable, zoom in from big things they could see down to things that are very, very tiny, like atoms
TED-Ed video: uses everyday objects like fruits and football stadiums to understand the scale of atoms, great animations
Traditional Atomic Theory notes and timeline- sequentially goes through how our idea of atom got better and better. Less focus on names and dates, more on how it changed.
Atomic Carnival : simulations that mimic scientist's experiments and activities on a larger, more fun scale

Teaching Strategies HOW I MAKE THIS STICK

-**Sense & Meaning:** (Sousa, 2011)
Start big, (penny) and zoom in. Make more sense, going step by step down until it wouldn't make sense unless we had zoomed in increments.
Also, everything around them is made of atoms, so this has meaning because it is why everything is the way it is!

-**Primacy/Recency:** (Sousa, 2011)
As students enter the classroom, I prompt them with a Do Now that connects to the days' learning, such as "I think a _____ is close to the size of an atom."
(A. mist droplet, B. speck of dust, C. dot of my pencil, D. none of the above/other)
For PrimeTime1, discuss Pennies assignment from the night before- do they think the atoms in a pennies are hard or soft, shiny or dull, etc and why. Then they hang their sketches of atoms around the room and for the first DownTime, they walk around the room, checking out everyone's sketches. They get a sticker to vote for their favorite, we discuss briefly what their class chose as the "best" sketch, and then we move into PrimeTime2, the Scale of the Universe zooming activity, where they are focused and engaged and curious about the scale of things. At the very end of this activity, they have a brief amount of time to discuss with their neighbors what the BIG IDEA of the lesson might be, and we collectively decide it is that atoms are very, very small.
-**Learning Styles:** (Gregorc, 1985)
Atomic Theory notes- Concrete Sequential (CS) learners see the logical progression of how ideas changed over time as technology improved.
Atomic Carnival - Abstract Random (AR) learners excel at finding the relationship between the carnival games and the different theories of what the atom looked like.
-**Multiple Intelligences:** (Gardner, 1993)

- Linguistic students -Atomic Theory lecture – The "story" of how our idea of the atom changed over time.
- Logical students - sorting each carnival activity and connecting it to the model. They often are the first to recognize the patterns and categorize. Many will have a clear idea of whose diagram is the "best" during the Pennies-Atom gallery walk, and can acknowledge the most accurate diagram by voting.
- Visual students - creating their own diagram of an atom (before we even learn about it!) and then evaluating the diagrams of others for the one they think is the best representation. They also enjoy the

TED-Ed and Scale of the Universe videos/tools. The rich animations and comparative-scale zooming give them vivid input to grasp the tininess of the atoms. They also enjoy sketching what they did at each Atomic Carnival station.

- Kinesthetic learners - moving/doing/competing activities of the carnival, when they are asked to move, investigate and create with physical objects rather than pen and paper.
- Interpersonal students - working with their peers to connect carnival stations to steps in the atomic theory. At any point in the unit when we pair-share, discuss as a class, or I ask for individual feedback, they can excel at being leaders for students who might be feeling a little lost or unmotivated by the activities.
- Existential students (I always seem to have a few every year) - the idea of how tiny the atoms are, and how tiny we are in the greater scale of the entire universe… this often triggers even more questions about how did we end up how we are?

Technologies

In general, the main way that technology is regularly used in my classroom in via the ceiling-mounted projector, connected to my computer, and thereby giving us access to the internet.

- BozeScience class website allows students to access the information, web links and videos outside of class time for extensions of the learning we do in class daily.
- The "Scale of the Universe" web-tool could be a student-guided exploration activity, but for the sake of time, we explore it together as a class. I have considered bringing my students to the computer lab and letting them explore on their own if time allows for a day to do just that in future years. I use this tool because it gets students curious, gives more sense to the scale of what we are talking about.
- The 5.5 minute TED-Ed video "Just How Small Is An Atom?" by Jon Bergmann uses animation to make the concept of this tiny, tiny thing that makes up everything a little more easy to grasp. He uses models of things they can understand: a house, a football stadium, oranges, and cars to help illustrate the size, scale and density of these tiny little things. I use this tool to engage my visual learners, and also for its humor and ability to explain something very tough to understand from a point of view other than my own (the kids do get sick of hearing my voice from time to time, I'm sure.)

Brain Research

-Neurons: (Sousa, 2011)

introducing new information and relating it to old information,
cultivating formation of new connections between neurons.
By creating meaning, storing this information in multiple locations for easier recall down the road, and for building a greater understanding of the order and sense of the world around them.

-Sensory Input: (Sousa, 2011)

By triggering multiple senses, the lessons engage multiple areas of my students' brains. The two technology pieces (Scale of the Universe, and the Atom video) stimulate visual and aural centers. The Atomic Carnival has students manipulating different materials (boxes, balls, marbles), intentionally asking students to use senses other than sight to complete some of the activities, particularly sense of touch and hearing to try to solve the mystery of what is inside the mystery boxes and also trying to "hit the nucleus" while blindfolded.

-Cerebral Lobes: (Sousa, 2011)

frontal lobes - ponder what they think an atom looks like (formative assessment) and are focused and engaged in the lesson.
temporal lobes -sound and music in the videos and web-tools and in the recall of any past ideas of what an atom appears like.
occipital lobes - process the images in the videos and play the games in the Atomic Carnival.
Parietal lobes - playing Nucleus Nuke-Em and determining the contents of the Mystery Boxes (spatial orientation),
motor cortex - carnival activities as they use their sense of touch, play with the marbles and throw the ball.

-Limbic System: (Sousa, 2011)

thalamus – takes in all sensory information, sorts it to the motor cortex, occipital and temporal lobes.

hippocampus connects their learning to past learning. (refer back to 6th grade science experiences)

All these activities work together to cement the idea that atoms are very, very small, our understanding of them has increased over time as different technologies have become available, and by understanding atoms, we can understand why things look and act the way they do in the world around us.

Citations:

Pennies Formative Assessment image, slide #3
Teacher-developed materials, Microsoft Word

Atomic Carnival image, slide #4
Teacher-developed materials, Microsoft Word

Balloon Lab image, slide #5
Teacher-developed materials, Microsoft Word

Atomic Theory Quiz image, slide #6
Teacher-developed materials, Microsoft Word

Scale of the Universe (screenshot), slide #7
"The Scale of the Universe 2." *The Scale of the Universe 2*. Web. 19 Oct. 2014Atom and Hands image, slide #9

Embedded TED-Ed video, slide #8
Bergmann, Jonathan. "Just How Small Is an Atom? - Jonathan Bergmann." *TED-Ed*. Web. 19 Oct. 2014.

Atom and Hands image, slide #9
Hogue, Bascom. "Atom and Hands Machine Drawing." *Superpower Wiki*. Web. 19 Oct. 2014. <http://powerlisting.wikia.com/wiki/File:Atom_and_hands_machine_drawing.jpg>.

Atomic Theory Timeline image, slide #9
Teacher- developed materials, Microsoft Word

Boxes of Mystery, Nucleus Nuke 'EM, Marble Madness images, slides #11-13
Teacher-developed materials, Microsoft Word

BozeScience website image, slide #16
Bozenmayer, Mary. "Friday, October 17th, 2014 - BozeScience." *Friday, October 17th, 2014 - BozeScience*. 17 Oct. 2014. Web. 19 Oct. 2014.

Gardner, H. (1993). *Frames of Mind: The theory of multiple intelligences.* (Rev. ed.) New York: Basic Books.

Gregorc, A. (1985). *Gregorc Style Delineator: A Self-Assessment Instrument for Adults.* Columbia, CT: Gregorc Associates, Inc.

Sousa, D. (2011). *How the Brain Learns.* Thousand Oaks, CA: Corwin Press, Inc.