Itty, Bitty Living Space:
A "look" at the unseen

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This curriculum unit is recommended for:
OCS Applied Science
Elementary Science Classrooms

Keywords: Chemistry, Atomic Structure, Atoms, Molecules, Properties of Matter, States of Matter, Chemical Changes, Physical Changes

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: This unit relates what the teacher learned in a technology about nanotechnology to practical applications in the classroom. This curriculum unit will provide teachers with activities they can use to incorporate when teaching a unit on properties or states of matter. This unit provides hands on learning experiences for students to practice what they're learning. It also provides links to videos and ideas for how to demonstrate properties that students might struggle with. The activities provided could be modified and adapted to fit most grade-level's science curriculum, provided it teaches basic chemical properties. Lab activities are safe for students to perform with minimal support from adults.

I plan to teach this unit during the coming year in to 15 students 10th grade OCS Applied Science

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Heather Nash

"Phenomenal cosmic powers...itty-bitty living space."[1]

Challenge Accepted

I fully and wholly believe in challenging one's self. I think that it builds character. I try to live my life (and encourage in the lives of my students) this mantra: "Don't lower your expectations to meet your performance. Raise your level of performance to meet your expectations."[2]

When CTI applications came out this past school year I took a look at the list and really wasn't sure I was interested. Then, it occurred to me. I hold my students to (nearly) impossibly high standards. I teach high level concepts to "low-level" students. I expect them to step up and "do". Which, I have found to be successful, because it's not that my students can't "do"… it's that no one has ever asked them to! Why then wouldn't I hold myself to that same standard?

Throw myself into a completely foreign topic and make it work? Challenge Accepted.

Rationale

This curriculum unit will be directly related to the Nanotechnology seminar that I participated in at The University of North Carolina at Charlotte with Professor Marcus Jones. This CTI seminar had a focus on the properties and applications of nanoparticles. We have participated in a variety demonstrations and lab experiences about these topics. I would be lying if I said that I had not struggled with some of the material in this seminar. It often required lots of processing and discussion after the class to fully understand the materials. One thing that Marcus helped with was giving real-world examples. Did you know you could understand particle-wave duality through looking at the way guitar strings are played? Yeah, me either!

I chose to participate in the nanotechnology seminar for a few reasons. First, I didn't know a whole lot about the topic and I was starting to see and hear about it everywhere! I wanted to look into it further and see how it could and does apply to everyday life. The pursuit of knowledge was a big driving factor. The second reason I chose to participate in this particular seminar is that I like a challenge. I have done 2 seminars before and they were both philosophy seminars. The curriculum, while challenging for me, was easy to fit into my classes because we

are constantly striving to teach critical thinking as a 21st century skill. This seminar requires me to incorporate content-knowledge into my classes.

For a myriad reasons, the students in my classes don't always get to experience the same things that their same-grade peers do. The essential standards for OCS specific classes (that don't have a general education counterpart) tend to be a little less rigorous than that of the standard course of study and some subjects are cut completely. I really try to make things as real-world for my students as I can. I also try and give them the same experiences (or as similar as I can make it within the essential standards) that their friends are getting in general education classes.

My students, so often, have never gotten a true lab experience due to funding, accessibility of lab materials, or personnel that are interested in giving them that experience. To that end they often get a very "watered-down" version of lessons and explanations that require abstract thinking. It is my goal, as their teacher, to be the one who can give them these experiences. It is important to me that they are seeing things that will excite them and make them eager to learn. It is also a personal and professional goal of mine that I am able to make things accessible to them. Sometimes scale and abstract thinking can be a little bit of a challenge for my students. I strive to find ways to make them "see" and understand the things we are discussing.

Background

Teacher

I received my Bachelor's degree in Elementary and Special Education from The University of North Carolina at Greensboro in 2009. I am licensed to teach K-6 elementary education and K-12 special education. I have also taken the licensing test to be able to teach 9-12 grade Biology. This is my eighth year teaching and seventh in Charlotte-Mecklenburg Schools (CMS). I teach in the Exceptional Children's department at East Mecklenburg High School, which is located in an urban neighborhood just outside Charlotte.

School

East Mecklenburg has a fairly diverse student population of nearly 1,900 students. Our populace consists of many different sub-groups (as defined by No Child Left Behind) including: 47% African American, 1% American Indian, 8% Asian, 22% Caucasian, 19% Hispanic, and 4% Multiracial. Our sub-groups also include: 61% economically disadvantaged students (receiving free and reduced lunch), 16% students with Limited English Proficiency, and 10% students with disabilities.

East Mecklenburg offers a wide variety of programs and classes including Advanced Placement, IB Middle Years Programme, and honors classes. We have an A International Baccalaureate diploma track. East Mecklenburg is one of only 5 schools in North Carolina that has an Academy of Engineering where students take many STEM related classes as well as having a STEM focus in their academic classes. East Mecklenburg has self-contained, inclusion and consultative services available for students with limited English proficiency. We also offer the full continuum of classes and services for students with mild to profound disabilities.

Our vision statement at East Mecklenburg is "East Mecklenburg High School provides all students with a world class education that creates life-long learners, while recognizing, affirming, and valuing each person's uniqueness" Our diversity promotes an inclusive and collaborative environment and a well-rounded education for all of our students. We utilize this diversity and collaboration to help us continuously strive toward our school vision statement, each and every day. Having so many different programs for students to be involved in and so many different types of students is beneficial for all involved at East Mecklenburg staff and students alike. We are able to offer clubs and activities with a variety of focuses and topics.

Students

The Exceptional Children's (EC) department at East Mecklenburg offers a wide range of classes and service delivery models. Consultative services entail the case manager meeting with the student or his/her general curriculum teachers twice a month to check in, ensure accommodations are being provided and offer supports in the classroom as necessary. These students are not served academically by the EC teacher. The inclusion model involves students with disabilities being "mainstreamed" into a general education classroom where there is a regular education teacher who serves as the expert in content and a special education teacher who is the expert in content delivery. The resource model is a separate, small group setting where an EC teacher has 10-12 students enrolled in general education classes who benefit from extra, individualized attention. The resource model is used sparingly because No Child Left Behind determined that a teacher must be highly qualified to teach this type of class; only an EC teacher who is dually licensed can teach this sort of class. The self-contained model includes students with severe and profound disabilities who are served in a separate, small group setting. Students in this group, typically, receive a certificate of completion, rather than a diploma, as they follow extensions to the standard course of study.

Many of the classes I teach are in the Occupational Course of Study (OCS) program. The OCS program is in the middle of this spectrum of services. This program offers students with disabilities an alternative path to the standard North Carolina diploma. These students are served in a resource-level class, with no more than 14 students with a teacher (and most often an assistant). The students in the OCS program require specially-designed, modified instruction for the general education content and curriculum to be accessible to them.

The OCS program provides a modified math, science, social studies and English curriculum, aligned with the North Carolina Standard Course of Study. All of our classes, including the academic classes, have a focus on employability, post-secondary planning and functional life skills. Along with taking these core classes, students must take Career–Technical Education (CTE) classes. The students also have an occupational requirement. They are required to earn 600 vocational hours during the 4 years to receive their diploma. These hours are divided up into categories: they must earn 150 school-based hours- doing a variety of jobs around school; they must earn 225 community-based hours- where the go off-campus to job-sites to complete various tasks; and they must earn 225 paid-employment hours- where the find an independent job and work for wages. If a student is unable to find paid-employment while attending school they can substitute additional community-based hours or independent volunteer hours for that time.

Students enrolled in the OCS program typically have below average intellectual and academic abilities, most functioning between 2 and 4 grades below grade level. Students in this program participate in small-setting resource classes which provide teachers with a chance to focus on individual skill needs, as laid out by the Individualized Education Plan (IEP) that has been designed for every student.

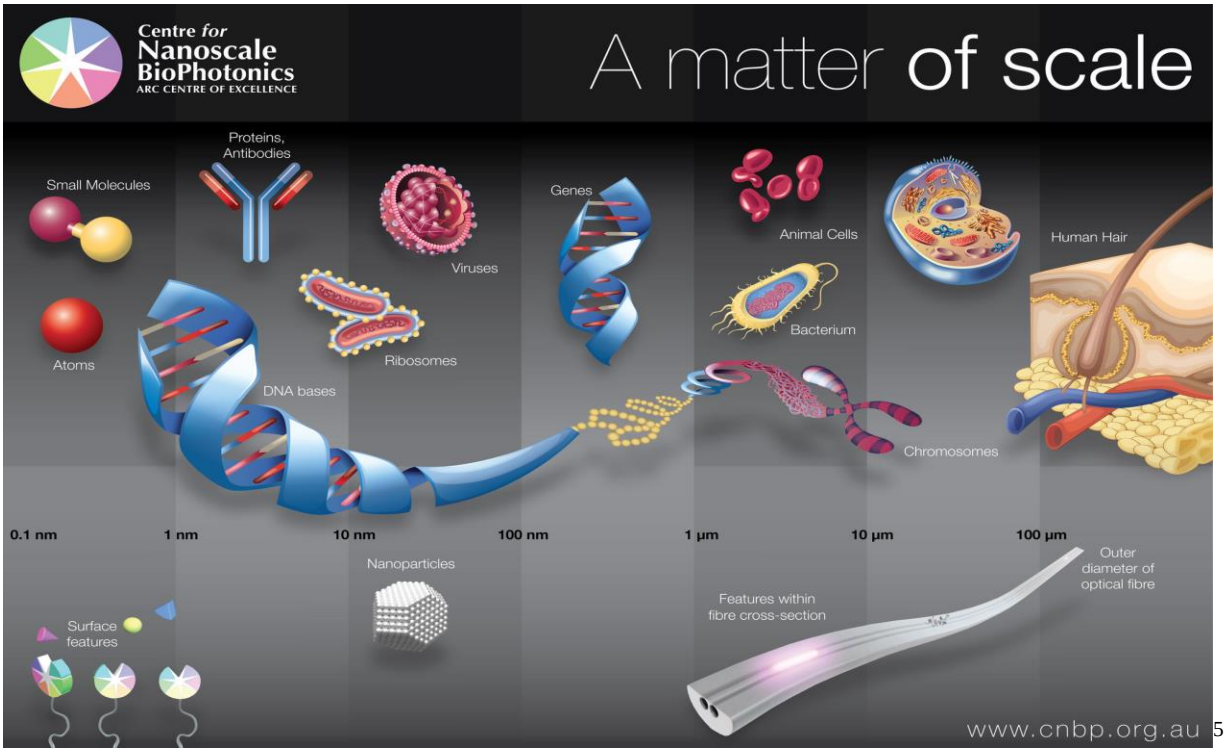
This unit will be geared toward students who are served in the OCS program, enrolled in OCS Applied Science. Applied Science is a general science overview class that covers matter, chemicals, the environment, forces and motion, and the human body. This class is used as a pre-cursor to when these students take Biology. The lessons and activities in this curriculum unit will be geared toward the OCS level modified curriculum, with additional suggestions for how to complete this lesson in a standard level science class without the modifications.

Nanotechnology Research

The seminar I participated in with CTI this year was on nanotechnology. According to the National Nanotechnology Initiative, nanotechnology can be defined as "science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers."[3] To truly understand nanotechnology you have to first understand nanoscale. Nano comes from the Greek prefix that means "dwarf".

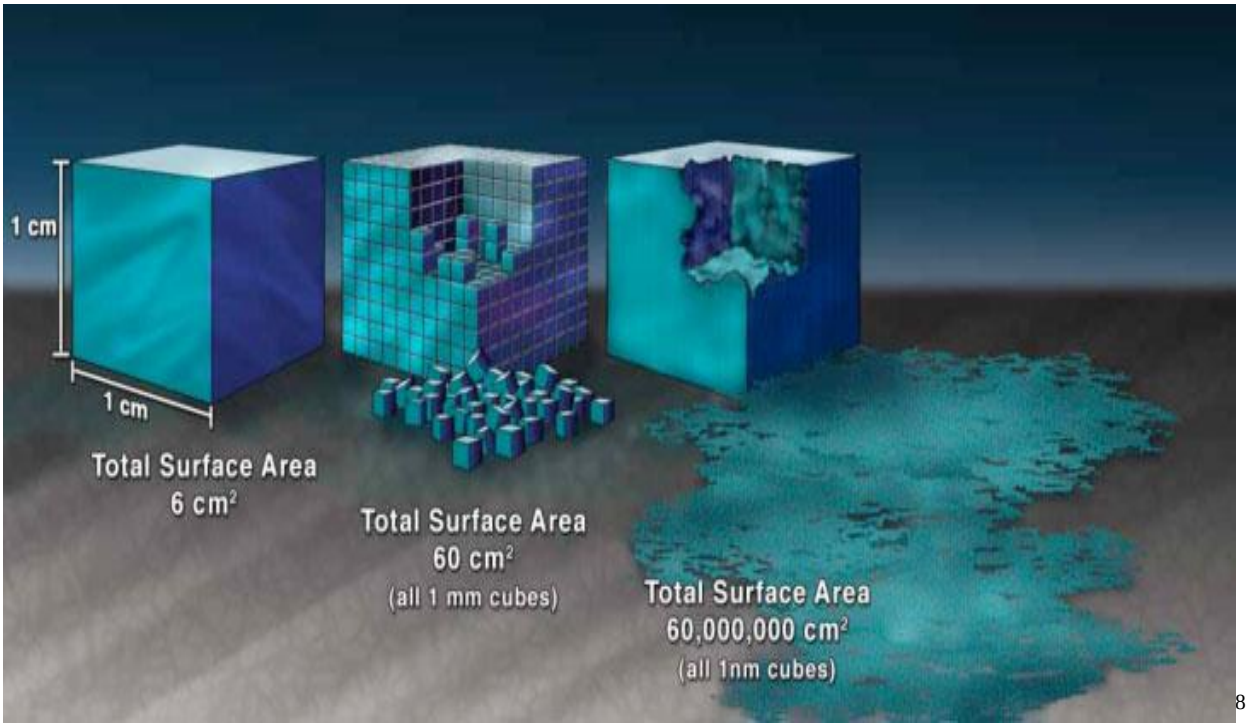
> "In the International System of Units, the prefix "nano" means one-billionth, or 10-9; therefore one nanometer is one-billionth of a meter. It's difficult to imagine just how small that is, so here are some examples:
> A sheet of paper is about 100,000 nanometers thick
> A strand of human DNA is 2.5 nanometers in diameter
> There are 25,400,000 nanometers in one inch
> A human hair is approximately 80,000- 100,000 nanometers wide
> A single gold atom is about a third of a nanometer in diameter
> On a comparative scale, if the diameter of a marble was one nanometer, then diameter of the Earth would be about one meter
> One nanometer is about as long as your fingernail grows in one second"[4]

This scale is difficult for people to comprehend because it is so much smaller than anyone is able to see with the naked eye. For a comparison to some things we can see, see figure 1.



I think that Richard Feynman said it best when he was describing nanotechnology at a talk given to the American Physical Society at the California Institute of technology in 1959. Feynman described nanoscale and nanotechnology as "the strange phenomena that occur in complex situations."[6] Things happen very differently at the nanoscale; particles behave differently and have different physical and chemical properties. A lot of what we discussed in this seminar had to do with the properties of different materials and how the properties would be different at the nanoscale.

Nanoparticles have inherent properties that make them act and react differently than they would at the visible scale. The most important physical property of any nanoparticle is surface area. "Nanoscale materials have far larger surface areas than similar masses of larger-scale materials. As surface area per mass of a material increases, a greater amount of the material can come into contact with surrounding materials, thus affecting reactivity."[7] An increase in surface area is shown below in figure 2.



[8]

As you can see, the same material can have a different surface area based on the size of the particles we can divide it into. At the nanoscale level there is 10,000,000 times more surface area. Using this information about surface area and nanoparticles, I will relate this information to visible objects as well. Increased surface area in any material will increase its reactivity because more particles of the materials will be accessible to react with the other material[9].

Nanoparticles are "effectively a bridge between bulk materials and atomic or molecular structures." [10]As Richard Feynman described, nanotechnology is the manipulation of individual atoms.[11] In my classes, we're going to see the go smaller than "nano" and discuss individual atoms then jump over "nano" and talk about "bulk materials."

The Science

To understand the lessons in this unit you will need an understanding of basic chemistry concepts as well. Here I am going to define some of these words and provide some examples.

Everything (well almost) is made up of atoms. These particles are incredibly small. Atoms have sub-atomic particles with different electrical charges that allow them to bind with other atoms to form molecules. Anything that is made up of atoms is considered matter. Matter is any object (or particle) that contains mass. Sound and light energy would not be considered matter, but pretty much anything else your students could point out is matter.

We see matter in different forms, or states, all around us. There are three states of matter that your students with which students will be readily familiar. These three solids, liquids and gasses. Within each of these states of matter, the atoms behave and move differently.

In solids, atoms are tightly packed together and vibrate back and forth. This vibration is so

slight that we can't detect it with the naked eye. Solids will maintain their shape and volume. In liquids, atoms are more spaced out and will flow past each other. Atoms in a liquid will take the shape of whatever container in which they are poured. In gases, atoms are even further spaced out than in liquids and take up the shape of whatever container they are in.

All matter has certain properties that can be described or observed. A property, as defined by Webster, is "quality peculiar to an individual."[12] In science we use the word property to refer to a characteristic of a specific object or material.

There are two categories of properties that we can use to classify matter in chemistry. The first type is chemical properties. "Chemical properties are any of the properties of matter that may only be observed and measured by performing a chemical change or chemical reaction."[13] An example of a chemical property is how a material will react with other materials. If you mix baking soda with water, nothing will happen but if you mix it with vinegar the mixture will bubble. The reaction with the acid is a chemical property of the baking soda.

The second type is a physical property. Physical properties are things that can be observed or measured about a material on its one. Color, volume, and size are all examples of physical properties. The physical properties of baking soda would include: white, soft, powder.

Objectives

Curriculum Unit Objectives

My objective for this unit is to take a deep dive into an abstract and often difficult topic in my OCS Applied Science class. I will do my best to model the scale of the things we are talking about. My goal is for the students to be able to understand these complex topics and maybe even be able to apply them to a new situation.

In my OCS Applied Science class we are challenged to look at and classify objects based on their common properties. In the past, incorporating this into classroom activities was a very basic assignment. There was a simple task assigned to the students where they chose 3 random objects around the room and they described as many properties as they good. These properties usually included things like "hard, heavy, and red". My students, even after learning about properties of matter, struggled to use scientific vocabulary to describe what they meant. My first objective in this unit is to increase the science that they're seeing and using. I would like students to think deeper about the world around them.

Another objective for this unit is one that has become the "north star" by my principal and CMS over the past few years. My principal tells us all the time that students "should be reading, writing, thinking and speaking every day in every class." This is a good objective because it incorporates the reading, writing, and speaking requirements of the Common Core standards that North Carolina adopted a few years ago. Including reading and writing in the content area is something that my principal, CMS and Common Core all encourage. It is said that increasing reading and writing in content area classes will increase reading and writing skills while at the same time teaching the content requirements. I would like to find ways for my students to incorporate literacy skills as they are reading and exploring these topics that are new to them.

The will also use writing skills as they are discussing/defending their answers during different activities.

State Content Objectives

This unit will include activities that are focused around the North Carolina Essential Standards for OCS Applied Science. These activities could potentially be modified to meet standard level Chemistry standards as well. The OCS Applied Science curriculum is a varied list of topics that include Newtonian motion and human body systems. I will be focusing this unit on the matter objectives. The matter objectives include understanding and distinguishing between the different states of matter and classifying materials according to physical and chemical properties.

Instructional Implementation

I plan to use a variety of instructional strategies and activities in this unit. For this class, and all my OCS classes, I like to try and keep my activities and instructional strategies as engaging as possible. My students tend to "zone out" or "shut down" because a lot of what I'm asking them to do is a stretch for their ability levels. I like to find a balance of activities that are easily accessible to them and those that have enough "shock value" to keep them engaged without realizing that what I am asking of them is "hard".

Strategies

Interactive Notebooks

Students will use notebooks to keep track of all information from this unit. The style of notebook doesn't necessarily matter, but it is important to ensure that students keep information in a logical order. The information in this unit should be kept in chronological order, as the information builds on itself. For example, you should have the notes for atoms earlier in the notebook than you have the states of matter notes where you describe how atoms move within a substance. It is also important to organize the notebook in such a way where you have vocabulary activities near the lessons to which they correspond.

Guided Notes

I think there is something to be said for having students hear and write down key terms and important ideas about a topic. The students I teach tend to struggle to keep up with a lecture, either because they don't know what is important so they struggle to write down everything or because they don't know what is important so they don't write anything down. Guided notes provide the students a way to see and hear the important information and write down only the key words.

Vocabulary

One of the things I try to do when I am teaching science content to my struggling students is to get them to learn how to break down the science vocabulary into parts that make sense. I do this by teaching Greek and Latin roots, prefixes and suffixes that go along with teach sub-unit topic. I find that when students come across unknown words containing these word parts they are more likely to try to understand the meaning of an unknown word rather than just skipping the word and moving on.

Students are given vocabulary words that align to the content curriculum we are learning that week. Students are given the words and definitions on Monday, they review and make flash cards on Wednesdays and are quizzed on the words of Friday.

Foldables/Cut-and-pastes

Once students have heard the notes in a lecture/guided notes style, they will use this information and knowledge to complete paper manipulatives like foldables and cut and paste activities. This will help students to review the information they learned and organize it in a new way. They will also be able to add graphics and color to help them remember information in a different way.

Videos

I will show different videos to go with each part of this unit. I will project them on my smart board and students can watch with a viewing guide or I will upload them into our Google Classroom and students can watch the video at his/her own pace with the viewing guide/questions. The videos will be used to introduce or reinforce topics and allow students to "see the unseen". I will also show videos to demonstrate labs that are unsafe or unreasonable for my classroom (not lab) setting. I also use videos to follow up things that students will find interesting about a topic.

Non-Fiction Reading Activities

This is a strategy I try to include in every topic I teach/discuss in my classroom. Students will read and analyze a non-fiction article on the topic of properties of matter and nanotechnology. Often, with my students, I have to read aloud news articles, as they are written at a level above that of my student's ability. While I am reading, students will work on "talking to the text", annotating the words they don't recognize, questions they have, reactions to the text and important details they feel will help them understand the text.

All of the non-fiction articles in this unit will come from the website Newsela[14]. By signing up for a free educator account, one has access to articles from media sources around the world that have been differentiated into 5 different Lexile levels. The best part about using Newsela is students can read the article at their own instructional level and they will still have received the content so a class discussion could still be carried out. Aside from our school and district's push to increase non-fiction texts, these article will allow students to recognize that students the things they are learning do exist outside the walls of the school.

Unit segments

Atoms, Elements, The Periodic Table and Atomic Structure

I will introduce this segment with a YouTube video that gives some analogies of the size of atoms. It compares them to things that students can see and gives a scale size of atoms and molecules.[15] Students will then watch a Bill Nye episode about Atoms and Molecules. This video does a great job of demonstrating the space inside an atom (at a scale that students can actually see). It also reviews elements on the periodic table and how we use some of them! [16]

In this part of the unit students will learn, by taking guided notes in their interactive notebook, the smaller parts that make up an atom, the charges of each of the subatomic particles. Students will also take notes on the parts of the periodic table and how to read it.

After taking notes, students will demonstrate their learning by doing three different activities. In the first activity, students will use a worksheet to practice reading and understanding the information on the periodic table.[17]

In the second activity, students will create an element notation using a cut and paste. Students will be required to label a box from the periodic table in their interactive notebook with examples and names glued underneath. See Appendix 2 for the parts of the cut and paste activities.

The third activity will require students to demonstrate knowledge of atomic structure. Students will model the number of protons, neutrons and electrons in different elements by modeling it with the nucleus/electron diagram found in Appendix 3 and M&Ms. Students will use different colored candies to represent the protons, neutrons and electrons in an atom. The teacher will call out an atom name and the students, using their periodic table, will use their candies to put the correct number of parts in the correct place.

Students will read a few non-fiction articles in this unit. Some will be from the text book describing the atomic structure and the history of its discovery. One will be from Newsela and is about the discovery of 4 new elements on the periodic table.[18] Another article I like to have students read during this unit is one that talks about an optical, atomic clock developed in Poland.[19]

The vocabulary words for this unit will be: a- (not), -tom- (cut), proto (first), neut (no sides), sub (under).

States of matter

In this segment students will be introduced to the 3 states of matter by watching an episode of Bill Nye the Science Guy.[20]

Students will take notes during this part of the unit on the different states of matter. We will discuss how atoms behave in each of the states of matter. I will demonstrate this by showing students a demonstration with math link cubes. We will look at what happens when the cubes are close together with very little space in between them (solid), we will look at what happens when molecules are filling up the space they are in by putting them in a beaker, there is significant space in between and when they are poured out they will take up the space in which they land. I will also demonstrate the behaviors of atoms in gasses by throwing the math cubes all over the room- this will show students that atoms in gasses are spread out and take up all the space available to them.

Students will create a foldable to put in their interactive notebook for the notes in this section. The will write down important information about atomic formation, volume and shape of each of the 3 states.

Once students know the different states of matter we will do a lab experiment called "Ooblek". [21] Ooblek is a non-Newtonian fluid. "Non-Newtonian fluids change their viscosity or flow behaviour under stress. If you apply a force to such fluids (say you hit, shake or jump on them), the sudden application of stress can cause them to get thicker and act like a solid"[22] Students will be given a cup of water and a ball of playdoh. The will be asked to try and hold, mold and pour each one. On the board we will write properties of how the liquid and the solid behave differently. Then students, with background information on non-Newtonian fluids first, will be given a sample of ooblek. There will be a worksheet (see Appendix 4) with this activity that will ask the students to do different tasks with their ooblek. With each activity they will be asked to jot down some notes and to decide whether or not the ooblek I acting like a solid or a liquid. When they are finished with all of the activities, the students will have to decide whether ooblek is a liquid or a solid. Once students have decided we will discuss as a whole group whether or not ooblek is a solid or a liquid based on the results of the activity. Once we have a class decision, students will be told the truth about non-Newtonian fluids. Students will watch a video from Crash Course Kids, found on YouTube[23], where the host will review the properties of solids, liquids and non-Newtonian fluids.

As an interesting follow-up to this activity, students will also watch two videos of ooblek. The first video[24] shows what happens when ooblek is poured onto a speaker. This will demonstrate for students the property of viscosity. They can see that the more force that is added the the ooblek the more viscous it gets. When the speaker is turned on- the more the ooblek acts like a solid, bouncing around the surface of the speaker, when the speaker is turned off the ooblek returns to its more liquid-like state, pooling in the middle of the speaker. The second video [25] shows people running, cartwheeling, playing soccer and riding bikes across a pool of ooblek. This will demonstrate to the students that the ooblek will act like a solid when consistent force is applied but when there is less force it acts like a water and the person sinks.

The vocabulary words for this segment will be chem- (related to chemicals), prop- (quality), sol- (whole/firm), khaos/gas (empty space), liqui (flow).

Properties of Matter

In this segment of the unit, students will take notes on the physical and chemical properties of the matter. Physical (observable) properties include color, size, surface area, weight, length. The chemical properties include those that deal with the reactivity of a substance- whether it will dissolve in water, how it reacts with an acidic substance and whether or not it is flammable.

Once students have completed the notes they will do an activity where they have names of different physical properties (white, sweet, rough) and different chemical properties (dissolves in water, reacts with acid, flammable) and they will cut, paste and sort them.

Students will participate in two lab experiments in this segment of the unit. First, they will do a lab called "Mystery Substance". In this lab, students will test different materials to identify them based on their physical or chemical properties. This will start out pretty basic, identifying some substances based on physical properties (taste) and it will gradually get more complex looking for chemical properties of reaction with an acid. As a bonus, this lab also fits in well as a pre-Biology activity in this class because often times we use iodine as an indicator of the presence of starch in our Biology labs. A lab worksheet for this lab can be found in Appendix 5.

The Alka Seltzer[26] lab will give students the opportunity to see how surface area affects chemical reactions. For each of the 3 trials of this lab, students will be given 4 Alka Seltzer tablets. The first one they will leave whole, the second tablet they will break in half, the third tablet they will break into quarters and the last tablet they will grind into a powder. The students will then take 4 beakers with white vinegar in them. The students will put the whole table into the first beaker, observe and time the reaction- noting times and significant sounds/sights on their lab sheets. Second, the students will put the tablet broken in halves into the second beaker, observe and time the reaction- noting times and significant sounds/sights on their lab sheets. Third, the students will take the tablet broken into quarters and put it into the 3rd beaker, noting the times and any significant reactions on their lab worksheet. Last, students will put the powder into the third beaker, observe and time the reaction- noting times and significant sounds/sights on their lab sheets. This lab procedure will be repeated 3 times. The lab worksheet can be found in Appendix 6.[27]

Another lab experiment I plan to use with students to show the effect on surface area on particle behavior is to grow sugar crystals. This activity[28] will demonstrate for students how surface area can affect how particles react with each other. Because the particles of powdered sugar are smaller than those of granulated sugar we expect them to behave and recombine differently than those of the granulated sugar. Students will follow the lab procedures in the worksheet (found in Appendix 7) to grow sugar crystals from each type of sugar. We will then observe the crystals under a microscope and determine the differences in each type of crystal.

The vocabulary words for this section of the unit will include: dens (thick), solub (may be dissolved), flam (fire), myxte (more than 1 element).

Assessment

Subjective

The discussions that happen during this class will be a key part of assessing what the students are learning. I would like to have them engage in academic conversations and observe them as part of their assessment. Often times, to motivate the students to discuss and participate we as teachers have to offer them participation grades. I like for them to know that I would rather (and their grade would benefit more from) talking to me and giving the wrong answer than it would from sitting and staring at me. Establishing the rules for academic conversations early is key. I think it is important for students to feel safe and know that it is okay to make a mistake as long as you're talking.

Another subjective means of assessment is for students to answer open-ended questions to establish and defend their answers to thought-provoking questions. Examples of open-ended questions I might use in this unit are:

- Which is the most important state of matter? Why?
- Why might it be important to know and understand the chemical properties of a substance?
- Why is it important to know and understand the structure of an atom?

Objective

Due to the nature of this course and my students, this unit will also have to have an objective assessment aspect. This course is a prerequisite to OCS Biology, which has a North Carolina End-of-Course test. To prepare my students for the types of assessments they will see in Biology, I try to do as much objective, multiple-choice assessment as I can. This will come in the form multiple choice, standards-based quizzes and tests that will be used to determine mastery on the state standards.

One of my favorite objective assessments of vocabulary words is Kahoot! For those, unfamiliar with Kahoot! it is "intended to provide a unique learning experience that teaches through play."[29] Vocabulary quizzes can get boring if they are matching or fill in the blank quizzes all the time so I like to switch it up so students can be engaged while still demonstrating their knowledge of vocabulary words. Vocabulary units and assessments are cumulative in this unit. The first week, students only quiz on the first vocabulary unit, the second week, they quiz on the first and second units and the final week they'll test on all three units. This allows students to figure out which words they're struggling with in each unit and figure out a new way to study.

Student Resources

"Matter Is the Stuff Around You." Chem4Kids.com: Matter. Accessed October 27, 2016. http://www.chem4kids.com/files/matter_intro.html.

This is a really great website. It is student friendly and provides lots of pictures and easy to understand information.

"Properties of Matter." Properties of Matter. Accessed October 27, 2016. http://schools.bcsd.com/fremont/5th_Sci__matter_Properties_of_matter.htm.

This website provides students with a lot of information as well as some animations to understand the properties of matter. There are also some review questions at the bottom and links for them to find more information.

Dr. Seuss. Bartholomew and the Oobleck. New York: Random House, 1976.

This is a picture book that could be used while doing the ooblek lab with younger students.

O'Leary, Katie. "STATES OF MATTER." TED-Ed. Accessed November 11, 2016. http://ed.ted.com/on/jZ6fjTgR.

This is an activity build on the TED-Ed site that has a video for students to watch and then questions for them to answer which reviews the important information about states of matter.

"StudyJams." StudyJams. Accessed November 11, 2016. http://studyjams.scholastic.com/studyjams/jams/science/matter/solids-liquids-gases.htm.

This activity has a video to watch and a few interactive activities for students to learn or review information about the states of matter.

Teacher Resources

National Nanotechnology Initiative. "What Is Nanotechnology?" Nano. Accessed September 21, 2016. http://www.nano.gov/nanotech-101/what/definition.

This website gives lots of background information for nanotechnology that can be useful to provide a bit of information for teachers to process and share with students. Gives current information about research that is happening in the field of nanotechnology.

"StudyJams! Solids, Liquids and Gases Teaching Guide | Scholastic.com." Scholastic Teachers. Accessed November 11, 2016. http://www.scholastic.com/teachers/lesson-plan/studyjams-solids-liquids-and-gases-teachers-guide.

This is a teacher's guide that provides information on the student StudyJam activity. Teachers can use this site to review the activity. It also provides assessment questions and some differentiation ideas.

Spangler, Steve. "States of Matter Archives - The Lab." The Lab. Accessed November 11, 2016. https://www.stevespanglerscience.com/lab/categories/experiments/states-of-matter/.

This website has resources for many labs about the states of matter. It includes videos for the labs you are not able do in your classroom and pictures for how to go through the labs if you want to conduct the experiments with your students.

"National Nanotechnology Infrastructure Network." Nanooze Magazine | National Nanotechnology Infrastructure Network. 2013. Accessed November 21, 2016. http://www.nnin.org/education-training/nanooze-magazine.

Nanooze is a magazine published for kids that covers a variety of nanotechnology topics. The articles are written with students in mind. Nanooze will send you free classroom copies if you request them or you can get all of their articles in PDF form.

List of Classroom Materials Needed for This Unit

- Notebook

Helps keep students organized and keeps their guided notes and foldables in an order that makes sense.

- Colored paper and markers

Makes the notes and activities that students are working on more fun for them.

- Scissors and tape

Students need scissors and tape to put together cut and paste activities.

- Computer with projector

Used to project presentations with the lecture, YouTube videos and Kahoot!.

- Internet access

Used to access Kahoot! Activities and YouTube videos.

- Student computers or cell phones

Used for students to play the Kahoot! game.

Alka seltzer tablets, vinegar, granulated sugar, powdered sugar, baking soda, corn starch, iodine, salt, M&Ms, Skittles, flour

Used for students in lab experiments

Appendix 1: Implementing Teaching Standards

This unit covers the North Carolina Essential Standards for OCS Applied Science. The unit encompasses the standards about Chemistry and understanding the properties of matter. This unit will be used to teach, review and assess these standards in each class.

OA 4.1 Understand properties of matter (color, shape, volume, density, texture).

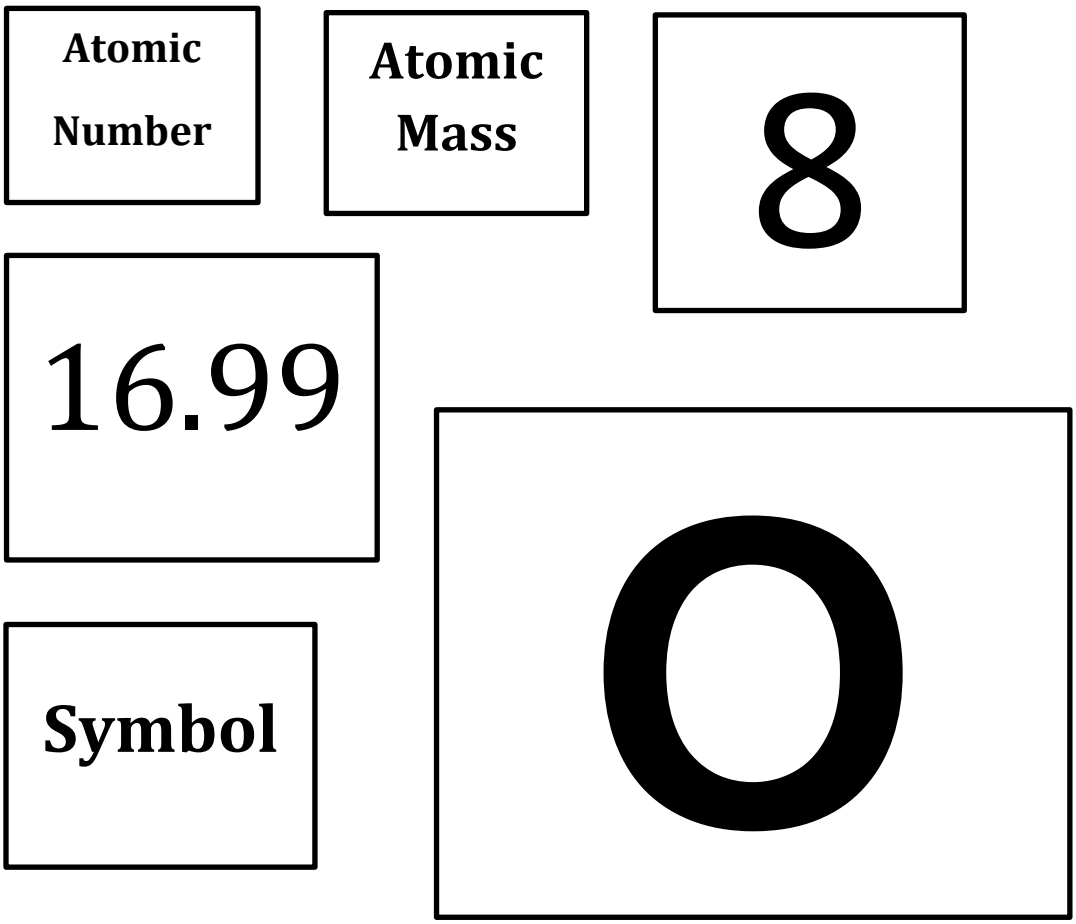
OA 4.1.1 Distinguish between the three states of matter (solid, liquid, gas).

- Students are asked to demonstrate knowledge of the 3 states of matter including the effect of shape and volume on atoms within the 3 states of matter.

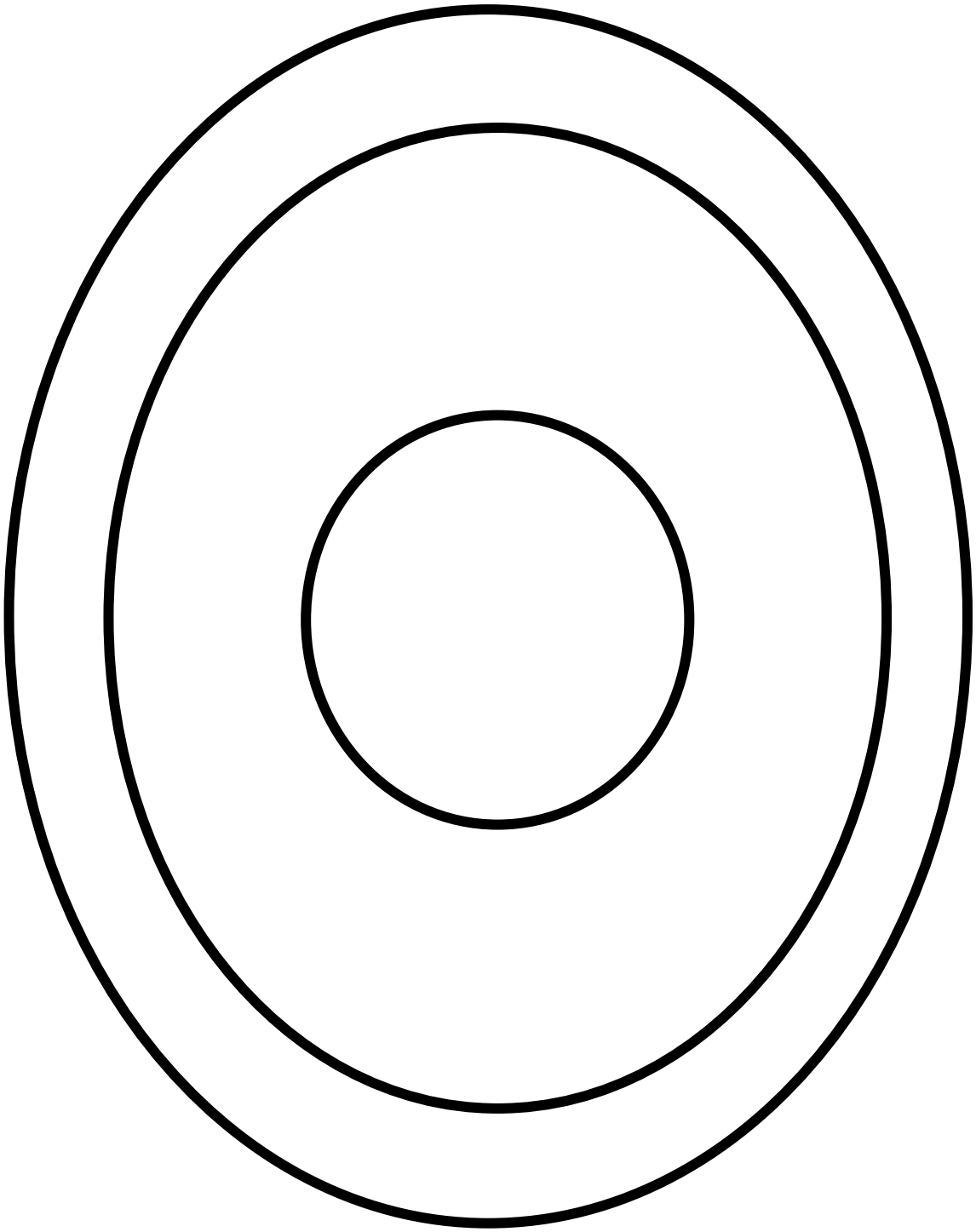
OA 4.1.2 Classify common materials according to their properties (color, shape, volume, density, texture).

- Students will look at various physical and chemical properties of different substances.

Appendix 2: Oxygen Cut and Paste



Appendix 3: Atomic Structure Diagram



Appendix 4: Ooblek Worksheet[30]

Tests	***Describe how the Ooblek Acted***	***Acting like a Solid or a Liquid?***
Push your finger ***slowly*** into the Ooblek cup.		
Push your finger ***quickly*** into the Ooblek cup.		
Pick up the Ooblek and hold it in your hand.		
Roll the Ooblek into a ball		
Roll the Ooblek into a snake		
Roll the Ooblek into a snake then pull the snake apart		

Appendix 5: Mystery Substance Lab

Oh no! Your lab assistant forgot to label the beakers with the new substances you created! ☹ Looks like you'll have to test some physical and chemical properties to determine which substance is which! For each pair below, read the procedure at each station, conduct the test and fill in this data chart!

Pair 1: Is it an M&M or a Skittle?

Pair 2: Is it sugar or salt?

Sugar tastes sweet and salt tastes salty.

Pair 3: Is it baking soda or flour?

Baking soda will bubble when it comes in contact with vinegar and flour will not.

Pair 4: Is it starch or flour?

Starch will turn black when it comes in contact with iodine and flour will not.

Pair #	Identify the Substance in Beaker A	How do you know? What kind of property did you use?	Identify the substance in beaker B	How do you know? What kind of property did you use?
1				
2				
3				
4				

Appendix 6: Alka Seltzer Surface Area Lab

Particle Size	Reaction Time (s)			Average Reaction Time (s)	Observations: Sights, sounds, anything interesting.
	Trial #1	**Trial #2**	**Trial #3**		
Whole Tablet					
Tablet Broken in Half					
Tablet Broken in Quarters					
Powdered Tablet					

Appendix 7: Growing Sugar Crystals

In this activity, you will grow crystals from sugar solutions made from sugar with two different surface areas. How do you think the difference in surface area will affect the behavior of the sugar particles and the resulting crystals?

To grow and compare your sugar crystals, you'll need:

– Two clean glass cups or measuring cups
– 2 pieces of thin cotton string (with length at least 1.5 times the cup's height)
– 2 pencils or sticks
– A washer or screw to weigh down the string
– 3 cups of granulated sugar
– 3 cups of powdered confectioners' sugar (icing sugar)
– 2 cups very hot water (poured by an adult)

Procedure:

Step One: Label each cup with the type of sugar it will hold. Have an adult pour one cup of very hot water into each of the two cups.

Step Two: Add 3 cups of each type of sugar into their respective cups and stir to dissolve (the water will look perfectly clear when the sugar is dissolved).

Step Three: Soak a piece of string in each cup of sugar water, then place it on a plate to dry for at least ten minutes. This allows starter crystals to form.

Step Four: Tie one end of the string to a pencil. Add a weight (a washer or screw) to the other end of the string.

Step Five: Place the appropriate string into the water with the weighted end down, allowing the pencil to sit across the top of the cup, holding the string in place.

Step Six: Observe the cups each day for 4-7 days. If possible, examine a sample of each of the resulting crystals under a microscope.

Questions:

1. Which type of sugar dissolved more quickly? What effect do you think the difference in surface area had on the results?
2. How are the crystals grown from the granulated sugar and those grown from the powdered sugar different? How did your results differ from your hypothesis?

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