Teacher Work Sample

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Physical Science Composite Education
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1. Learning Context:

School District: Cache County

Name of School: South Cache Middle School

Title 1 school? No

Demographics of School:

- Enrollment 1364
- Race/Ethnic Minority 12%
- English Learners <10%
- Low Socio-Economic 31%
- Students With Disabilities 12%
- Chronic Absenteeism 11%
- Mobility <10%
- 1% Asian, 0.7% Black, 89.3% Caucasian, 8.2% Hispanic, 0.2% Native American, 0.6% Pacific Islander
- South Cache is:
  - 52.2% proficient in language arts
  - 64.2% proficient in mathematics
  - 56.1% proficient in science

Description of school climate:

South Cache is a middle school where only seventh and eighth grade students attend. On average, attendance is about ninety-five percent. There is a student council, as well as a “S.W.A.T.” student organization which stands for “Students Working All Together.” This group is made up of students selected by their teachers who work with school counselors to “promote teamwork and success.” There is no school-wide discipline plan.

Parent involvement is highly encouraged. They are invited to join the Parent Teacher Association (PTA), and to be on the School Community Council. Parents receive monthly school progress reports as well as PTA newsletters. Additionally, parents with children who have a D or lower for one or more of their grades receive a notice half-way through the trimester.

The physical environment strives to be welcoming. Teachers decorate their classrooms with interesting, content-related materials. The academic environment encourages hard work to reach higher levels of learning. The school provides one hour for study hall Monday through Thursday each week to allow students time to work on homework and have access to the help they need. South Cache is also implementing an after-school tutoring session where students are invited to stay after school to work with tutors from Utah State University, as well as teachers, in order to improve their learning. The school provides a late bus for students who wish to attend the tutoring sessions.
Grade Level: 8th

Learning environment:

The school has an average of about 95% attendance. Teachers take role quickly and easily each hour by using the quick and easy system on PowerSchool. Seating charts are common throughout the school and are made in PowerSchool. The seating charts are used in conjunction with the attendance-taking feature. The seating chart allows those who require preferential seating to always have the seat they need, as well as aids in classroom management. Student engagement in learning tends to be quite high, and the teachers are often praised for their efforts in making lessons interesting for the students. However, 11% of students reported in a survey that they do not like school, and 20% reported that they do not feel safe at school.

Subject matter of lessons: Integrated Science - Chemistry unit

Number of students in focus class: 35

Students with special needs and short explanation of the needs:

- With IEPs: 5
  - Preferential seating, minimized distractions, extended time, written as well as oral instructions, allow calculator, spell check, and text-to-speech use; allow breaks, provide shortened assignments, alternate location, avoid showing frustration when student misunderstands
• Students who receive speech/language services: 0
• English Language Learners: 1
• Gifted and talented: 0
• Other: 6
  ○ Parent request for student to only be allowed to be checked out to one specified person
  ○ Many 504 health plans for conditions including asthma, hay fever, foot trouble, severe peanut allergies, and seizures

Students’ prior knowledge for these lessons:

Students have had primarily life-science and earth-science classes prior to eighth grade. Students have little background knowledge in the physical sciences (i.e., chemistry and physics). As a class we spent the first unit covering scientific skills that will benefit students in this unit. Topics such as proper observations, identifying variables, making inferences, the nature of science, the scientific method, metric measurements, and graphing were covered.

Students’ background and interest for these lessons:

In a survey given at the beginning of the semester, there were a variety of feelings conveyed towards science. There were many students who said they don’t like science while others said it’s their best subject. Some said they found the subject interesting, but had a hard time understanding the content. Students who indicated they do not like science suggested doing hands-on activities to make things more interesting and understandable. Students who indicated they do like science made the same suggestion. Chemistry is a section where many activities can be done, and therefore will hopefully be a topic of interest for all students.
Chemistry is one of our future units. However, students who stated that they have a difficult time understanding the content in science stated that taking a slow pace with clear explanations would be beneficial to them. I will need to ensure I am checking for understanding, slowing my pace, and explaining things clearly all throughout the semester, but especially with the chemistry unit as it is a potentially confusing topic.

I had a couple of students tell me on the survey that they are a little bit nervous for this class. Some students have had mean science teachers in the past, which makes them cautious about my class. I also asked in the survey about students’ personal interests. Many students love hiking and being outdoors. Several students were understanding that school is meant to be a place for learning, but asked that I also allow them to do fun activities on occasion.

The information that I have obtained has reinforced my belief that the classroom always needs to be a safe place for students. I don’t want to hinder their learning because they’re afraid of coming to class. I have tried to create an open atmosphere with my students by trying to take times to teach my class in a conversational manner. I have also tried to implement a variety of methods of assessment in order to reach out to various students’ strengths because I know not everyone excels at science. I have had assessments that involved writing, drawing, math, individual work, partner work, group work as well as true blue science activities. I have also tried to be mindful of the fact that the students really haven’t been exposed to a lot of the physical sciences before, and so I make an effort to not assume that students know the small things. I explain the small things as I go along, as well as relate the new concepts to topics they are familiar with such as relating the metric system to the English system of measurement. I want to give all of my students chances to display their strengths and hopefully help them gain a love of
science in the process. I have tried to keep in mind that my students are willing to learn but that they want to do fun things too. I did some demonstrations, a crime scene investigation activity, and a couple outdoor activities to try to give the students a change of pace. A week ago I did an exit card asking the students to tell me something they had liked or disliked so far about the class. There was a lot of positive feedback about the writing assignment (which was a creative story including independent and dependent variables). I also had a student indicate that she, “liked that no one ever gets bored in this class.” I also received some helpful feedback, such as students wishing they had a little more time to work on the story assignment. Therefore in the future I plan to continue to do a variety of activities to keep the students engaged, but I will also give them a little more time for bigger assignments such as writing assignments.
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2. Focus Students:

Description of Student 1

Focus Student 1 showed on his Matter Unit Pre-Assessment that he understands that three of the states of matter are solid, liquid, and gas. He was also able to draw accurate depictions of the molecular behavior of the three states of matter he listed. However, this student left out one of the commonly referred to states of matter and one uncommon state. He also showed that he was unfamiliar with phase changes as well as chemical and physical properties of matter.

In the previous unit, Focus Student 1 showed that he struggles with academics. He often would not turn in his assignments, or they would be turned in incomplete. He has an IEP that says he needs extended time on his assignments, and when he is reminded about them, he will get them turned in. Additionally, this student informed me that he struggles with reading. He has a hard time focusing and staying on task in class and loves talking with his peers.

Focus Student 1 has some family struggles. There is a note on his account that says he is only allowed to be checked out of school by one person which leads me to believe there have been problems with other family members trying to take him in the past. I gathered the majority of the personal background of Focus Student 1 from parent teacher conferences. He came in with his mom and grandmother. The grandmother did most of the talking and seemed to try to keep his mom in the background. The grandmother seems to be the main person trying to help Focus Student 1 be successful in school.
As stated above, Focus Student 1 enjoys talking in class and has a hard time staying focused and on task. He also has difficulty turning in his assignments. He also seems to have little belief in his own academic ability.

Keeping all of the characteristics stated above in mind while I prepared lessons, I decided to start with a new seating chart. I placed this student around classmates who are more reserved but also moderately academically successful in order to provide fewer distractions and availability of peer assistance. I also did more to get this student involved in class by doing things such as having him sort cards on the board for the class with his partner. I assigned him sections of reading that were shorter and easier to understand, as well as provided more visual representations. On more difficult subjects I provided direct instruction.

**Description of student 2**

Focus Student 2 is one who is a quick learner and is academically successful. He provided an accurate definition of matter and listed four of the states of matter on the unit pre-assessment. In addition, all of the answers he provided on the pre-assessment were correct, with the exception of not providing the lesser-known, fifth state of matter. This student shows that he has a firm grasp on matter and the properties thereof from his prior learning.

Focus Student 2 is a high-achieving student who turns in all of his assignments. They are always completed; he always gets high scores on the assignments. This student is capable of being stretched to deeper levels of thinking, and even seems to be bored in class when the content is too easy for him.

There is nothing known about the personal background of Focus Student 2.
Another relevant characteristic of Focus Student 2 is that he tends to be fairly quiet in class. He often doesn’t like to raise his hand to answer questions or make comments, however if I call on him, he is willing to share.

Keeping the above characteristics in mind while planning lessons made me realize that I need to include some activities that push the students to a deeper level of thinking. I decided to ask the students more involved questions that would require a deeper level of thinking in order to help this student stay engaged. I would ask things like, “All of the other phase changes have an opposite process, so does sublimation have an opposite process? If so, what is it called?” and, “If water freezes at zero degrees celsius, then why doesn’t water turn to ice all at once?” I also decided to specifically call on this student to help him be more involved with the class.
3. Lesson Plans:

Erika Bloxham

**Lesson 1 Title**

Introduction to Matter and Its Relation to Energy

**Subject and grade level**

Integrated Science, eighth grade

**Approximate time**

50 minutes

**Rationale for methods**

Before students can understand the effect that energy has on the state of matter, they first need to understand what matter is. By doing an inquiry-based lesson and allowing the students to determine the definition of matter on their own, the definition is likely to be more meaningful to the students. Focus Student 1 is a student with an IEP who struggles with reading and transferring what he knows to paper. He is also a student that has a hard time staying focused, and who rarely turns in his work. He loves talking to his peers, which is part of the difficulty in keeping him engaged. I am hoping that this activity will help him stay engaged as he will get to work with his peers and debate their findings. The activity also requires very little reading, and encourages learning through trial and error. Therefore, the lesson is designed to be one that will not be overwhelming for Student 1.

Focus Student 2 is a student who showed on the unit pre-assessment that he is already quite familiar with the subject content of this unit. He has historically been a high-achieving student, who stays easily engaged in the material. However, it is clear that he is ready to attempt a higher level of understanding with this content. I plan for this activity to allow him to achieve this higher level of learning by requiring him to create his rationale for where he sorts
the various objects (whether they be matter or non-matter), and try to convince his classmates of his reasoning during a form of a class debate. He will also be able to construct his own definition of matter, rather than simply being required to memorize a provided definition.

**Content Standards**

8.1.5

**Develop a model** that uses **computational thinking** to illustrate the **cause and effect** relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes and on calculating density of a substance’s state.

In this lesson I will be introducing the molecular-level models of solids, liquids, and gases and how these phases relate to energy.

**Academic language/vocabulary objectives**

1. Students will need to analyze the various items given to them, and organize them into three categories - matter, non-matter, and unsure. They will then need to defend their logic. Students will next be asked to evaluate the sorted items to see what they have in common and construct a definition of matter. Finally, they will engage in a discussion to hypothesize how the energy of the molecules in matter determines the state in which the matter exists.

2. Students must learn what matter and energy are and be able to differentiate between examples of matter and energy. They will also be required to learn the four states of matter. Finally, they will need to be familiar with what a molecule is.
Required materials, resources, and technology

- Eighteen sets of cards with various examples of matter and nonmatter will be provided for the students to sort through. This will allow the students to try for themselves to differentiate between matter and non-matter.
- One set of cards will be enlarged and have magnets attached to the back to be able to use for sorting as a class. This will be useful for the class debate, as it will allow me to move the cards between categories as the debate progresses. This will also be a useful visual aid for the students to see the progression of the debate.

Lesson Objectives

- Students will be able to differentiate between matter and nonmatter.
- Students will develop a definition for matter.
- Students will be able to differentiate between the different states of matter.
- Students will be able to identify the relative energies of the molecules in a solid, liquid, and gas.

Instructional Procedures

- Students were previously given a pre-assessment for this unit. This pre-assessment showed that a large majority of students can give the definition of matter, but when pressed for further information such as properties of matter there is some confusion.
- Arrange students into partnerships for working on this activity. Instruct the students that they are only allowed to discuss with their partner at this point in the lesson. (1 minute)
- Give students the instructions for the activity (5 minutes):
○ Each person (not just partnership) needs to take out a piece of paper and on one side write “Our Guess,” and make three columns that say matter, non-matter, and unsure. On the other side write “Class Conclusion,” and make two columns that say matter and non-matter.

○ Each partnership will be provided with a set of 28 papers that need to be sorted into the categories of matter, non-matter, and unsure.

○ Before putting anything into the matter and non-matter categories, students have to have a reason for why they are putting it there. If they don’t have a reason, then the paper needs to go in the “unsure” category. The reason students need to have a purpose for where they put each paper is because partnerships have to be able to defend their reasoning in a variation of a class debate. We are ultimately going to work as a class to put everything into the correct categories.

○ Students have 15 minutes to work with their partner (and only their partner) to sort out these papers. Remind the students to make sure they have a reason for why they put each paper in the matter or non-matter categories.

○ Once the have sorted everything, on the side of the paper that says “Our Guess,” they will write down which categories they sorted everything into.

  ● Give the students time to complete the assigned task. (15 minutes)
  ● Have the students make sure they are ready for the debate! Have the students turn to another partnership near them. Both partnerships should share their reasoning for the placement of their papers. (2 minutes)
  ● Call on one partnership to tell me how they arranged their papers. (1 minute)
  ● Ask for a raise of hands for partnerships that arranged their papers exactly the way this group did. Ask students to raise their hands if they arranged theirs differently. Call on
one group to tell me what they did differently. Pull out the papers that are in question. (1 minute)

- Ask the first group to explain to me why they sorted the paper where they did. (1 minute)
- Ask the second group to explain to me why they sorted the paper differently. (1 minute)
- Ask for a raise of hands to see who sorted the paper the way the first group did, and to see who sorted the paper the way the second group did. (0.5 minutes)
- Ask for one student who agrees with the first group, and one who agrees with the second group, to explain to me their reasoning. (0.5 minutes)
- Do a class vote to decide where the paper should be placed. (0.5 minutes)
- Ask for a raise of hands for partnerships that sorted theirs exactly like what is on the board, and for those who sorted differently. Repeat the above process until all arguments have been made up to five differences. (up to 10 minutes)
- If needed, move the papers around so they are in the correct category. (0.5 minutes)
- Call on a couple students to tell me what their definition of matter was that they used to sort their papers. (1 minute)
- Ask students to look at the two categories for a minute and think about the differences between them. In addition, ask students to look at what is similar among everything inside of each category. Have students list some of the things they notice. (1 minute)
- Ask students to talk with their partner and one other partnership by them about what everything in the matter category has in common, and try to come up with a definition to use for matter. (2 minutes)
- Have a couple groups share their definition. (1 minute)
- Come to a conclusion on a class definition of matter. (1 minute)
• Have students turn their papers over and write down the correct sorting of the papers along with the class definition. Have them make sure their name is on the top, and check their partner’s paper to make sure their name is on the top, and pass the paper forward. (2 minutes)
• Ask the students if the matter category can be sorted into any further categories. Have partnerships sort them into solid, liquid and gas. (1 minute)
• Ask someone to tell me how to sort them. (0.5 minutes)
• Explain that solid, liquid, and gas are three of the four phases/states of matter. Meaning these are the ways matter exists. Ask if anyone knows the fourth phase/state of matter (plasma). (0.5 minutes)
• Point out a couple items in the non-matter category that can be classified as energy. Explain that energy and matter are different. (0.5 minutes)
• Mention that the phase that matter exists in is dependent on how much energy the molecules in the substance have. A molecule is a combination of atoms that are bonded together. Atoms are what make up everything. (0.5 minutes)
• Depending on how much time was spent debating the correct sorting of the papers, lesson may need to be stopped here for a 50 minute lesson. If there is time remaining, the following can be discussed:
  ○ Ask students which state of matter they think has the most energy. (0.5 minutes)
  ○ Ask students what the molecules would look like in the matter with the most energy versus the matter with the least energy. Draw them on the board. (2 minutes)
  ○ Explain that plasma is really the matter that has the most energy, and that plasma is what makes up stars. It occurs at very low pressures (fluorescent
lamps) and very high temperatures (stars). Plasma has such a high energy that no bonds can exist in it, and it’s basically just free positively and negatively charged particles zipping around really fast. Draw it on the board. (2 minutes)

- Draw on the board the representation of how particles in a liquid move. At this point there should be four drawings on the board showing the least to most energetic states of matter. Explain that this is the relative order of energies of the states of matter. Energy of the particles is what determines the state of matter. (1 minute)

- The relationship of energy and matter will continue to be discussed and discovered in following lessons.

**Adaptations/accommodations**

The papers in this activity used for sorting have pictures on them along with the word. This will help English language learners have a better understanding of the objects they are sorting. It will also help Focus Student 1 who struggles with reading. The variety of activities and changing between working in partnerships, groups, and as a class will benefit Focus Student 1 as he loses focus when he has to do one long activity. Working with others will also help this student gain a better understanding of the material. In addition, the assignment that will be turned in is one that will be done in class, so this student doesn’t have to worry about completing it on his own time and potentially forgetting to turn it in. Finally, this will give Focus Student 2 a chance to think for himself rather than to be told he has to memorize the information that is provided. He gets the chance to think critically to gain his own understanding.
Assessment

Students will fill out a paper of how they think the papers should be arranged prior to discussion. After the activity the students will be asked to resort the objects and fill out their sorting on the other side of the paper. They will also be required to write their definition of matter on this side of the sheet of paper. I will listen to the students’ arguments as the debate proceeds to see if they are beginning to change their understanding of matter. Once we reach the point where we are constructing definitions of matter, I will assess the students’ definitions to see if they have constructed a correct definition of matter. As I will not have time to listen to every student, they will turn in their papers with their definition written on the paper. I will look through them and determine if students have correctly understood how to classify matter. These will be formative assessments. Later in the unit, a test will be given that will ask students to sort various objects into matter and non-matter, as well as provide a definition of matter. This will be a summative assessment.

Idea for lesson activity inspired by http://seplessons.ucsf.edu/node/351
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Matter Unit Pre-Assessment

1. What is matter?
   Anything that takes up space.

2. How many states does matter exist in, and what are those states?
   S, L, G

3. Use the back of this page to draw how the molecules behave in each state of matter. Be sure to label your drawings.

4. What is a phase change?
   When not all of something is gone away or not time but waxing and waning like the moon.

5. Give one example of a physical property of matter.
   Gas, solid

6. Give one example of a chemical property of matter.
   Like when you put chlorine in a swimming pool.

7. Describe the difference between a chemical and physical change.
   Like when a catalyst turns into a butterfly, and when you put chlorine in a swimming pool, the chemical change has occurred.

8. What are some examples of evidence that a chemical change has occurred?
   Dark matter

9. Can matter be destroyed?
   No
Matter Unit Pre-Assessment

1. What is matter?
   Anything that has mass and takes up space.

2. How many states does matter exist in, and what are those states?
   liquid, solid, gas, plasma.

3. Use the back of this page to draw how the molecules behave in each state of matter. Be sure to label your drawings.

4. What is a phase change?
   When something changes its state of matter through energy.

5. Give one example of a physical property of matter.
   Density.

6. Give one example of a chemical property of matter.
   Rustability.

7. Describe the difference between a chemical and physical change.
   A physical change is a change in appearance and a chemical change is a change in the makeup.

8. What are some examples of evidence that a chemical change has occurred?
   Popcorn popping, smoke, a scent, change in color.

9. Can matter be destroyed?
   No. It can only be made smaller.
Artifact 2

Focus Student 1

My Guesss

Matter: Marvin, The Sun, Air, Dissolved sugar, Atom, skin cells, clouds, soil, Butter, smoke, saliva, water

Non Matter: Wisdom, fear, Gravity, Heat, Temperature, light, magnetism, force, sound, pressure, gasoline, fire, paper, wind

Unsure: Energy and Electricity
Conclusion

Matter:  *Butter, the Sun, Mars, Air, Dissolved sugar, Atoms, Skin cells, clouds, soil, saliva, water, smoke, gasoline, paper*

**Non Matter:** wisdom, light, sound, magnetism, Temperature, pressure, food, face, Energy, electricity, Heat, Gravity, fire, wind

Definition: *anything that takes up space and is physical.*
My guess

Phyto: soil, water, skin cells, atoms

dissolved sugar, saliva, the sun, smoke, clouds

tire, rust, oil, gasoline, paper, rubber

Non-matter: heat, fear, wisdom, electricity, sound, temperature, gravity, force, energy, pressure, magnetism, light, wind

Unsure: wind
Conclusion

Matter: soil, skin cells, butter, clouds, mars, gasoline, dissolved sugar, the sun, paper, car, smoke, saliva, air, water

Nonmatter: electricity, heat, wisdom, magnetism, light, sound, wind, pressure, fire, gravity, force, temperature, fear, energy

Definition: takes up space and has mass.
Erika Bloxham

**Lesson 2 Title**

Effect of Energy on the State of Matter

**Subject and grade level**

Integrated Science, eighth grade

**Approximate time**

50 minutes

**Rationale for methods**

For this lesson, students will be reading an article taken from Prentice Hall *Physical Science: Concepts in Action* by Wysession, Frank, and Yancopoulos about the kinetic theory of matter. The reading is broken into four sections. The article can be a bit difficult to understand when it is read through quickly, as there is a lot of information packed into it. A couple of the sections are shorter and easier to understand than others. I decided to do a jigsaw activity where each student is given a section of the article to read. The student will be asked to underline the important information so that they can later share it in a group setting. Groups will consist of students that were each assigned to read different parts of the article.

I chose to carry out the activity in this way to help Focus Student 1. He struggles with reading, but I feel that even though this is the case he should still be expected to practice reading. He will be given the shortest part of the article. This piece of the article contains the least amount of information and is fairly straightforward, so it shouldn't be too overwhelming for the student. Focus Student 2 who is a high-achieving student will be given the longer, more information-intensive part of the article. It is my intention that this activity will also teach students how to break down scientific articles into smaller pieces and to pick out important information. I will listen to and write down the information that the focus students share.
Students will also engage in a group activity where they find songs that they can associate with the different states of matter. This is a worksheet that my mentor teacher suggested and provided. It will be a fun activity for the students, and hopefully be a useful way to help them understand the relative energies of the various states of matter. I will listen to and write down what the focus students share as well as collect their song worksheets.

**Content Standards**

8.1.5

*Develop a model* that uses *computational thinking* to illustrate the *cause and effect* relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes and on calculating density of a substance’s state.

In this lesson I will be focusing on the part of the standard that focuses on molecular-level models of solids, liquids and gases, and how they are affected by an increase or decrease in energy.

**Academic language/vocabulary objectives**

1. Students will need to understand the reading that they are assigned in order to be able to explain the information to their classmates. They will also then be required to apply what they have read to songs with which they are familiar.

2. Students must learn what kinetic energy is. They also need to remember the definition of matter, and that solid, liquid, gas, and plasma are the four states of matter.
**Required materials, resources, and technology**

- Kinetic theory of matter reading will be cut into the four different sections. I will need nine copies of the reading so that there are enough sections to give to the students.
- “So You Think Particles Can Dance?” worksheet.
- I will also need to inform students the day before that they will need a phone or an ipod for this activity, as they will be presenting their songs to the class.

**Lesson Objectives**

- Students will read and find the important information in their section of the article.
- Students will summarize the information and inform their group.
- Students will apply what they read and find a song that they think matches the motion of each state of matter.

**Instructional Procedures**

- Divide students into groups of four. There may have to be a group of five in some class periods depending on attendance. (1 minute)
- Assign sections of the reading (1-4) for each student. There may have to be two students in one section depending on attendance. (1 minute)
  - I will assign sections of reading strategically. I will give the longer, more information-heavy sections to the higher-achieving students. The students who need more support in reading will receive the shorter sections.
- Have students read their section independently and underline the important information as they read with a colored pencil. Have them write a short summary of what was included in their section. (7 minutes)
- Have students get with their groups and take turns discussing their section of reading. (10 minutes)
● Bring the class back together and ask one student from each section of reading to share what they read. (5 minutes)

● Summarize the information for the students. The kinetic theory of matter states that the amount of energy the molecules in a substance have will determine the phase that the matter exists in. The state of matter with the least amount of energy is solid, while plasma has the highest amount of energy. A liquid has more energy than a solid, and a gas has more energy than a liquid. (1 minute)

● Give students instructions for the assignment. (2 minutes)
  ○ Students will need to get into groups of three.
  ○ Students will begin by filling out the table on the worksheet with the information they gained from the reading. They may work with their groups to do so.
  ○ Each group needs to have at least one device that can play music (e.g., Ipod, mp3, phone).
  ○ Groups will work together to find a song that they think is a good representation of the solid, liquid, and gas states of matter. They should be prepared to share their findings with the class.
  ○ Students should finish the questions on the worksheet.

● Now have students divide into groups of three of their choice. (1 minute)

● Give students time to work on the “So You Think Particles Can Dance” worksheet. (22 minutes)

● If students seem to be finishing, start the group presentations to the class. Have each group pick a segment of one song to share with the class. Students will also need to be ready to explain their reasoning. If students are still working we will do the presentations on the following day.
**Adaptations/accommodations**

All students will be asked to underline the important information in their section with a colored pencil. This will help students pick out the important information. They will also be asked to write a short summary of what they read in their own words. This will help solidify the information they read, and will also make the information more understandable for the other students in their group as it will be put into words that are more familiar to the students. Focus Student 1 will be given the “Kinetic Theory” portion of reading. This is the shortest portion of reading, and is the most straight forward with small amounts of information. This will be beneficial to Focus Student 1 as he struggles with reading and comprehension.

Focus Student 2 will be given the “Explaining the Behavior of Liquids” portion of reading. This is the longest section and contains the most information. It also contains the most academic language. Focus Student 2 is a high achieving student who is likely able to comprehend this more difficult level of reading, while some of the other sections may be uninteresting to him as they are a lower lexile level.

**Assessment**

I will listen to and write down what the Focus Students share in their reading groups. I will also collect their summary paragraph of their reading. I will take note of students’ presentations and collect their worksheets in order to gauge their level of understanding on the kinetic theory of matter. If students are able to explain their assigned reading section to their group, then I will know that they have successfully understood the reading. If they are able to apply what they have read as well as the information their group has shared to familiar songs,
then I will know they have a good grasp on the Kinetic Theory of Matter and what it entails in a solid, liquid, and gas.
Artifact 3

Focus Student 1

**kinetic Theory**

- An object that is moving has *kinetic energy*.

- The word *kinetic* comes from Greek, its mean is "to move".

- Kinetic energy is the energy an object has due to its motion.

- The kinetic theory of matter says that all particles of matter are in constant motion.
Kinetic Theory

Why, under ordinary conditions, is copper a solid, mercury a liquid, and helium a gas? To begin to answer that question, you need to know something about kinetic energy. An object that is moving has kinetic energy. The word kinetic comes from a Greek word meaning "to move." Kinetic energy is the energy an object has due to its motion.

The faster an object moves, the greater its kinetic energy is. According to the kinetic theory of matter, particles inside a solid such as a baseball are moving. Particles in the air that the baseball travels through are moving too. The kinetic theory of matter says that all particles of matter are in constant motion.

Explaining the behavior of Gases

You can compare the motion of the particles in a gas to the movement of balls during a game of billiards (pool). When a cue ball strikes a ball at rest, the first ball slows down and the second ball begins to move. Kinetic energy is transferred during those collisions.

Unlike billiard balls, the particles in a gas are never at rest. At room temperature, the average speed of the particles in a sample of gas is about 1,600 km/hour. During a collision, one atom may lose kinetic energy and slow down while the other atom gains kinetic energy and speeds up. There are forces of attraction among the particles in all matter. If the particles are apart and moving fast, as in a gas, the attractions are too weak to have an effect. Under ordinary conditions, scientists can ignore the forces of attraction in a gas.

Explaining the behavior of liquids

The particles in liquids also have kinetic energy. So why does a liquid such as mercury have a definite volume at room temperature instead of expanding to fill its container? The average speed of a mercury atom is much slower than the average speed of a helium atom at the same temperature. A mercury atom has about 50 times the mass of a helium atom. This greater mass is only partly responsible for the slower speed. What other factor is responsible?

The particles in a liquid are more closely packed than the particles in a gas. Therefore, attractions between the particles in a liquid do affect the movement of the particles. This is similar to the movement of students in a crowded hallway; they are packed close together but they can move to different places. In a liquid, there is a kind of tug of war between the constant motion of particles and the attractions among particles. This tug of war explains the general behavior of liquids. A liquid takes the shape of its container because particles in a liquid can move to new locations. The volume of a liquid doesn’t change because forces of attraction keep the particles close together.

Explaining the behavior of solids

You might compare the particles in a solid to a polite audience in a movie theater. Although people move around in their seats, each person remains in essentially the same location during the movie. They have “fixed” locations in a total volume that does not change. Solids have a definite volume and shape because particles in a solid vibrate around fixed locations. Strong attractions among the atoms in a piece of copper restrict their motion and keep each atom in a fixed location relative to its neighbors. Each atom vibrates around its location but it does not exchange places with a neighboring atom.
3. The particles in a liquid also have kinetic energy. The particles in a liquid are more closely packed than the particles in a gas. Therefore, collisions between the particles in a liquid do affect the movement of the particles. A liquid takes the shape of its container because particles in a liquid can move to new positions. The volume of a liquid doesn't change because forces of attraction keep the particles close together.

1. An object that is moving has kinetic energy. The faster it is moving, the more energy kinetic energy.

2. Kinetic energy is transferred through collision.
Kinetic Theory

Why, under ordinary conditions, is copper a solid, mercury a liquid, and helium a gas?
To begin to answer that question, you need to know something about kinetic energy. An object that is moving has kinetic energy. The word kinetic comes from a Greek word meaning "to move." Kinetic energy is the energy an object has due to its motion.
The faster an object moves, the greater its kinetic energy is. According to the kinetic theory of matter, particles inside a solid baseball are moving. Particles in the air that the baseball travels through are moving too. The kinetic theory of matter says that all particles of matter are in constant motion.

Explaning the behavior of Gases
You can compare the motion of the particles in a gas to the movement of balls during a game of billiards (pool). When a cue ball strikes a ball at rest, the first ball slows down and the second ball begins to move. Kinetic energy is transferred during those collisions.
Unlike billiard balls, the particles in a gas are never at rest. At room temperature, the average speed of the particles in a sample of gas is about 1,600 km/hour. During a collision, one atom may lose kinetic energy and slow down while the other atom gains kinetic energy and speeds up. There are forces of attraction among the particles in all matter. If the particles are apart and moving fast, as in a gas, the attractions are too weak to have an effect. Under ordinary conditions, scientists can ignore the forces of attraction in a gas.

Explaning the behavior of liquids
The particles in liquids also have kinetic energy. So why does a liquid such as mercury have a definite volume at room temperature instead of expanding to fill its container? The average speed of a mercury atom is much slower than the average speed of a helium atom at the same temperature. A mercury atom has about 50 times the mass of a helium atom. This greater mass is only partly responsible for the slower speed. What other factor is responsible?
The particles in a liquid are more closely packed than the particles in a gas. Therefore, attractions between the particles in a liquid do affect the movement of the particles. This is similar to the movement of students in a crowded hallway; they are packed close together but they can move to different places. In a liquid, there is a kind of tug of war between the constant motion of particles and the attractions among particles. This tug of war explains the general behavior of liquids. A liquid takes the shape of its container because particles in a liquid can move to new locations. The volume of a liquid doesn't change because forces of attraction keep the particles close together.

Explaning the behavior of solids
You might compare the particles in a solid to a polite audience in a movie theater. Although people move around in their seats, each person remains in essentially the same location during the movie. They have "fixed" locations in a total volume that does not change. Solids have a definite volume and shape because particles in a solid vibrate around fixed locations. Strong attractions among the atoms in a piece of copper restrict their motion and keep each atom in a fixed location relative to its neighbors. Each atom vibrates around its location but it does not exchange places with a neighboring atom.
Introduction: Think of how music makes you feel. Does slow music relax you and put you to sleep? Does fast music make you want to move? It seems that the more energy the music has, the faster you want to move. In this activity, you will learn how adding energy to a substance can also make the particles move faster.

Procedures: DAY 1:
After listening to the teacher read the "Kinetic Theory" section, read the next three sections on your own and fill out the chart below.

<table>
<thead>
<tr>
<th>Section</th>
<th>How do the particles move?</th>
<th>What type of music or dance does this particle movement make you think of?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavior of Gases</td>
<td>Fast</td>
<td>rock</td>
</tr>
<tr>
<td>Behavior of Liquids</td>
<td>Medium</td>
<td>pop</td>
</tr>
<tr>
<td>Behavior of Solids</td>
<td>Slow</td>
<td>Christmas music</td>
</tr>
</tbody>
</table>

Now, get with a group of three and see if you can add to the things you wrote above in the space below.

My Group's Ideas:

---

DAY 2: My Group Names
In the space below, write the name of the song your group chose to represent each state of matter. Explain why you chose it and how it relates to that particular state of matter. (Your group will share this with the class.)

<table>
<thead>
<tr>
<th>State</th>
<th>Song</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLID</td>
<td>Summertime</td>
<td>Its strong and</td>
</tr>
<tr>
<td></td>
<td>Sadness</td>
<td>happy</td>
</tr>
<tr>
<td>LIQUID</td>
<td>Want you back</td>
<td>Its poppy</td>
</tr>
<tr>
<td>GAS</td>
<td>Carry on my w</td>
<td>Its fast and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pushed up</td>
</tr>
</tbody>
</table>

Analysis:
1. Describe two differences between how the particles move in a solid and how they move in a gas.

2. In the reading, the movement of liquids was compared to students walking in a crowded hallway. Describe another example from everyday life that could be used to describe the movement of the particles in a liquid.

3. When the beat or tempo of a song changes, it makes you want to move differently. What needs to be added or taken away to make particles move faster or slower?

4. Describe an example that supports your answer to question three.

5. Conclusion: (What was the purpose of this activity?)
**Introduction:** Think of how music makes you feel. Does slow music relax you and put you to sleep? Does fast music make you want to move? It seems that the more energy the music has, the faster you want to move. In this activity you will learn how adding energy to a substance can also make the particles move faster.

**Procedures:** DAY 1
After listening to the teacher read the "Kinetic Theory" section. Read the next three sections on your own and fill out the chart below.

<table>
<thead>
<tr>
<th>Section</th>
<th>How do the particles move?</th>
<th>What type of music or dance does this particle movement make you think of?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavior of Gases</td>
<td>quickly</td>
<td>rap/dubstep</td>
</tr>
<tr>
<td>Behavior of Liquids</td>
<td>slightly away</td>
<td>pop</td>
</tr>
<tr>
<td>Behavior of Solids</td>
<td>vibrate slowly</td>
<td>pop</td>
</tr>
</tbody>
</table>

Now, get with a group of three and see if you can add to the things you wrote above in the space below.

**My Group's Ideas:**

**DAY 2: My Group Names**
In the space below, write the name of the song your group chose to represent each state of matter. Explain why you chose it and how it relates to that particular state of matter. (Your group will share this with the class)

<table>
<thead>
<tr>
<th>Song</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLID</td>
<td>It is slow and heavy</td>
</tr>
<tr>
<td></td>
<td>Bohemian Rhapsody</td>
</tr>
<tr>
<td>LIQUID</td>
<td>happy</td>
</tr>
<tr>
<td></td>
<td>because it is medium fast</td>
</tr>
<tr>
<td>GAS</td>
<td>because it is fast and random</td>
</tr>
<tr>
<td></td>
<td>Hello</td>
</tr>
<tr>
<td></td>
<td>45-60</td>
</tr>
</tbody>
</table>

**Analysis**

1. Describe two differences between how the particles move in a solid and how they move in a gas.
   
   **solid is slow and heavy**
   **gas is random**

2. In the reading, the movement of liquids was compared to students walking in a crowded hallway. Describe another example from everyday life that could be used to describe the movement of the particles in a liquid.
   
   **water being poured from a glass**

3. When the beat or tempo of a song changes, it makes you want to move differently. What needs to be added or taken away to make particles move faster or slower?
   
   **Energy**

4. Describe an example that supports your answer to question three.
   
   **Mercury**

5. Conclusion: (What was the purpose of this activity?)
Erika Bloxham

**Lesson 3 Title**

Introduction to Phase Change Diagrams

**Subject and grade level**

Integrated Science, eighth grade

**Approximate time**

50 minutes

**Rationale for methods**

At the beginning of class, students will be asked to answer the following bell ringer question:

“If ice melts once it gets warmer than zero degrees Celsius, then why doesn’t an ice cube melt all at once?”

I want to get students thinking before we get into the lesson, therefore I will ask this question to make them wonder why.

I will be starting this lesson with a visual reminder of how molecules act in each of the phases/states of matter. I want to give students something they can actually see to help them understand molecular behavior in each of the states. In addition, it is important that the students have a firm grasp of the kinetic theory of matter prior to learning about phase change diagrams. Therefore, giving a visual representation will also get students thinking about the phases of matter so that we can easily transition into phase changes.

I chose to use direct instruction for this lesson because due to the imperfect and unisolated systems in the classroom, an inquiry based lesson would not paint a very clear picture of phase change diagrams. Students will also benefit from being familiar with this concept prior to engaging in labs on phase change because otherwise it can be hard to
understand why the temperature takes a while to change as a substance begins to melt or boil, versus the steady climb in temperature during other times of the experiment.

I will show this short video (https://www.youtube.com/watch?v=xf8O6ZalPtw) to give an overview of phase change diagrams. This will give the students some variety which will aid in keeping them engaged.

Providing direct instruction will aid Focus Student 1, as this student tends to need clear explanations because of his struggle with reading and interpreting data for himself. He also gets easily distracted when working with classmates, so for this activity I need to have students work on their own.

**Content Standards**

8.1.5

**Develop a model** that uses computational thinking to illustrate the cause and effect relationships in particle motion, temperature, density, and state of a pure substance when heat energy is added or removed. Emphasize molecular-level models of solids, liquids, and gases to show how adding or removing heat energy can result in phase changes and on calculating density of a substance’s state.

For this lesson we will be focusing on how the addition or removal of energy can result in a phase change.

**Academic language/vocabulary objectives**

1. Students will need to remember the four phases of matter, and how the kinetic theory of matter relates to each phase. They will need to understand what is meant by a phase
change and how to interpret phase change diagrams. They will then need to apply this knowledge to an independent practice worksheet.

2. Students must learn what a phase change, and phase change diagram are. Students will learn terms such as freezing point, melting point, boiling point, condensation, sublimation, evaporation, and deposition.

**Required materials, resources, and technology**

- Marshmallows will be used to do a quick visual representation of the behavior of molecules in the various states of matter. This will give students a concrete example that will be easier to remember.

- Video: [https://www.youtube.com/watch?v=xf8O6ZaIPtw](https://www.youtube.com/watch?v=xf8O6ZaIPtw)

- Phase change diagram worksheet will give students the chance to practice what they have learned about phase change diagrams.

**Lesson Objectives**

- Students will be able to explain why the temperature of a substance does not change when a phase change is occurring.

- Students will be able to read and interpret a phase change diagram.

- Students will be able to define freezing point, melting point, boiling point, condensation, sublimation, evaporation, and deposition.

**Instructional Procedures**

- Have students take out a piece of paper and answer the following bell ringer questions (3 minutes):
  
  “If ice melts once it gets warmer than zero degrees Celsius, then why doesn’t an ice cube melt all at once?”
• Briefly discuss the bell ringer. Ask students what they came up with. After hearing a couple of student answers, explain that zero degrees Celsius is the temperature where the phase change begins for the transition between solid and liquid no matter which direction we are going. Explain that this is also the temperature the substance will stay at until it has completely finished changing phases. (2 minutes)

• Quickly review the four phases/states of matter and how the kinetic theory of matter relates to each phase. (2 minutes)
  ○ Remember that the four phases of matter are solid, liquid, gas, and plasma.
  ○ Solid has the least amount of kinetic energy, while plasma has the most kinetic energy. Demonstrate this by showing marshmallows all aligned in a specific shape (representation of a solid). Then put marshmallows in a bowl and show how they roll around and slide past each other (representation of a liquid). Finally, throw the marshmallows in the air to demonstrate the behavior of the particles in a gas.

• Explain that when a substance switches states it is called a phase change. The process can be graphed with a phase change diagram. (1 minute)

• Show the video to the students as an introduction to phase change diagrams.
  https://www.youtube.com/watch?v=xf8O6ZalPtw (6 minutes)

• After watching the video, I will construct a phase change diagram on the board. Inform the students that we will use the graph for water. Ask them where on the graph I should label zero degrees Celsius and one hundred degrees Celsius. (2 minutes)

• Inform the students that the flat lines are where the phase changes occur. The substance does NOT increase in temperature during a phase change (even though the energy continues to be added) because all of the energy is going into converting the
substance from one phase to another. Because this substance is water, the phase changes will occur at zero and one hundred degrees Celsius (if you are at sea level).

Ask the students if this will be the same for all substances. (2 minutes)

- The temperatures of the phase change will vary. Melting/freezing points and boiling/condensation points vary among substances. (1 minute)

- Define the following terms for the students on the board (4 minutes):
  - Melting point: The temperature at which a substance melts. The substance changes from a solid to a liquid.
  - Freezing point: The temperature at which a substance freezes. The substance changes from a liquid to a solid.
  - Boiling point: The temperature at which a substance boils. The substance changes from a liquid to a gas.
  - Condensation point: The temperature at which a gas changes to a liquid.

- Explain to the students that because melting and freezing are opposite processes, they occur at the same temperature (for water, zero degrees Celsius). Similarly, boiling and condensing are opposite processes so they occur at the same temperature as well (for water, 100 degrees Celsius). (2 minutes)

- Inform the students that during a phase change (the level spots on the graph) the substance is partially in one phase, and partially in the other until the temperature starts to change again. When the temperature is changing the substance is all in one phase. (1 minute)

- Point out where the solid, liquid, and gas states would be on the graph, and the phase changes between them. Label each spot on the graph on the board. Additionally, label
where the melting/freezing points, and the boiling/condensation points are at on the graph. (4 minutes)

- Ask students what the phase change diagram would look like if we were cooling the substance. Explain that the same concept would apply, the graph would just be turned around. Draw an example. (1 minute)

- Ask students what sublimation means. Explain that it is when a substance skips the liquid state because it is heated so rapidly. It goes directly from a solid to a gas. (1 minute)

- Ask the students that if a substance can go directly from a solid to a gas, can one go from a gas to a solid? Yes! It's called deposition. (1 minute)

- Transition to the students working on the phase change worksheet. They should have time to fully complete it in class. They will apply the information they were given to this worksheet. (17 minutes)

**Adaptations/accommodations**

In order to help Focus Student 1, the lesson will be entirely direct instruction. However, in order to help keep his focus as well as the focus of my other students, we will do a couple different activities to provide some variety. Because Focus Student 1 has a hard time completing assignments when they are sent home as homework, I will provide enough time in class for the assignment to be completed.

This lesson is one that will likely be somewhat easy for Focus Student 2, who is a high-achieving student. However, I have included some questions that require students to think outside of the box in order to help keep this student's attention. Asking questions such as, “What would this diagram look like if the substance were being cooled?” and, “What would be
the opposite of sublimation?" will still stretch students who have already mastered the concept of phase changes and diagrams.

**Assessment**

I will collect the students' bell ringers to gather information on their understanding prior to this learning activity. Students will apply their new knowledge on the phase change diagram worksheet, which I will also collect in order to gauge their understanding after engaging in this learning activity.
What is a phase change?
A phase change is like the moon, you rarely see all of it at one time. So like when it goes from waxing to waning.

At sea level, water freezes at zero degrees Celsius. What temperature does it melt at?
It melts at 112
1. When something changes phases of matter.

2. It

3. Yes
PHASE CHANGE GRAPHS

Use the following diagram to answer questions 1-9.

1. Is heat being added or removed from this substance? Explain how you determined this.
   
   added because the solid is melting and solid has the least energy so you can only go up

2. There are two flat sections in the above graph. What is happening to the temperature during these two time periods? Why is this happening even though a heat source is constantly present?
   
   melting and boiling

   What is happening to the substance during segments a, c, and e?
   
   they are changing phases

4. In what state of matter (phase) is the substance during segment a?
   
   liquid

5. Which segment represents the point where a liquid is turning into a gas? What is this process called?
   
   condensation

6. Which segment represents a time when the substance is all in the liquid phase?
   
   C

7. Which segment represents the point at which a solid is turning into a liquid? What is this process called?
   
   B

8. In what state of matter is the substance during segment e?
   
   solid

9. Imagine this diagram represented the changes that H₂O molecules went through over time. What temperatures would you expect segment b and segment d to be associated with?
   
   0°C (col) segment b, what about segment d?

10. On the diagram above... draw in what the molecules would be like at a, c, and e.
Use the following diagram to answer questions 10-15.

11. Is heat being added or removed from this substance? Explain how you determined this.

12. What is the substance doing between minutes 1 and 3?

13. In what state of matter is the substance during segment a? c? e?

14. Which segment represents the point during which the gas is turning into a liquid? What is this process called?

15. Which segment represents the point during which the liquid is turning into a solid? What is this process called?

16. How long did it take for the substance to condense completely? (From the beginning of the condensation process to the end – don’t start w/ minute 0!).

17. On the diagram above... draw in what the molecules would be like at a, c, and e.

18. Does this chart represent a chemical or physical change? Explain.
PHASE CHANGE GRAPHS

Use the following diagram to answer questions 1-9.

1. Is heat being added or removed from this substance? Explain how you determined this.

2. There are two flat sections in the above graph. What is happening to the temperature during these two time periods? Why is this happening even though a heat source is constantly present?

3. What is happening to the substance during segments a, c, and e?

4. In what state of matter (phase) is the substance during segment a?

5. Which segment represents the point where a liquid is turning into a gas? What is this process called?

6. Which segment represents a time when the substance is all in the liquid phase?

7. Which segment represents the point at which a solid is turning into a liquid? What is this process called?

8. In what state of matter is the substance during segment e?

9. Imagine this diagram represented the changes that H2O molecules went through over time. What temperatures would you expect segment b and segment d to be associated with?

10. On the diagram above... draw in what the molecules would be like at a, c, and e.
Use the following diagram to answer questions 10-15.

11. Is heat being added or removed from this substance? Explain how you determined this.
   - 

12. What is the substance doing between minutes 1 and 3?
   - condensing

13. In what state of matter is the substance during segment a? c? e?
   - Gas, liquid, solid

14. Which segment represents the point during which the gas is turning into a liquid? What is this process called?
   - b, condensation

15. Which segment represents the point during which the liquid is turning into a solid? What is this process called?
   - d, freezing

16. How long did it take for the substance to condense completely? (From the beginning of the condensation process to the end – don’t start w/ minute 0!)
   - 2 min

17. On the diagram above... draw in what the molecules would be like at a, c, and e.

18. Does this chart represent a chemical or physical change? Explain.
   - Chemical because it is changing what it is doing.
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Summary of Artifacts

Artifact 1:

A pre-assessment of students’ knowledge for the upcoming unit. Focus Student 1 was able to answer a couple of the questions, but struggled with the rest. Focus Student 2 was able to easily answer each of the questions correctly.

Artifact 2:

Students were asked to work with a partner to sort cards into matter and non-matter. The front side of the page is the student’s guess, while the back side of the page is their conclusion after the class discussion, as well as their own definition for matter. Focus Student 1 sorted them all correctly on the first try with the exception of two that he sorted under “unsure”. This activity was actually one that made Focus Student 2 think a little bit more, as there were a couple that were not sorted correctly, and one that was put under the “unsure” category. Both of the students were willing to actively participate in the class discussion.

Artifact 3:

This is the summary paragraph that each student had to write individually from their assigned section of reading as well as the paragraph they underlined prior to writing their summary. Both students provided a detailed summary of their paragraphs, and both were able to finish in the allowed amount of time. Focus Student 2 also started reading and writing summaries of the other paragraphs.
Artifact 4:

Artifact four is the worksheet from our “So You Think Particles Can Dance” activity. Both students were able to find songs that accurately matched the molecular behavior of the three assigned states of matter. However, Focus Student 1 struggled with giving a reason why he thought the songs matched the particle motion. Focus Student 2 was able to explain his reasoning.

Artifact 5:

This artifact is a bell ringer that asked the following questions:

1. What is a Phase Change?
2. At sea level water freezes at zero degrees Celsius. What Temperature does it melt at?
3. Is it possible to boil water without heating it?

I used this to introduce the students into phase change diagrams. Most of the students were unsure of the answers, which helped to gain their attention because it made them curious. Focus Student 1 struggled with these questions. He attempted the first two, but didn’t get to the third question. Focus Student 2 correctly answered questions one and three, and was really close with question two.

Artifact 6:

This is the phase change diagram worksheet that followed the lecture after the bell ringer. Students were given the opportunity to apply what they learned. Focus Student 1 struggled with this assignment, but often with assignments such as these he doesn’t turn them in at all so I was impressed that he turned it in completed. Focus Student 2 did well on this
assignment, although he did get a little confused on whether a phase change is a chemical or physical change.
4. Reflection and evaluation of lessons, including analysis of data

Analyze student learning:

The objectives for lesson one included the following:

1. Students will need to analyze the various items given to them, and organize them into three categories - matter, non-matter, and unsure. They will then need to defend their logic. Students will next be asked to evaluate the sorted items to see what they have in common and construct a definition of matter.

2. Students must learn what matter and energy are, and be able to differentiate between examples of matter and energy. They will also be required to learn the four states of matter. Finally, they will need to be familiar with what a molecule is.

Focus Student 1 is the student who has an IEP and struggles with science. I was impressed by how well student one did with this activity. The partner he was paired with helped him a lot, but he was also doing a lot of critical thinking for himself. He was able to defend his reasoning for the sorting of the objects. I asked him and his partner to sort the classroom set of cards on the board. He seemed to take a lot of pride in this, and ever since this activity I have gotten more participation from this student. On his paper, he had sorted everything correctly but had two that were sorted under unsure. However, as the two students sorted the cards on the whiteboard they were also able to correctly sort the two cards they were unsure about. At the conclusion of this activity, Focus Student 1 was able to construct an accurate definition for matter.
Focus Student 2 is a high achieving student, and he was also quite successful with the matter sorting activity. He was a big help to his partner who often has a hard time understanding and staying engaged in class. Focus student 2 did sort fire into the incorrect category originally, and was unsure about where to sort wind. After the class discussion, both items were put in their proper categories. I was glad to see that this activity made student two dig a little deeper. At the conclusion of this activity Focus Student 2 constructed a proper definition of matter.

Lesson 2 objectives:

1. Students will need to understand the reading that they are assigned in order to be able to explain the information to their classmates. They will also then be required to apply what they have read to songs that they are familiar with.

2. Students must learn what kinetic energy is. They also need to remember the definition of matter, and that solid, liquid, gas, and plasma are the four states of matter.

Focus Student 1 was assigned the shortest section of reading. He did well to write a short summary of his reading and included all of the key points. He displayed a firm understanding of the kinetic theory of matter by being able to select songs and explain how those songs related to their corresponding state of matter. However, Focus Student 1 did not complete all of the questions on the music worksheet. I believe this is because students were allowed to pick their own groups, and student one was in a group with his friends. Focus Student 1 has a difficult time focusing and staying on task when he works with these friends. To help remedy this problem, I would assign groups next time.

Focus Student 2 also successfully summarized his assigned section. He was given the longest section to read through and summarize. He included all of the key points from this
paragraph and even started reading and summarizing the other sections in the article. He was able to break down the lengthy section and explain it to his classmates. This student was also able to find and songs to represent the three states of matter, and identify how these songs related to the states of matter. He completed the questions on the worksheet, but there were a couple questions he didn’t seem to read through fully. Next time I teach this lesson, I will read through the five questions with the class so they can better understand what the questions are asking.

Lesson 3 objectives:

1. Students will need to remember the four phases of matter, and how the kinetic theory of matter relates to each phase. They will need to understand what is meant by a phase change and how to interpret phase change diagrams. They will then need to apply this knowledge to an independent practice worksheet.

2. Students must learn what a phase change, and phase change diagram are. Students will learn terms such as freezing point, melting point, boiling point, condensation, sublimation, evaporation, and deposition.

For this lesson, I decided to use a bell ringer to give the students a chance to think outside the box. Focus Student 1 struggled with this assignment. He thought that a phase change was pertaining to the moon, and was confused about the temperature that water melts at. He also was unable to address the third question. I knew that this student would likely have a hard time with these questions, however I think I would still do this part of the activity the same way. I didn’t penalize the students for getting answers wrong, I just wanted them to think a little deeper and give the higher achieving students a chance to be challenged a little. The second
artifact for this lesson was a phase change diagram worksheet. I did direct instruction for this lesson in hopes that it would reduce student confusion. However, Focus Student One still had a difficult time with this assignment. He mostly struggled when the graph went the opposite direction of the example I worked on the board. I did briefly mention how to do the graph that was going the opposite direction, but when I teach this lesson again I will go over the opposite graph in just as much detail as the first. When introducing the assignment next time, I will also go over some of the vocabulary students may run into, such as differentiating between the state of matter the substance is in versus the phase change the matter is undergoing.

Focus Student 2 correctly answered the first and third questions on the bell ringer, and was really close on the second question. I was again glad to see that these questions challenged this student a little. Focus Student 2 did well on the phase change diagram worksheet. He read through each question thoroughly and displayed an understanding of the content taught during this lesson. However, he was a little confused on whether this was a chemical or physical change. I had only briefly covered chemical and physical changes, and did not inform the class if the phase changes were a chemical or physical change. I hadn’t realized this question was included on the assignment. Next time I teach this, I will either remove this question, or wait to teach it after chemical and physical changes have been discussed.

**Analyze teaching effectiveness:**

For the most part I was happy with the results of these lessons. The one thing I did differently than I had originally planned was I changed the demonstration I did before the phase change diagrams. I was originally going to show another example of the arrangement of particles in the three states of matter using marshmallows, but I decided that the students had already mastered this concept. I decided that students needed to watch something new and
unfamiliar to them. In their bell ringer I asked them if it was possible to boil water without heating it. Rather than giving them the answer to this question we tried it in class. I put a beaker of water in a vacuum sealed-container and removed all of the air. In the absence of air pressure the water did in fact boil without adding heat. This gained their attention and showed them how to find an answer to a question.

The activity where students sorted cards into matter and non-matter was very successful. I feel that this is because it was a hands-on activity that included pictures for those who struggled with reading. It was also a low stress activity where we worked together to find the answer. The students had fun doing this, and seemed to grasp the concept.

The phase change diagram activity was not as successful as I had hoped it would be. It was a lot of direct instruction and although I worked through problems on the board, I think I didn’t use enough visual representations for students with auditory processing disorders and reading difficulties. I decided that when I passed back the graded assignment with my comments, I would review the phase change diagrams. Students responded well the comments and to the review and seemed to have a better understanding afterwards.

Students seem to learn best when they have a hands-on activity where they can practice what they are learning, as well as when topics are broken into small increments. In the future I will provide more hands-on activities, and will provide opportunities to practice the content in smaller chunks. I feel that the students will be more successful with the phase change diagrams if the worksheet was more of a guided notes assignment where I teach one piece, and they answer a corresponding question. After doing this they will be better prepared to do a worksheet with phase change diagrams on their own.

In addition, I want to try assigning groups differently in the the future. I usually just assign groups based on where the students are sitting, but I think it would be beneficial to think about
groups the night before a group activity. I plan to look at a list of the students in the class and pick specific students to be in each group based on academic ability as well as how these students work with others. At this point in the school year I have a fairly good idea of which students are friends and can handle working together and staying on task, and those who need to not be allowed to work with friends in their groups. Strategically assigning groups would likely improve student engagement, and help the students who struggle.