I. MATTER:
In this matter unit, our scientists will be exploring matter and three of the phases in which it appears (solid, liquid, and gas). Additionally, our scientists will become particularly familiar with water as it is transformed between said phases. Throughout, we will hone our skills so essential to the scientific practice, including asking questions, making predictions, conducting experiments, as well as collecting and analyzing data.

II. Big Idea/Essential Question:
• What is matter and how do we measure it?
• What are the properties and classifications or states of matter?
• Water (and other matter) can change state by adding or taking away heat (energy).
• (Overarching): How do scientists transform an idea or question into a fact?

III. Learning Goals:
a. CONTENT: This matter unit will be addressing two content standards outlined in the Massachusetts Frameworks for physical science (pg 64):
   2. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.
   3. Describe how water can be changed from one state to another by adding or taking away heat.

   Additionally, this unit builds upon the following Common Core reading standard for informational text (pg 18):
   3. Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

   Finally, students will be asked to apply several mathematical skills listed in the Measurement and Data section of the Common Core standards (pg 41):
   3.MD.2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.
b. **PRACTICE**: My learning goals for this unit go beyond the acquisition of content understanding. In addition to this, I hope that students learn the ways in which scientists think and conduct their practice. As such, there are many scientific habits of mind that I strive to teach throughout this unit:

- Scientists work together to find answers to questions.
- Scientists use a method in order to discern facts from experiments.
- Scientists employ technical language and vocabulary to communicate precisely.
- Scientists search for solutions to authentic, practical, everyday situations.

c. **LITERACY**: These content goals and habits of mind are complemented by a series of language objectives, which emphasize the desired gains for our scientists’ growing literacy:

   - **Writing**: SWBAT sort a written list of items into categories: solid and not-solid; students will create groupings for the items on the not-solid list. (LAP 2) SWBAT develop their written hypothesis and conclusions. (LAP 3)
   - **Listening**: SWBAT listen to several sources (text and video) and distill the properties that make a gas a gas. (LAP 4)
   - **Speaking**: SWBAT explain orally and in writing that adding heat to snow will melt it. (LAP 1) SWBAT orally describe their observations during the experiment. (LAP 3)

d. **COMMUNITY**: This unit encompasses many goals for our classroom community of learners, which will enable us to achieve new heights in the other areas of learning goals (content, practice, and literacy). Students will be tasked with collaborative thinking and experimenting, which will help students to view one another as funds of knowledge and support. To bolster this point, the scientific practice often enables all students to engage and shine, especially those students who are not often recognized in traditional practice. As such, all students will have something to contribute. In fact, they will have to delegate and share the burden of work among given roles; until they have agreed on their roles, they will not be allowed to participate in the experiments. Given this, students will be held accountable on an individual level while still benefiting from the support of their group. As in all subjects, scientists will not be chastised for their mistakes, but instead lauded for their bravery and creativity.
IV. Rationale:

a. All of the unit’s essential questions and big ideas tackle the fundamental content of physical science and practice of science in general. A basic understanding of matter is essential to students’ growth within the field, which they will dabble in throughout the rest of their educational experience. Additionally, an understanding of how scientists transform a question into facts through the scientific method will enable them to flourish in all areas of science. Equally as relevant to the field are the learning goals of this unit. All goals seek to strengthen discipline specific skills so that students are constantly doing the work of scientists. As such, nothing could be more important to the discipline than achieving the goals of scientific collaboration, scientific literacy, and scientific habits of mind listed above. Perhaps less obvious is how these learning goals, essential questions, and big ideas are meaningful students. Matter and mass are bound to be abstract concepts initially, but students will engage quickly with a little enthusiastic teaching and a grounding in concepts they already understand (solid, liquid, and gas). Building upon this prior knowledge will help them to see how relevant and remarkable these concepts can be! Additionally, our experiments, which underpin any scientific process, are bound to engage students and demonstrate how practical and engaging science is.

b. The essential questions and big idea are carefully based on the content and practice standards outlined in the Massachusetts frameworks. As mentioned above, this unit will address the two Matter standards listed in the physical science section of the scope and sequence. We will achieve this primarily through a variety of collaborative experimentation and independent research and reading. The first of these two matter standards matches two of the essential questions of this unit: What is matter and how do we measure it? What are the properties and classifications or states of matter? Additionally, the second standard aligns with a third element, or my single essential question of the unit: Water (and other matter) can change state by adding or taking away heat (energy). In addition to being based on content objectives, my essential question and big idea are influenced by the following guiding principles of the Massachusetts framework: I. All students k-12 will be engaged in science, in that this is a third grade classroom; II. We will build fundamental knowledge of science by engaging with one of the most basic and influential topics of physical science; III. Our science will be closely
linked with mathematics, as demonstrated by the measurement and data standards that we will achieving within this science unit; IV. The initial task of the unit will be unraveling students preconceptions and misconceptions; V. Experimentation or discovery will occur in every lesson of the unit; VI. Literacy goals are an explicit part of every lesson, as made clear by language objectives; VII. All students will be asked to meet a high set of expectations, as outlined in the learning goals section; VIII. Assessment will not only measure student growth but teacher success and required modifications; IX. Successful participation within a group is essential to students’ achievement of the aforementioned expectations.

c. Student interest plays a large role in this unit, particularly in the introductory phases. This means that I will employ a variety of songs, video clips, and demonstrations to pique their innate scientific interests. This will only be reinforced by the strength of their prior knowledge, of which they have plenty, especially in the area of solids, liquids, and gasses. Given this, I am only planning for a single lesson on the states of matter, which will focus more on the properties that define the classification and less on the objects that belong to each category. Despite this prior knowledge, I will remain conscious of their academic abilities when grouping students or providing assessments. In order to provide equitable assessment to all students at every level, I will use the WIDA Can-Do indicators. Furthermore, their performance within the community will inform my groupings. For instance, Cristian will be placed with students he preforms well with and near to the back of the room under Patty’s watchful eye. He will not be placed with Alejandro, Jack, or Eduardo. In general, all students will be placed in groups that will allow them to succeed best academically, so that they are bolstered by stronger students but do not have the discovery elements taken away by students who operate at a faster pace than them.

d. As mentioned above, the needs of the students have been carefully considered in the planning of this unit. Students who interact well socially will be placed in proximity of one another, while others are placed under close observation of the teacher. It is essential, however, that all students participate and engage with their peers. The nature of this discipline allows students to shine who do not often get to do so. As such, we must provide as much opportunity for careful mainstreaming. This applies for academics as
well. Most activities will feature heterogeneous grouping, to ensure that students are able to serve as resources for one another. This academic support will be accompanied by other scaffolds, such as modified worksheets, repeated instructions, and explicit instruction of all domain specific language. As always, students who require quiet spaces or smaller groupings (such as pairs instead of groups of four or five) will be provided with these accommodations.

e. The unit is thoroughly informed by researched best practice, especially those listed in Zemelman and Daniels’ *Best Practice*. These include teacher models, gradual release of responsibility, collaborative work, and safe classroom environments for experimentation and mistakes. These are complemented by Gibbons’ *English Learners Academic Literacy and Thinking*, which provided insights into thoughtful teaching and both formal and informal assessments that comprise this unit. Specifically, Gibbons’ emphasized the need for explicit instruction of academic language, as well as conscious teaching of domain specific vocabulary. Additionally, I pulled from *Subjects Matter* for several activities that are featured in the lessons, including the cloze activity. Furthermore, I looked to Koch’s *Science Methods for Elementary and Middle School Teachers* for domain specific best practice. This includes extended period for inquiry and direct instruction of the scientific process. Lastly, my emphasis on the observation and recording of data is taken from Cameron and Fulton’s *Science Notebooks*. I have also been greatly inspired by the best practice demonstrated by my mentor teacher, who has lent me her methods of classroom management that allow our students to flourish in a space of continuous and consistent support.

V. Assessments:

a. Throughout the unit, students will be informally assessed through their participation and cooperation with fellow scientists during both the lessons’ discussions and activities. With my informal assessment, I hope to monitor my more abstract learning goals; that is, I hope to measure how well my students are contributing to the community of scientists we are as a class. Furthermore, I will be assessing their ability to work collaboratively. Students will be formally assessed through their completion of their various worksheets. These will serve as my formative assessment of the unit, as they will demonstrate to me
in real time how successful my lessons are and what I need to do to make the future lessons of the unit more successful. Our final assessment will be a scientific report, which students will complete in pairs.

b. Students will know the teacher’s standards for the informal assessment of participation and cooperation, as they are the common policy of the class. If behavioral issues arise, I will reiterate explicitly my expectations for their conduct. Should students need reminding, I will state directly why I need their attention and why what we are doing is important. Additionally, more formal methods of assessment will feature explicit directions as well as a teacher model so that they may best meet my expectations. Students who require additional scaffolding or support will be provided with the appropriate materials and accompanying directions and examples.

c. The culminating assessment of this unit is attached below. Students will be required to fill this worksheet out to completion on their own. They will be very familiar with the first page, which will be our worksheets for the entire unit. We will use this scientific method form to compliment all of our experiments. As a scaffold, students will be provided with a model one at first, with later versions requiring more and more student involvement. Given this, students should be very capable at filling the last one out for our Oobleck experiment. In addition to demonstrating their fluency with the scientific method, students will also have to complete a cloze exercise that demonstrates their understanding of the vocabulary. The students will be provided with these exact definitions in writing throughout the unit for their individual study, in addition to each being placed on an anchor chart. For their final assessment, students are provided with a word bank, as I am not interested in their ability to recall or memorize. Instead, I want to test their ability to determine what makes the most sense.

d. Students will receive written feedback from the teachers throughout the unit. I will be sure to give oral feedback to the class when issues that apply to the whole class arise. If I feel it is necessary, I will return to the worksheets with more explicit modeling to reiterate expectations. Finally, students and parents will both be able to see all of the scientific methods that the students produce. While I will not be assigning homework for this unit, students will be encouraged to share their work with their parents and engage in science at home too!
## VI. Unit Calendar:

<table>
<thead>
<tr>
<th>Date</th>
<th>Lesson</th>
<th>Learning Activities and Strategies</th>
<th>Essential question</th>
<th>Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
<td>Prior Knowledge Connection: Water Cycle Meltdown! Discovery project <a href="#">Magic School Bus Video</a></td>
<td>What’s happening when water changes states?</td>
<td>Meltdown Worksheet (f) Discussion (i) Exit slip: <em>What can you add or take away to make water change state?</em> (i)</td>
</tr>
<tr>
<td>TWO</td>
<td></td>
<td>Read aloud Discussion Solid Sorting Activity Not-Solid Sorting Activity Share Out</td>
<td>What is matter? What is a solid?</td>
<td>Discussion (i) Activities and worksheet (f)</td>
</tr>
<tr>
<td>THREE</td>
<td></td>
<td>Review/Discussion Read aloud Experiment Share Out</td>
<td>What is a liquid?</td>
<td>Discussion (i) Worksheet (f)</td>
</tr>
<tr>
<td>FOUR</td>
<td></td>
<td>Discussion Read Aloud <a href="#">Bill Nye: Gas</a> Gas Experiment</td>
<td>What is the gaseous state?</td>
<td>Gas Worksheet (f) Discussion (i)</td>
</tr>
<tr>
<td>FIVE</td>
<td></td>
<td>Unusual Matter Game Oobleck Experiment</td>
<td>What else is there other than the big three?</td>
<td>Unusual Matter Game (i) Scientific Method worksheet (f)</td>
</tr>
</tbody>
</table>
This sequence of activities models the gradual release of responsibility and includes copious amounts of modeling so that the students may achieve the ways of knowing in science and content standards that compose this unit. Students will be supported throughout with high quality examples and clear expectations.

VII. Resources:

a. Parental involvement is not necessary but encouraged throughout the unit by assisting their children at home. This might take the form of conversations or further experiments. I will gladly provide any parents I interact with throughout the day with the details of our work in this unit and any other additional materials that they can employ. I will also recommend and encourage that students talk to their parents about what we are working on in our science, so that they may deepen and enrich their own understanding. Finally, parents are always invited to visit the work of their children, which we will hang proudly in a public space within the school. Parents may monitor their students’ performance through my written feedback on their worksheets, as well as my response on the culminating assignment.

b. I will be drawing mainly on community resources within our own community of learners in the classroom. As mentioned above, students will be encouraged to engage with their parents. Hopefully students will find the work engaging and relevant enough to provoke out of school conversations regarding their successes or frustrations. I have also drawn on many video resources as an academic supplement to the unit; these are reputable and age appropriate sources such as Bill Nye, BrainPop, and Magic School Bus. As such, we will be using the computer and ELMO as instructional technology. Last but certainly not least, I will be leaning on my cooperating teacher to provide one-on-one support to students who require teacher proximity throughout the unit.

c. As mentioned above, all internet resources are both reputable and age appropriate. Additionally, they are known to be factually accurate and are always cited, whenever used.
VIII. Reflection:

a. This unit on matter has been a joy to teach! Each topic proved ripe with opportunities for experimentation and exploration. All students came in with some schema that provided rich ground upon which the rest of the unit flourished. Their understanding over time and their skills as scientists have both solidified into a strong foundation for their future work with matter and other sciences.

i. CONTENT: By the end of this unit, most students demonstrated a clear understanding of both of the scientific content standards at the heart of this unit. In their summative assessments, students correctly employed the main vocabulary of the unit ("solid" and "liquid"). In their use of these words, students demonstrated proficiency in isolating at least one property of a given state. Additional, repeated oral conversations demonstrate their growing comfort with the concept of adding/removing heat to make a substance change state. This was particularly evident in the work of the first two lessons, in which they described both orally and in writing said process. Beyond these scientific standards, this unit also fully achieved the learning goals encapsulated by the Common Core ELA standard that emphasized the use of the scientific method. In all five lessons of the unit, students wrote out a complete scientific method, at first with a worksheet as a scaffold and then with only little prompting by myself. By practicing using the scientific method, all students performed the scientific task of recording technical procedures. Even students that required scribe accommodations were able to participate and access this learning goal of the unit, as I made sure to sit with those students and make sure they produced. Despite all these accomplishments, we did not achieve the mathematical standard, as we did not conduct a lesson on mass as was originally planned. While certainly a related topic, mass concerned me as it’s difference from weight might have confused students and thrown them off track from the scientific concepts at the heart of the unit. PRACTICE: As unfortunate as it is that we did not get to the concept of mass, the class achieved so much in the way of habits of mind or practice standards. The first practice standard (Scientists work together to find answers to questions) was achieved by all in every lesson through group work,
discussions, and game activities. All students also had access to the second practice standard (Scientists use a method in order to discern facts from experiments) in that they all were able to complete the scientific method worksheets, whether completely independently, with the help of a scribe, or with the scaffold of a picture in lieu of words. While not perfectly ubiquitous, the third practice standard (Scientists employ technical language and vocabulary to communicate precisely) was certainly demonstrated by most students in a developing capacity throughout the unit. Lastly, the final practice standard (Scientists search for solutions to authentic, practical, every day situations) was achieved by all students in several way: their participation in the discussion in our first lesson regarding what would happen to the snow outside the window, their group work in the Unusual matter game which required them to think about matter in their own world and homes, and our discussion of steam from neighboring buildings as a gas. LITERACY: I carefully constructed literacy learning goals that were based on the language objectives of each lesson. Given the importance of students reading, writing, listening, and speaking across the disciplines, I was careful to construct objectives for most of these domains. However, I was not as concerned about students reaching the literacy learning goals universally as I was about students reaching my content or practice goals. Instead, I differentiated my expectations. For instance, when students were tasked to write hypothesis and conclusions, I allowed students to draw pictures as a scaffold to their writing. In several cases, I provided a scribe accommodation or permitted students to skip writing entirely and simply draw. I was not striving for all students to achieve the same level of literacy within this unit, because such an expectation would have been unattainable. However, all students were able to engage in at least one of the domains so as to continue their literacy development. COMMUNITY: Lastly, our community learning goals were for the most part achieved. I had hoped that this unit would further our skills at collaboration through group work and explorative experiments. There were many instances in this unit where students worked excellently together, pushing one another and helping one another. However, there is still room to grow on this social front.
ii. The main challenge of this unit came out of our gas lesson. Up to that point, students had demonstrated a firm grasp of the states of matter that we had learned (solids and liquids). I had not anticipated the extent to which gases would prove confusing! I struggled to express the concept of indefinite volume as the defining feature that separated gases and liquids. This was a real failure on my part, as students wrote in their worksheets that a gas was a type of liquid. While students needn’t use the exact terminology to explain what separates a liquid from a solid, I should have provided them with more of a foundation. I’d really hate for them to go into the fourth grade with that misconception under their belt. However, I was unable to return to the concept of gasses given the time constraint of the unit.

iii. I believe I differentiated this unit to the best of my ability, and the student samples support that claim. For instance, I have a paper from Jack for every lesson, in which I either scribed on his behalf or had him draw a picture to demonstrate his understanding. While I do not have complete documentation of Rachel’s and Caroline’s work, they were not present for four out of the five lessons of this unit, as they are pulled out for special education support. All students had the space and ability to express their ideas, and the sentence starters and practice using a single method and worksheet only enhanced everyone’s access to the scientific concepts at hand.

b. Of the many changes I would make to this living document, I would add another lesson on gasses that clearly delineates the difference between liquids and gasses. At that time I would make an explicit anchor chart using the language of “sure amount” and “unsure amount” to get across the concept of indefinite v. definite volumes. This would also require an experiment that emphasized even though both liquids and gases can be poured, only one (liquids) ALWAYS has a definite volume. We would then talk about the air around us, how it takes the shape of its container (like a liquid) but we cannot measure how much there is of it (unlike a liquid). Perhaps we would employ the visual of water in a pool versus air in an empty pool. Other changes would include

1. more anchor charts (at least one a lesson),
2. discussing why the groupings are the way they are and collaboratively concocting new groupings,
3. exploring the practice of measuring something out and what is a negligible difference,
4. being less tense and stop trying to control the room so fiercely,
5. two oobleck lessons, one for generating lists of matter (usual and unusual) and the other for figuring out where oobleck belongs.

With these small changes, I know that the unit will improve and provide even greater and richer learning opportunities to the kids. From this unit, I’m taking away the power of discovery as an enriching learning activity for everyone! Going forward, I want to work on showing my kids how much I enjoy and treasure their hard work.