Hi! My name is Ayesha Qadri and I am a current high school science teacher. I completed my apprentice teaching semester at Austin High School in Spring 2018 where I taught two regular chemistry classes. My certification area is Composite Science 7-12, which includes biology, chemistry, physics, and earth sciences. I have completed the certification requirements through the UTeach program at UT Austin! I graduated with a Bachelor of Science and Arts in Biology in May 2018. To learn more about my student teaching experience, you can visit my student teacher website.

I am proud to say that I currently teach AP/IB Environmental Science this upcoming 2020-2021 school year at Lamar High!! Go Vikings!!

I plan on adding my future maker lessons to this website! Stay tuned!
MORE ABOUT ME & MAKING!

I was born and raised in Chicago, Illinois and grew up in a tight-knit community. When I turned 8, my family and I moved to Texas. Growing up, I have always wanted to become a teacher and got some classroom experience as a PALS mentor in high school.

After deciding to pursue a career in education, I decided to join the UTeach program at UT Austin. After interning with Mathhappens as part of the UTeach internship program for a year, I realized my passion for making and creativity in the classroom.

MAKING IS A LASTING JOURNEY

I plan on using this site to share the making I do during my personal time and making that goes on in my classrooms!
I am excited to say that I have fulfilled the UTeach Maker program requirements and am officially a UTeach Maker Teaching fellow!
Summer Reading Book Club

In summer 2017, both old and continuing makers participated in a book club reading Meaningful Making, a resource to learn about issues prevalent in maker education, projects put on by teachers and makers around the world, and insight into makerspaces and fab labs. Reading this book really made me think about what making meant to me. I did a lot of making before this, but if I was asked to define making, I would not be able to give a response. However, after reading Meaningful Making, I was not only able to define what making meant to me, but also understood the issues of
Week 4 Prompts:

1. In looking at the various projects, what ideas do you have for they types of learning activities you might ask students to engage in during your own Maker lesson?

1. One thing I took away from these articles is that the making aspect of these lessons is so challenging that students think it is hard, but also fun. I liked how in the article "Exploring Circuits: Make Stuff Light Up and Move," the teachers wanted the students to brainstorm first and then materials were provided, similar to normal classroom instructions. However, I think it would be cool if I was to ask students to make anything they would like to make. After that, I would give them a set of materials to choose from and with that, students would have to adjust their ideas to accommodate for the materials provided and to make it science themed. I think this allows for the students' imagination to never end!

2. Select one of the projects to explore in depth and consider ways that it might plug into the content standards for your discipline. This might include state standard such as the TEKS (Links to an external site.), NGSS (Links to an external site.), and standards from NCTM (Links to an external site.).
This was a bit difficult for me because the TEKS for biology are pretty specific to content. I think if I were to take the article "Eighth Graders Design Monuments to Historic Figures" and shift it to a biology teacher's perspective, I would be able to get those students to look up scientists and build something that the scientist discovered or thought they discovered. Then students would peer-review each other's model and provide feedback. The following TEKS this making lesson would touch upon is the following:

- **(3) Scientific processes.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:
- **(D) evaluate the impact of scientific research on society and the environment;**
- **(E) evaluate models according to their limitations in representing biological objects or events; and**
- **(F) research and describe the history of biology and contributions of scientists.**

**Week 6 Prompts:**
1. This is our last week so let's open it up. What did you think about this final section or the book as a whole? What were your big take aways? How did this material connect to your own life/interests?

1. This book was a great introduction for people like me who did not know much about making and what tools were out there/are used for making. This final section opened it up to how teachers who had access to makerspaces and had their students do a making lesson were able to solve problems, start from scratch, make something for themselves, their classroom, and/or schools. Museums also have implemented makerspaces and began to offer the public more than just the exhibits. From this, some of my big take aways are that making can be anything, you just have to think of something you want to make and figure out how it can be done. Second, there are plenty of resources, such as books, videos, real people that can provide help and offer ideas to help you with your maker project. Third, making always involves something that you are passionate about, something that you and other can benefit from, and something that can always be adjusted to be better than what it already is! This is how it has connected with other interests; it's a work in progress.
THE MAKER MOVEMENT AND MAKER EDUCATION

In our education system, we are taught to be as creative and innovative as we possibly can. However, this type of teaching style somehow for some reason is less and less encouraged and emphasized as we are promoted from one grade to another. The Maker movement, which is based on the constructionist and constructivist principles of Seymour Papert and Jean Piaget, is the solution to maintain and excel the innovative and creative minds that progress through the education system and that will one day go out in the real world equipped with the necessary tools needed to succeed. The maker education movement emphasizes design thinking and media literacy and focuses on students taking control of their time in the classroom through inquiry based learning. Students deal with real-world problems and engage in project-based activities not as an end product, but as the vehicle for learning. Students are given the opportunity to work in groups, establish roles within those groups, become comfortable with multi-disciplinary problems, learn and master different technologies, and convey their knowledge to their community. This allows students more agency and the opportunity to impress the teacher with their talents and strengths. I believe if teachers are able to incorporate maker ideas and practices within the classroom, they are preparing their students to go out in the world and be confident in what they can do to bring about changes that are necessary in society. Maker education is not an alternative way of teaching; I believe it is the way we as educators should educate. It is difficult, but one of the most important aspects of maker education is the idea of collaboration. If educators work together to help students become active learners, then teaching students in a constructive manner becomes much easier.

EQUITY, DIVERSITY, & ACCESS IN MAKING

It would be grand if every student had access to a makerspace, wouldn't it? However, we all know that unfortunately this is far from the truth. In maker education, students of all backgrounds do not have equal access to the tools necessary to make. For an example, the maker lesson I implemented in my chemistry class had students design a soap dish for the soap bar they had made.
However, to have a physical soap dish, students would work with digital fabrication and laser cut their soap dish design. Well, the school does not have a laser cutter so I gave my students the option of coming to UT and laser cutting it there. It would be great if students were able to access a laser cutter right at their school or near the school, but issues of equity also arose in which not all of my students had the transportation to come and meet me at UT to do so. As a result, having first hand experience with these challenges really made me think about the disparity and inequality facing making in the classroom.

http://sde.ok.gov/sde/equity-plan

**Personal Definition of Making:**

To me, making means transforming an idea or a thought into reality by producing it and using it to benefit those around you.
"Vulnerability is the birthplace of innovation, creativity, and change." - Brene Brown
I think I have had the coolest internship ever with the UTeach program!! I interned with MathHappens, a non-profit organization co-founded by Lauren Siegel and her husband, Phil Siegel, for a year. During this year, I learned how to use a laser cutter and then laser cut many math-based projects, some that I have shared and discussed here! MakeATX, a laser cutting place, was where I cut all the projects. MathHappens had a membership with the owners of the makerspace, which fortunately eliminated any issues of access. Each laser cutting project had its own challenges, the most prevalent one being unable to get the proper size of the design cut and setting the raster and vector speeds correctly the first time. Using this high-power tool has taught me how to be creative when designing different math tools, accurate at setting the speeds for efficient cutting, patient with the software being used (Corel Draw) and most importantly, understanding that I am not going to get it right the first time. This helped me realize the importance and effectiveness of iterations and re-designing prototypes, something I had to do for every single one of my projects!

There are many issues of equity and access when it comes to laser cutting. MakeATX was the only location where the other interns and I went to cut out our projects! If we were to use another tool to produce our projects, there would have to be a few adjustments and modifications to do so.
To become certified to teach geology, I had to take two geology course, one of which was gems and gem minerals. During this course, my awesome professor, Dr. Helper, taught us about gems and different minerals gems were made of. For our semester project, students had to facet a quartz gem! Using the faceting machine pictured below and different laps to polish and facet the quartz gem, I ended up with the finished product, a clear quartz gem. This project took a lot of patience and a month to complete. One of the biggest challenges I faced was not being able to remove all the scratches from my gem. My gem still has some scratches which can only be seen with a magnifying glass. Unfortunately, I did not have the opportunity to make facet another gem, although Dr. Helper was super cool and let us do so! I got to choose the type of cut I wanted on my gem, which made the gem more personal to me. However, if I was to facet another gem, it would be the pear cut on a sapphire gem. The problems I would run into would be getting the materials and equipment for this project, which are very expensive.

The design process included following a set of directions to facet each part of the gem such as the table, crown, girdle, and pavilion. To begin, I was given a quartz gem dopped onto a dop stick with a coating of shellac. I followed the instructions to facet the gem and started faceting the crown main facets. For each cut, it was important to ensure that the index on the faceting machine and the protractor were correct and the facets were of equal size. Four different laps were used during the project. To make the cuts on the gem, a medium lap was used. This basically shaped the gem based on the size and angle I needed. A fine and extra fine lap were used to slightly re-cut parts of the gem, such as the table, and to remove any scratches from the medium lap. Water from the faceting machine is used to help this process. The last task for each part of the gem was to polish it. The polishing lap containing cerium oxide was used on the motionless lap. Polishing the gem was the most difficult part of the project and required a lot of back and forth on the lap! Some of the procedures I followed for the project are below!
MATHHAPPENS PROJECTS!

The following slideshow shows pictures of some of my work and work of other interns, Lauren, and I all collaborated on to produce. All the math objects were laser cut at MakeATX, except for the stereographic projection!
Feel free to visit MathHappens' blog, a documentation of all the work the non-profit organization accomplishes every month! To see more of what former (including myself) and current interns have accomplished with Lauren Siegel, press the button above:)

https://ayeshaquteachmaker.weebly.com/maker-projects.html
MAKERS...AND MORE MAKERS!!!

THE MAKER COMMUNITY
Having a maker community has helped me in many ways. I have learned so much from my maker mentor, Lauren Siegel, my maker peers, and my UTeach professors involved with making. The maker community has helped me define what making is and motivate me to explore different technologies that I would normally not do. Sharing ideas with others and learning from their designs has really helped me think deeper into how unique making is for each person. Moreover, being a part of the maker cohort with other UTeach makers, attending cohort meetings, learning about makerspaces and what they have to offer, and participating in design
During my first year with the UTeach maker program, I was interning for a non-profit organization co-founded by my maker mentor, Lauren Siegel. Lauren was working with a high school math teacher in the Austin area to design a math field trip about math related to Alice in Wonderland, which was successfully implemented at the Harry Ransom Center! Two of the teacher's students wanted to come and make a giant sized coin and paper. Lewis Carroll was known to amuse people with his famous coin trick challenge. I met up with the two seniors at MakeATX, a lasercutting workshop, and showed them how to use the laser cutting machine and helped them design their giant-sized coin and paper. Some issues with the design was that the dimensions were off and the coin and paper had to be the correct dimensions in order for the trick to work! After converting units and modifying the design a couple of times, the high schoolers were able to get a giant-sized coin and paper for the coin trick! This was a great way to teach and support high school students in a small maker project with big lessons!

HELIUM BALLOON DESIGN CHALLENGE
This helium balloon airship design challenge took place at the Ann Richard's Makerspace. My maker mentor, Lauren Siegel, peer Payton Crawley, and I were trying to design an airship with tape, helium-filled balloons, string, and toy pieces such as quadcopters. The hardest part was getting the proper buoyancy and balance so that our airship would actually move through the air and stay in the air when propelled to do so. Although our airship design resulted in a product that only last three seconds in the air, I learned a lot from this challenging experience! Doing this challenge in a group brought about more ideas, such as when Lauren decided to use a stereographic projection to ensure our design had a balance. We also got to see other groups and their designs, which included one group that used remote controllers and toy mouse!
At our last cohort meeting of the semester, makers were challenged to learn how to use micro bits and then design a functioning inchworm. This was a challenge for me, especially because I was not comfortable using the technology. However, after the two hours went by and I brainstormed ideas with my group members and tried things out, we had a semi-functioning inchworm! Our design including using two micro bits, cardboard, and lots of tape!
I had the cool opportunity to participate in the UTeach summer conference with MathHappens. We shared two highly successful projects with others, the Austin Nature and Science Center calipers and golden ratio exhibit established by MathHappens and the La Belle field trip (which was a huge success) at the Bob Bullock Museum. We all had lots of fun talking to teachers from around the country and sharing some of our work and reflections of it with those who were passionate about making! Our visitors really liked how MathHappens was able to create a math field trip focusing on nautical mathematics for an exhibit at a history museum.
LA BELLE FIELD TRIP

Overview. This La Belle field trip was held in May 2017 at the Bob Bullock Museum. The field trip created for 75 7th graders focused on the navigation tools used in the era of the La Belle that were created by mathematicians. This field trip was without doubt a team effort. Each intern during this semester was assigned a project to complete for the field trip. Lauren challenged us to "create activities that would display and explain the navigation instruments..."
MAKERSHIP: Let's make some soap! I assembled a parallel ruler to take home as part of one of the stations of the field trip. Students really enjoyed this making opportunity and Ashley Cauich, the intern who designed the parallel rulers and headed the station, had lots of fun as well.

Reflection. If I was told that I would be part of a team that put on a math field trip my freshmen year, I would probably laugh for a good five minutes. This is because I did not know about making. The best part of it is that you can learn how to do all these cool things if you are passionate about what you want to do, have the resources, and have others to bounce around ideas. I had to research a lot and read excerpts from math books I never thought I would ever read, but that was another outcome of working on this field trip that really stuck with me. I really appreciated being a part of making this field trip happen and had a blast showing kids how the nocturnal worked!! It was SO FUN!
1. Describe the maker lesson.

This lesson was implemented in both of my chemistry inclusion classes during this apprentice teaching semester. Because my students did not make anything throughout the school year in the chemistry class, this lesson was an introduction to making that came with two critical components: students making a bar of soap and designing a soap dish. The maker project took five days to complete. Day one was the introduction to what making is and maker education. I talked to students about my maker journey and asked students to share things they have made or are making in a class. For day two, students made their first round of soap bars using olive oil. After realizing that olive oil does not harden as fast as needed, day three had students learn from day two and make their second soap bar, this time using coconut oil. Students had the opportunity to add scents, color, and use a mold to make their soap bar personal to them. On day four, students used an online software editor, Method Draw, to modify templates of soap dishes and to create their own design if they were ambitious and determined. At the end of the day, students reflected on what they learned so far in the project and prepared to present and talk about their soap bar and holder for next class. On day five, students participated in a gallery walk in which they presented to other classmates and members of the UTeach community, including a University facilitator, some of the UTeach professors, a former UTeach graduate and maker, and my maker mentor. This allowed students to realize the importance of their hard work, share it with their classmates and members of the larger community, and reflect on it. Students then turned in a foldable documenting they learned and how it can be used to help them with other projects/ideas in
sitting in a study room on campus watching cool chemistry experiments when another video on the side about saponification popped up and caught my eyes. I then clicked on it and watched a couple more after I realized that I totally wanted my students to make soap. Moreover, in order for students to have something to hold their soap, I wanted students to design their own soap dish. I then contacted Shelly Rodriguez and Jason Harron, UTeach Maker program coordinators and spoke with them about my scattered ideas. Shelly, Jason, and I then met one morning at Kerbey Lane during which I communicated my ideas, got feedback on my ideas for my soap lesson, and had a rough, multi-day overview of my project. I was debating whether or not the project would be four or five days. I initially wanted each student to laser cut their soap dish. The school I student taught at did not have a laser cutting machine. Because of limited access to materials and equity issues, I decided I would cut 42 students’ soap dish design on my own and bring it back to the school. Realizing that this would be infeasible due to time constraints, I gave my students the option that if they were very interested, they can come to UT and laser cut their soap dish design. Also, after incorporating a day for the gallery walk where students presented their work and shared their project with others, the project was planned to take five days.
Prep: Preparing all the lab stations to make sure each student has each equipment needed.

Prep: Heating up the coconut oil for students.

Students' first soap bar using olive oil (notice that some of them did not harden).

This students' second soap bar included three different colors and the Macintosh apple scent!

A students' work using one of the molds provided!
Reflection

This project was my first maker lesson project I ever implemented and I think for a first, it went well. Students were interested from day one when asked my their personal making experiences in their life or in the other classes. Students then made soap for two whole class periods and learned from day of soap making that olive oil was not such a good oil to use for making soap. For day three and the second round of soap making, every students except two chose to make their second soap using coconut oil. The realized that coconut oil compared to olive oil thickens faster, which will minimize the time it will take to heat their oil and lye-water solution, which means a faster soap making process as a whole. Students then liked the idea that I wanted for them to make the soap more personal to them and enjoyed the variety of colors and fragrance. Although the room stinked for a week, it did for a good reason. Students then had the
Revisions

Making the soap dish design with the software was very structured and was a bit less creative. If students were given more time to work with the software, I would not have had students use the templates. Using the templates helped students give a background of the software and the designs that could be made, which destroys the personal aspect of it as well as the creativity. However, students were able to modify the design, add images and colors, which helped make it more meaningful to them. Of course there were also other areas where I could and would improve on for next time. For future implementations, I would have students bring something in that they made and share it with the class on day one of the project when we talked about making. I would also do this project after we discussed acids and bases. Many students were confused over the difference between the two, which became evident during their presentations. The soap making aspect of the project went well, but I would change it to where students had to use more than one oil the second round and determine the difference in their soap properties after both days of soap making. Students would still be given the opportunity to use the same additives and maybe even be able to bring some of their own additives if they wished! For the gallery walk, I would invite other science teachers to come and have a look around at my students' work. This would allow teachers to talk to students they don't have as students and for students to share their project with another science teacher, someone they may have or have had or heard a lot of cool things about in the past!

All the lesson materials I used and created can be viewed and downloaded at the button below!
experience, and their research on pH! Students presented this information to me in a foldable in which students had to draw what each flap represented in the inside and write about it on the bottom flap. I got to see what my students learned, what they did not quite understand (very high pH and very low pH are both dangerous), and the artistic abilities of my students! I noticed a lot of doodling and art on my students' former assignments. To make this project more meaningful to those students, I had every student draw me what each flap meant. I also walked around during the gallery walk and talked to some students about their soap project. I learned a lot about what to modify for future implementations and more about my students!
STUDENT REFLECTIONS

Students were asked to reflect on their first soap bar to better their second bar of soap they would be making the next day. Students also had to reflect on their soap dish design and talk about the challenges that came with designing that.

1. What modifications or changes would you make to the soap-making process if you tried it again?
   
   Be more patient with mixing.

2. What potential errors were made during the lab that could’ve changed the way your soap turned out?
   
   I don’t think I mixed the soap that well.

3. What modifications or changes would you make to the soap-making process if you tried it again?
   
   To take my time and heat it up more to make it thicken up.

4. What potential errors were made during the lab that could’ve changed the way your soap turned out?
   
   That we first used olive oil that was an mistake because it doesn’t thicken up. It was a learning experience through.

5. How do you think your soap bar with different properties?
   
   So it can be unique.

6. How do you think your soap bar with different properties?
   
   So it can be unique.

7. What did you learn today? How can you use those design skills to create something you are passionate about?
   
   Some things to think about when designing your soap dish:
   - Unusual (long, wide, some on all sides)
   - Shaped (rectangle, non-regular, bowl, layers, etc.)
   - Make sure it has your name on it.

QUESTIONS:
1. What are some challenges you faced designing your soap dish today?
   - Trying to get the materials.
   - In the middle of the bars, then realized I didn’t put it in the same.
   - How did you overcome these challenges?
   - I figured it out, just make warm an

NICE!! X & Y coordinate for each shaped
Then potted it with the same.

We design in your book, you made and having a learning experience through.

We design in your book, you made and having a learning experience through.
The following three resources are those referred by the UTeach Maker program that have really helped me get creative with making, learn more about it, and to appreciate the resources out there and the willingness of makers to share their powerful work with others.

Agency By Design
Invent to Learn
Meaningful Making
Making Your Own Soap-Part 1

Introduction

The process of making soap is called *saponification* and is one of the earliest examples of using organic chemistry to produce a man-made product. Saponification involves the reaction of natural fats and oils, called *triglycerides* (see figure 1), with sodium hydroxide (NaOH).

![Figure 1. Structure of a Triglyceride](image)

The products of a saponification reaction are sodium or potassium salts of fatty acids and glycerol (Equation 1).

![Equation 1](image)

All soap molecules have two basic features in common. One end of the molecule is usually a long, nonpolar hydrocarbon chain, resembling a “tail.” The hydrocarbon tail is said to be *hydrophobic* (water-fearing) because it tends to repel or exclude water and will not dissolve in water. The other end of the molecule is a small ionic or polar group that is *hydrophilic* (water-loving). The hydrophilic group will tend to be surrounded by water molecules and will dissolve in water. These two competing structural features give soaps the unique properties that allow it to clean dirt and grease and protect us from germs and diseases.

When dissolved in water, soaps molecules spontaneously self-associate to form spherical aggregates called *micelles* (see Figure 2).
The nonpolar hydrocarbon tails in the soap molecules spontaneously arrange themselves toward the interior of the micelle, giving it a hydrophobic core that repels and thus excludes water. The ionic head groups are arranged on the outside surface of the micelle and are surrounded by water molecules. The ability of soap molecules to form micelles explains how and why soaps work.

Dirt and grease are nonpolar, hydrophobic substances that are not soluble in water. If water alone were used for washing or cleaning, the hydrophobic dirt and grease molecules would not dissolve in the water. In soapy water, however, dirt and grease molecules become trapped or suspended within the hydrophobic core of a micelle. The soap thus disperses or breaks up the dirt particles and dissolves them in the water. The dirt-containing micelles are water-soluble and are rinsed away in the wash. This is also how we rid our bodies of harmful germs to lead to infections and diseases.

*Note: we are not killing the germs, we are simply washing them off our bodies.

**Materials**

- Olive Oil
- Lye (NaOH)
- Water, distilled
- Balance, 0.1g precision
- Beakers, 50-mL and 250-mL
- Hot Plate
- pH paper
- Pipet, disposable
- Spatula, metal
- Stirring rod
- Weighing dishes, 2
- Thermometer

**Safety Precautions**

*Sodium hydroxide solution causes severe skin burns and eye damage.*

*Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron.*

*Notify the instructor and clean up all spills immediately.*

*Avoid contact of all chemicals with eyes and skin.*
Do not taste or ingest any material in the lab and do not remove any remaining items used in the lab. Wash hands thoroughly with soap and water before leaving the laboratory.

**Preparation of Soap**

1. Working individually at your lab station, measure out about 11.24 mL of DI water in the smaller of the two beakers. Use the graduated cylinder.

2. Zero out the weighing dish on the balance again. Wearing gloves, measure 3.65 grams of lye (NaOH) into a weighing dish.

3. Proceed to the FUME HOOD. Carefully add the lye to the smaller beaker under the fume hood. DO NOT do it the other way around.

4. Stir while you add the lye into the water and continue stirring for about 5 minutes. Once the solution is clear, you may proceed to the next step. MAKE SURE the solution is clear before moving to step 5.

5. Bring back the small beaker to your lab station. Add 29.57 mL of olive oil into the bigger beaker. Use your graduated cylinder to measure.

6. Place the beaker on a hot plate at the lowest setting (40 °C). Heat the olive oil in the beaker until the temperature ranges from 40–45 °C. Get your thermometer in the beaker.

7. Carefully remove the beaker from the hot plate using beaker tongs when the temperature reaches 40–45 °C. **Note:** Do not allow temperature to exceed 45 °C, monitor the temperature frequently with a thermometer. If necessary, remove the beaker periodically from the hot plate to cool, and continue stirring.

8. When both beakers are about the same temperature (no more than 45°C), add the lye-water solution to the larger beaker.

9. Continue stirring until the soap mixture gets thick—the product is ready to be heated again at a low setting. Use a glass dish to place on top of your big beaker to contain the heat.

10. When the soap that drips back into the beaker from the stirring rod traces a path (leaves a mark) on the surface of the soap, the soap is ready to pour.

11. Carefully pour the thickened soap solution from the beaker into one of the molds. Gently tap the mold on the table to evenly distribute the soap in the dish.

11. Allow the soap in the molds to dry until next class day. Initial the mold.
Conclusion Questions

*Turn this part of the lab in to be graded!

1. What does your soap look like? List 3 properties (color, appearance, texture):
   a) __________________________________________
   b) __________________________________________
   c) __________________________________________

2. What are the different kinds of soaps that you have used in your life? List two.
   a) _________________________ b)___________________________

3. What are some items you can add to your soap to change its properties?
   _______________________________________________________

4. Why would you want soaps with different properties?
   _______________________________________________________

5. What modifications or changes would you make to the soap-making process if you tried it again?

6. What potential errors were made during the lab that could’ve changed the way your soap turned out?
Let’s Make Soap – A Single Point Rubric

The goal of this project is to use chemical principles to create an original product that is functional and allows you to express your creativity. The rubric highlights important project elements and focuses on the process of ‘making’ soap as well as science content. You can use this rubric to guide and reflect on your work.

<table>
<thead>
<tr>
<th>Concerns</th>
<th>Criteria</th>
<th>Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Areas that Need Work</strong></td>
<td><strong>Personal Relevance</strong></td>
<td><strong>Areas Going Over and Above</strong></td>
</tr>
<tr>
<td>You create an original product and can describe its connection to your outside values or interests</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Iterative Design and Fabrication</strong></td>
<td>You provide evidence of the evolution of the creation including brainstorming notes, drawings, and/or prototypes</td>
<td></td>
</tr>
<tr>
<td><strong>Collaboration and Community</strong></td>
<td>You collaborate and connect with others to get design ideas, solicit feedback, or make improvements</td>
<td></td>
</tr>
<tr>
<td><strong>Sharing Work</strong></td>
<td>Products are presented publicly and you are able to clearly share ideas about your process and product with others</td>
<td></td>
</tr>
<tr>
<td><strong>Maker Mindset</strong></td>
<td>Habits of a maker mindset including persistence, reflection, and adaptability are demonstrated throughout the project</td>
<td></td>
</tr>
<tr>
<td><strong>Content Connection</strong></td>
<td>You are able to:</td>
<td></td>
</tr>
<tr>
<td><strong>Describe the pH scale, including the relationship between H+ and OH- ions, and</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discuss its application to the soap making process</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Identify polar and non-polar regions of soap molecules and</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Explain how this structure enables soap to function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Content Connection</strong></td>
<td>You are able to:</td>
<td></td>
</tr>
<tr>
<td><strong>Discuss how the transfer of energy takes place in soap making process, including both heat transfer and chemical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy used in the bonding process</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Introduction to Making!!

“Without the opportunity to learn through the hands of making, the world remains abstract, and distant, and the passions for learning will not be engaged” - Critical Making, UC Berkeley
Watching Making in Action
Maker Faire Austin 2017

Video:
https://www.youtube.com/watch?v=DF3rLZP-3Ng
What is Making??

"Making is an iterative process of tinkering and problem solving that draws on a DIY mindset. Making is collaborative and allows for self-expression through the creation of a personally meaningful artifact that is shared with a larger community.” - UTeach Maker Advisory Group, 2016
What does Making mean to you?

1. Write down a sentence, words, or phrases that come into your mind when you hear the word making.
2. Have you done any making in your life? If so, what did you make?
3. Share your thoughts with your partner.
4. Be ready to share with the class as well.
My Maker Journey
Math Happens

- Non-profit organization
- Dedicated to increasing math literacy in the community and beyond!
- Laser cutting
- Math Field Trips
Laser Cutting!!

https://www.youtube.com/watch?v=07eSudYY6hc
Fibonacci numbers which approach phi, the Golden Ratio which is an irrational number: \(1/2 + \sqrt{5}/2\).
Austin Nature & Science Center
Summer 2016

- Calipers
- Fibonacci
Cool things I got to do!
Faceting a Quartz Gem!
“Making is practicing and building upon your knowledge by taking your curiosity a step further and reinforcing it into something tangible. Making is what humans can do best, and that is the legacy we leave behind. To me, making means transforming an idea or a thought into reality by producing it and using it to benefit those around you.”
Introduction to Saponification
What is soap?

If oil is added to water, the two liquids do not mix.

Because of this, grease stains can be difficult to remove during washing.

Soaps are compounds which act as emulsifiers.

This means that they help the oil to mix with the water.

Detergents, Bile salts, also emulsify fats.
Saponification

acid (oil) + base (lye) = salt (soap)
How are soaps made?

Soaps are usually made from vegetable fats and oils. These consist of 3 fatty acid chains, held together by a glycerol molecule.

The reaction used to make soap from fats and oils is called saponification.
Saponification Reaction

Heat accelerates the reaction speed.

http://en.wikipedia.org/wiki/Saponification
How does Soap Work?

Modifications

- **Potassium salts** – yields softer lather
- **Air bubbles added to molten soap** – low density (floats)
- **Long fatty acid derived soaps** are harder and more insoluble in water
- **Short fatty acid derived soaps** irritate the skin and smell unpleasant!
- **GET CREATIVE!**

http://www.elmhurst.edu/~chm/vchembook/554soap.html
More Mods: Soapless Detergents

Soapless detergents can be made from crude oil, rather than vegetable oils or animal fats.

Soapless detergents are still made of long, hydrophobic carbon chains, but the hydrophilic end of the molecule is a sulfonate:

\[
\text{sodium octadecylsulfonate}
\]

hydrophobic end interacts with oil molecules  
hydrophilic end interacts with water molecules
Soaps vs. soapless detergents

What are the advantages and disadvantages of soapless detergents over soaps?

- Soaps form a scum with hard water, meaning that it is more difficult to produce a lather. Soapless detergents react with the substances in hard water to form soluble compounds, and so do not form a scum.

- Soapless detergents can be made from the by-products of the oil refining process, so can be cheaper to produce than soaps.

- Some soapless detergents are not biodegradable. This means that they stay in the water system causing froth in rivers and streams.
Next Time...

- Making our soap
  - Coconut oil
  - Olive oil
  - Sunflower oil
  - Vegetable oil
  - Fragrance oils
  - Color!!
Fill this out as you move around the classroom and discuss the soap project with a classmate. You must fill out the following 3 questions for each classmate you talk to. Check the project rubric to determine how many classmates you need to visit to get the score you would like on the project. A minimum of 3 classmates is required.

Classmate’s Name:

1. What are some challenges or obstacles your classmate came across during this project?

2. What is unique about your classmate’s soap bar and soap dish design? Any similarities with your bar and soap dish design?

3. What are some things your classmate learned from this project? How has it helped him/her?
Designing your Customized Soap Dish :) 

Instructions: Congratulations on making your soap bar!! The goal of today’s activity is to design a soap dish that is capable of holding your soap. If interested, you will have the opportunity to laser cut your soap dish out of acrylic!

➢ You will be working with soap dish templates. Modify the template and add or remove parts of it to make the soap dish unique to you.
➢ Download the templates from BLEND.
➢ Upload the templates to the software “Method Draw”: editor.method.ac.
➢ Find a cool pattern to add to your soap dish at https://dxf1.com/.

Some things to think about when designing your soap dish:
• Dimensions (long, wide, same on all sides, etc)
• Shapes (rectangular, box-shaped, holes, layers, etc)
• Text (“SOAP,” “YOUR NAME,” etc)
• Be creative :)

QUESTIONS:

1. What are some challenges you faced designing your soap dish today?

2. How did you overcome those challenges?
3. What did you learn today? How can you use these designing skills to benefit you in other classes and/or your personal life?
<table>
<thead>
<tr>
<th><strong>Grade Level and Subject:</strong></th>
<th>10th grade GL Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of Teacher:</strong></td>
<td>Ayesha Qadri</td>
</tr>
<tr>
<td><strong>Length of Lesson:</strong></td>
<td>5 block schedule class periods-</td>
</tr>
<tr>
<td>Day 1: Introduction to making (90 mins)</td>
<td></td>
</tr>
<tr>
<td>Day 2: Soap Making (90 mins)</td>
<td></td>
</tr>
<tr>
<td>Day 3: Second Soap Bar (90 mins)</td>
<td></td>
</tr>
<tr>
<td>Day 4: Designing Soap Dish (90 mins)</td>
<td></td>
</tr>
<tr>
<td>Day 5: Gallery walk (90 mins)</td>
<td></td>
</tr>
<tr>
<td><strong>Title of Lesson:</strong></td>
<td>Let’s Make Some Soap</td>
</tr>
</tbody>
</table>

**Main Idea of the Lesson:**
This main idea of the lesson was to introduce students to making and encourage them to take on a five-day maker lesson in their chemistry classroom. This lesson strongly connects with the concept of producing a tangible product in a chemistry class using skills such as observations, trial-and-error, peer feedback, and basic knowledge of the saponification process, and acids and bases.

**State or National Standards for Lesson:**

**Texas Essential Knowledge and Skills (TEKS)**
Chemistry (c) 2. (E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology, including graphing calculators, computers and probes, sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, safety goggles, and burettes, electronic balances, and an adequate supply of consumable chemicals; (G) define acids and bases...

**Next Generation Science Standards (NGSS)**
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
## Objective/s - Write objective/s in SWBAT form...

**The SWBAT:**
- Apply the saponification equation in lab and create soap from hypothetical procedures
- Explain the process of saponification
- Describe the pH scale, including the relationship between H+ and OH- ions and application to the soap making process
- Identify a product for each pH on the pH scale
- Identify polar and non-polar regions of soap molecules and explain how this structure enables soap to function
- Measure pH of soap and determine soap’s safe use
- Discuss how the transfer of energy takes place in the soap making process, including both heat transfer and chemical energy used in the bonding process
- Produce a second bar of soap after day one feedback
- Design a soap dish using an online software
- Present and share outcomes and products through a gallery walk

## Evaluation

In the space below, write at least one question to match the objective you listed or describe what you will look at to be sure that students can do this.

- What is the general equation of saponification?
- What acid was used for your soap project? Base?
- Compare and contrast polar and non-polar regions of soap molecules.
- What was the pH of your soap? Is your soap safe to use?
- What process did you use to make your soap?
- What types of energy transfer occurred during the process?
- What additives did you add? Why?
- How can you use the designing aspect of this lesson in other classes? Personal life?
### Engagement: Estimated Time: 90 mins

**Description of Activity:**
The teacher introduces the concept of *making*, identifies herself as a maker, and asks students to share examples of their own past creations. The teacher then provides students with basic information about the saponification process and its application in soap making. The students explore properties of the materials and tools they will be using. Students are presented with a rubric to guide their work. This rubric emphasizes the process of making as well as relevant science content.

<table>
<thead>
<tr>
<th>What the teacher does:</th>
<th>What the student does:</th>
<th>Possible questions to ask students – think like a student and consider possible student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher introduces what making is to students and plays a video of a local Maker Faire. <a href="https://vimeo.com/111461414">https://vimeo.com/111461414</a></td>
<td>Students watch and learn making and try to relate to it.</td>
<td>Have you heard of the maker movement? Share your thoughts/ideas with your partner.</td>
</tr>
<tr>
<td>The teacher mentions some history about making and the growing importance of it in education.</td>
<td>Students share thought with each other and ask questions about the maker movement to the class.</td>
<td>Are there any classes/activities/hobbies you are a part of that involve making?</td>
</tr>
<tr>
<td>The teacher asks students about their making history after sharing her journey in making.</td>
<td>Students take note of the chemical reaction of soap and what ingredients they will be using to make soap while watching the soap making video.</td>
<td>What did you like about the making experience you had? How did it challenge you and what did you learn from that?</td>
</tr>
<tr>
<td>Classroom Management Tip: The teacher walks around as students think-pair-share about their own making experiences.</td>
<td>Students begin to think of their soap recipe.</td>
<td>Discuss the polar and non-polar regions of soap molecules and explain how this structure enables soap to function.</td>
</tr>
<tr>
<td>The teacher introduces saponification by showing a short video at <a href="https://www.youtube.com/watch?v=wTuRmwSkuzQ">https://www.youtube.com/watch?v=wTuRmwSkuzQ</a> and gets students to understand the reactants and products of the chemical reaction. This video also compares and contrasts polar and non-polar regions of soap molecules with visual and auditory explanations.</td>
<td></td>
<td>What is the general equation of saponification?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What basic ingredients are needed to make soap?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How will you make your soap?</td>
</tr>
</tbody>
</table>
The teacher encourages students to make their own soap recipe for next class.

The teacher reminds students of the project overview and the rubric students will be graded with at the end.

**Maker Elements:**
Maker Mindset: Habits of a maker mindset including persistence, reflection, and adaptability are demonstrated throughout the project.

**Resources:**
Maker Faire Video [https://vimeo.com/111461414](https://vimeo.com/111461414)
Soap Making Introduction [https://www.youtube.com/watch?v=wTuRmwSkuzQ](https://www.youtube.com/watch?v=wTuRmwSkuzQ)
Let’s Make Soap Grading rubric
**Exploration:** Estimated Time: **90 mins**

**Overview of Activity:**
Students select from a variety of materials to fabricate and personalize their soap using a variety of bases, oils, molds, and fragrances. Students are allowed to work collaboratively. The teacher encourages safe practices while using laboratory tools. Students are encouraged to seek feedback from others throughout the making process. Students engage in multiple iterations of soap making to refine their process and product. Students use a foldable to document observations from each round and write reflections.

<table>
<thead>
<tr>
<th>What the teacher does:</th>
<th>What the student does:</th>
<th>Possible questions to ask students – think like a student and consider possible student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom Management Tip: The teacher prepares the lab in advance and assures each student has all the necessary materials (does take time). The teacher reviews the ingredients, lab safety, and possible errors students can make in the lab. The teacher is hands off for most of the lesson and walks around to make sure students are following safe lab practices and properly handling all lab equipment. The teacher provides a hypothetical soap recipe and students follow it if they wish or follow their own soap recipe. (see sample recipe in resources) Classroom Management Tip: The teacher rarely answers questions and encourages students to use the “three before me” rule to promote peer interaction.</td>
<td>The students review lab safety and wear safety gear for the lab. The students work individually to make their soap. Students reason quantitatively about the ratios of chemicals being used in the provided soap recipe and make adjustments for their own creations. With teacher oversight, the students carefully add the lye to the water and not the other way around. This is done under a ventilated fume hood. The students are patient, as some parts of soap making can become frustrating. Students are documenting each step of the making process and writing reflections in their foldable.</td>
<td>What equipment will you use to measure your ingredients? Why is it important to add the lye to water and not vice versa? What is the importance of the ventilated fume hood? How will you make sure you soap hardens enough to be poured in the mold? Do you think your soap bar will harden? Why or why not? What other recipes could you have followed to make your soap? How does this lab relate to other labs you have done? What will you change for next lab, if anything? Why? Note: Students will ask many questions, but because the lab involves flames and strong bases, the teacher should</td>
</tr>
<tr>
<td>The teacher handles the lye, NaOH, and monitors the handling of the lye and the fume hood for safe practice.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Management Tip: The teacher watches class time and paces the students during the lab.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Management Tip: The teacher allows for at least 10 minutes of clean up time and makes sure each lab bench and all equipment are clean for next class. <em>This is important to ensure the pH is unaffected for the second round of soap making as remains in equipment are more difficult to remove (oils).</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The students ask each other questions when confused and push forward.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The students use the hot process and add the lye water to the beaker with the correct volume of oil needed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The students take ownership of the lab and add additives such color, glitter, and fragrance in the proportions they believe are correct.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student stirs as appropriate and wait to see a trail from the stirring rod. Students also answer the concluding questions while waiting to see a trail in their beaker.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once the student sees the trail, the soap is ready to be poured in the mold.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The student pours the soap in the mold and initials it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After students initial their mold, students begin to clean up their equipment and lab bench.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students finish recording observations, making processes and reflections on their foldables.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>refrain from answering them and focus on ensuring all students are safe. Ask students to use the “three before me” rule and enforce it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Get students to think and reflect on their lab experience and how they can learn from it for their second attempt at soap making!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Connections to NGSS:
In the creation of the bars of soap, students reason quantitatively about the ratios of chemicals being used in their soap recipe and describe changes in the outcome after they modify their recipe.

Maker Elements:
Personal Relevance-You create an original product and can describe its connection to your outside values or interests
Iterative Design and Fabrication-You provide evidence of the evolution of the creation including brainstorming notes, drawings, and/or prototypes
Maker Mindset-Habits of a maker mindset including persistence, reflection, and adaptability are demonstrated throughout the project

Resources:
Molds, additives (fragrances, glitter, color), lye, oils,
Equipment (1 of each for each student): graduated cylinder, spatula, thermometer, small and big beaker, weighing boat, tongs, hot plate
At each lab station: Bunsen burner, beaker brushes, vinegar, and DI water
Making Your Own Soap handout

Sample Soap Recipe
Coconut Oil-6 oz.=170 g
Olive Oil-26 oz.=737 g
Water-10 oz.=283 g
Lye-4.4 oz=124 g

Safety Considerations:
Students must be careful when working with the hot plate and Bunsen burner, as burns can result from a lack of caution. Because a lot of glass is around, students should be careful not to break beakers by stirring too hard or leaving beaker on the hot plate for too long. Students MUST add the lye to the water and not the other way around; this will help avoid serious issues. The ventilator must be on and students must do this step under the fume hood to avoid inhaling any fumes. All broken glass must go in the glass disposal. Safety is of utter importance and students are told of the lab safety techniques and consequences for failing to follow directions.
**Explanation:** Estimated Time: **90 mins**  
**Overview of Activity:**  
Students have made their soap bar and there will be mixed responses from students regarding the successes and coming improvements. Students collaboratively discuss the pH scale and its implications for their own processes of creating soap. Customized designs and soap recipes, including temperature settings and concentrations, are included in the conversations and initial results are shared. Students provide constructive feedback to each other and continue to refine their recipes. This stresses the importance of iteration in making and develops the habit of reflection and revision.

<table>
<thead>
<tr>
<th>What the teacher does:</th>
<th>What the student does:</th>
<th>Possible questions to ask students – think like a student and consider possible student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher prepares student for the lab and mentions common errors and how to avoid them.</td>
<td>The students review lab safety and wear safety gear for the lab.</td>
<td>How have you modified your approach to making your second soap bar?</td>
</tr>
<tr>
<td>The teacher reminds students of the pH scale and asks students to recall prior knowledge of the pH of acids and bases. The teacher encourages students to share their ideas regarding safe pH levels of soap and if soap should fall into the category of acid or base.</td>
<td>After a first attempt, students modify their soap recipe to decrease hardening time, adjust the pH, and customize their fragrance and color.</td>
<td>Why is it important to add the lye to water and not vice versa?</td>
</tr>
<tr>
<td>Classroom Management Tip: The teacher calls on students randomly using name sticks to ensure equitable participation throughout the discussion.</td>
<td>Students engage in iterative design while creating their soap, switching from olive oil to coconut oil after encountering the unanticipated effect of slow hardening time.</td>
<td>What is the importance of the ventilated fume hood?</td>
</tr>
<tr>
<td>The teacher encourages students to recall the engagement video and the discussion of H+ and OH- ions in the soap making process.</td>
<td>Students measure the pH of their soap bar using pH strips and evaluate if it is safe to use.</td>
<td>Describe the pH scale, including the relationship between H+ and OH- ions and application to the soap making process.</td>
</tr>
<tr>
<td>The teacher takes a few minutes to offer hints and tips to a successful soap bar after watching students the previous day. She encourages</td>
<td>The students carefully add the lye to the water and not the other way around. This is done under a ventilated fume hood.</td>
<td>What is the pH of soap? What other products have similar pH?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What is the pH of your first soap? What can you infer from that regarding the quality of your soap?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How can you quicken the hardening process?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What types of energy transfer are taking place during the soap making reaction?</td>
</tr>
</tbody>
</table>
students to think about how using a different type of oil would affect the hardening time.

The teacher also prompts the students to think about the energy transfers that are taking place during the soap making process. She reviews endothermic and exothermic reactions and encourages students to recall both processes.

Classroom Management Tip: The teacher is hands off for most of the lesson and walk around to make sure students are following safe lab practices and properly handling all lab equipment.

Classroom Management Tip: During the lab work, the teacher rarely answers questions and encourages students to use the “three before me” rule to promote peer interaction.

The teacher handles the lye, NaOH, and monitors the handling of the lye and the fume hood for safe practice.

Classroom Management Tip: The teacher watches class time and paces the students during the lab. She provides visual and verbal time cues throughout the lab activity.

Once the lab work is mostly complete, the teacher fosters a group discussion where students are sharing results, comparing temperature settings and concentrations of chemicals used, answering questions posed by

<table>
<thead>
<tr>
<th>The students ask each other questions and provide suggestions for improvement of individual designs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student groups discuss how changing temperature or differing concentrations of various soap ingredients affect the chemical reactions involved in soap making and how these changes impact their final product.</td>
</tr>
<tr>
<td>Are endothermic or exothermic reactions occurring during the soap making process?</td>
</tr>
<tr>
<td>If you were to make soap again, what would you change and why?</td>
</tr>
<tr>
<td>The students use the hot process and add the lye water to the beaker with the correct volume of oil needed.</td>
</tr>
<tr>
<td>Students discuss how the transfer of energy takes place throughout the hot process.</td>
</tr>
<tr>
<td>Students discuss the types of heat transfer occurring throughout the bonding process.</td>
</tr>
<tr>
<td>Students discuss the effect of temperature on the chemical bonds between oil, lye, fragrance, food coloring, and glitter used to make their bars of soap.</td>
</tr>
</tbody>
</table>
the teacher, and providing constructive feedback to their peers.

Classroom Management Tip: The teacher allows for at least 10 minutes of clean up time at the end of class and makes sure each lab bench and all equipment are clean for next class.

<table>
<thead>
<tr>
<th>The student stirs as appropriate and wait to see a trail from the stirring rod. Students also answer the concluding questions while waiting to see a trail in their beaker.</th>
<th>Once the student sees the trail, the soap is ready to be poured in the mold.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student pours the soap in the mold and initials it.</td>
<td>After students initial their mold, students begin to clean up their equipment and lab bench.</td>
</tr>
<tr>
<td>Students complete the concluding questions and turn them in after lab.</td>
<td></td>
</tr>
</tbody>
</table>

Connections to NGSS:
After a first attempt, students modify their soap recipe to decrease hardening time, adjust the pH, and customize their fragrance and color.
Students engage in iterative design while creating their soap, switching from olive oil to coconut oil after encountering the unanticipated effect of slow hardening time.
Student groups discuss how changing temperature or differing concentrations of various soap ingredients affect the chemical reactions involved in soap making and how these changes impact their final product.
Student groups discuss the effect of temperature on the chemical bonds between oil, lye, fragrance, food coloring, and glitter used to make their bars of soap.
Students compare the results of their soap making with other groups and discuss how differing concentrations of chemicals impact the color, fragrance, hardness, and pH of their final product.
Students discuss how the transfer of energy takes place throughout the soap making process, including both heat transfer and chemical energy used in the bonding process.

Maker Elements:
Personal Relevance-You create an original product and can describe its connection to your outside values or interests
Iterative Design and Fabrication-You provide evidence of the evolution of the creation including brainstorming notes, drawings, and/or prototypes
Collaboration and Community - You collaborate and connect with others to get design ideas, solicit feedback, or make improvements.
Sharing Work - Products are presented publicly and you are able to clearly share ideas about your process and product with others.
Maker Mindset - Habits of a maker mindset including persistence, reflection, and adaptability are demonstrated throughout the project.

**Resources:**
Molds, additives (fragrances, glitter, color), lye, oils,
Equipment (1 of each for each student): graduated cylinder, spatula, thermometer, small and big beaker, weighing boat, tongs, hot plate.
At each lab station: Bunsen burner, beaker brushes, vinegar, and DI water.
Making Your Own Soap handout.

**Safety Considerations:**
Students must be careful when working with the hot plate and Bunsen burner, as burns can result from a lack of caution. Because a lot of glass is around, students should be careful not to break beakers by stirring too hard or leaving beaker on the hot plate for too long. Students MUST add the lye to the water and not the other way around; this will help avoid serious issues. The ventilator must be on and students must do this step under the fume hood to avoid inhaling any fumes. All broken glass must go in the glass disposal. Safety is of utter importance and students are told of the lab safety techniques and consequences for failing to follow directions.
### Elaboration: Estimated Time: 90 mins

**Overview of Activity:**
Students are introduced to the use of graphic editor software and laser cutters for making self-designed soap dishes. Graphic editor software is used to make precise measurements for laser cutting customized soap dishes. These designs are based on personal preference and utility, with each design being unique to the individual. Students are given the option to show their designs on the computer or meet the teacher outside of school to laser cut their dish.

### What the teacher does: | What the student does: | Possible questions to ask students – think like a student and consider possible student responses
---|---|---
The teacher introduces the objective of a customized, personal soap dish and passes around three laser cut soap dish designs for students to see. | Students fire up their laptops and visit the graphic editor software. | How can you make the soap dish unique to you? |
The teacher briefly shows how to use the graphic editor software, Method Draw. | Students play with “Method Draw” and begin to put a soap dish together. | What are some challenges you faced designing your soap dish today? |
The teacher lists a few points to think of when designing the soap dish and encourages peer interaction to generate ideas. | Students create a design for a soap dish using graphic design software and explain both the structural and aesthetic choices of the design. | What was the easy part? Hard part? |
The teacher encourages students to go above and beyond with their design and challenges students to think of the design in a 3D form, the layout of the design, measurements, etc. | Students are aware of important points such as measurements, shape of soap dish, etc. | How did you overcome those challenges? |
The teacher walks around and guides students with their design. | Students use their creativity to make the soap dish unique and personal to them. | What did you learn today? How can you use these designing skills to benefit you in other classes and/or your personal life? |
If laser cutting resources are available, the teacher provides times for students to come in | Students interact with one another and help each other learn how to use the software and offer tips to fix errors and minimize frustrations. They use the teacher as a last resort. | |
after school to assist with the laser cutting process to complete their soap dish designs.

The teacher provides the big picture of the maker lesson and helps student think of the big takeaways, what they learned, how they made their soap and soap dish, and the skills from this lesson they learned that can be used in other classes and everyday life.

<table>
<thead>
<tr>
<th>Students complete the “Designing Your Customized Soap Dish” handout and turn it in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students try their best to complete their soap dish design or at least have a general layout of it to present during the gallery walk.</td>
</tr>
<tr>
<td>Students begin to prepare for their presentations and use the questions, feedback, and points of revision mentioned to prepare for the lab.</td>
</tr>
</tbody>
</table>

Connections to NGSS:
Students create a design for a soap dish using graphic design software and explain both the structural and aesthetic choices of the design.
Students create digital models of their soap dish using graphic design software and share these designs as part of their class presentation

Maker Elements:
Personal Relevance-You create an original product and can describe its connection to your outside values or interests
Iterative Design and Fabrication-You provide evidence of the evolution of the creation including brainstorming notes, drawings, and/or prototypes
Collaboration and Community-You collaborate and connect with others to get design ideas, solicit feedback, or make improvements

Resources:
Computers
Method Draw software (free)
http://editor.method.ac/
Designing Your Customized Soap Dish handout

Safety Considerations:
For those students who choose to come in after school to participate in the laser cutting activity to complete their soap dish, proper laser cutter safety must be reviewed and implemented. The teacher operating the laser cutter will be trained for use and students will be able to assist while wearing the proper eye safety.
**Evaluation:** Estimated Time: **90 mins**

**Description of Activity:**
Formative evaluation occurs through the use of a rubric that was provided for students at the start of the lesson. The teacher uses this rubric to make notes on student progress at each stage of the 5E learning cycle. Students also use this rubric to self-evaluate and reflect on their work throughout the project. Additionally, students conduct presentations showcasing their soap and dish designs. The presentations include an explanation of their personalized making process as well as a discussion of the chemistry content. The audience is comprised of people from a variety of sectors within the community. After presentations, the teacher revisits the rubric and uses it to provide a summative evaluation for each student.

<table>
<thead>
<tr>
<th>What the teacher does:</th>
<th>What the student does:</th>
<th>Possible questions to ask students – <em>think like a student and consider possible student responses</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher sets up the room for the gallery walk and gives five minutes for students to prepare their presentations and their talking points.</td>
<td>Students prepare to talk about their soap and soap dish. They reflect on what making is, what it means to them, and how it came out during this project.</td>
<td>Questions to be included on the half slips of paper for gallery walk:</td>
</tr>
<tr>
<td>The teacher invites member of the community, other teachers, makers to the class as the audience to the student presenters.</td>
<td>Students walk around and listen to their peers present and complete a slip for each peer they hear present when time is called to switch.</td>
<td>How has this project helped shape your idea of making?</td>
</tr>
<tr>
<td>As students begin presenting and community members start asking questions, the teacher walks around and checks on students to check their understanding.</td>
<td>Students turn in their slips and work on their project foldable for the remainder of the class.</td>
<td>What were the challenges of this project? How did you overcome them?</td>
</tr>
<tr>
<td>The teacher offers encouragement to nervous students and assurance to everyone. The teacher acknowledges the hard work students have put into the project and remind them of that during the presentations.</td>
<td></td>
<td>What was the most fun part of the project?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What was the most frustrating part of the project?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What are some changes you would make if you did this project again? How and why?</td>
</tr>
</tbody>
</table>
The teacher also asks questions and makes sure students are going around and filling out the slips of questions.

When half of the class has presented, the teacher tells students to switch. Those that were presenting now go around and ask their classmates the questions on the slip and students who were asking questions now presented their lesson products.

At the end, the teacher tells students to turn in their slips all stapled together for a grade as part of the project rubric.

The teacher reminds students of the project rubric and gives students time to work on the project foldable. (Project foldable can be due as decided by the teacher).

| What skills did you develop during this lesson? How can these skills be used in the future either in your everyday life or in your classes and extracurriculars? |
| Would you embark on another maker lesson again? Why or why not? What do you hope to gain from it? |

**Maker Elements:**
- **Personal Relevance:** You create an original product and can describe its connection to your outside values or interests
- **Collaboration and Community:** You collaborate and connect with others to get design ideas, solicit feedback, or make improvements
- **Sharing Work:** Products are presented publicly and you are able to clearly share ideas about your process and product with others

**Resources:**
- Gallery walk slips, Soap dish design, and Soap bars (If available: Laser Cutter with trained operator, appropriate eye safety and materials for cutting soap dish)