TODOS: NGSS 3 Dimensional Science Unit Template

Name of Teacher(s):	**Title of Unit:**	**Grade Level and Course**
Gould	Explaining a chemical reaction and collision theory	High School Chemistry

NGSS Performance Expectation (PE) and 3 Dimensions

Next Generation Science Standard: Performance Expectation (PE) with code and any clarification or assessment boundary

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.

Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.
Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature

Disciplinary Core Idea (DCI):
PS1.B: Chemical Reactions
Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Science or Engineering Practice (SEP):
. **Constructing Explanations**
Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Cross Cutting Concept (CCC)
Patterns
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Big Idea Question for the Unit

Big Idea Question For Unit:
What does collision theory have to do with cooking corn?
How can we change the rate of a chemical reaction and what happens at the molecular level when we do?

Assessment

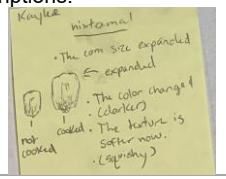
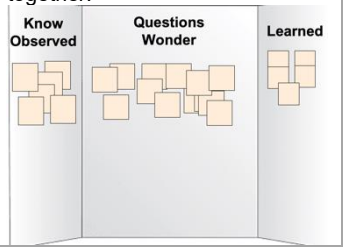
Directions: Locate an assessment(s) that is fully aligned with the performance expectation (s). It will show you an example of how students might do the practice (SEP) and use the crosscutting concept (CCC) to show their knowledge of the disciplinary core idea (DCI). The assessment will show you

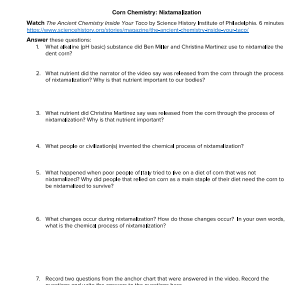
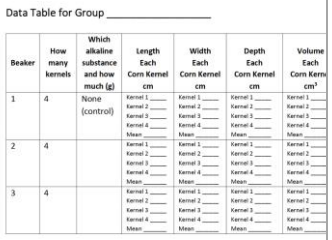
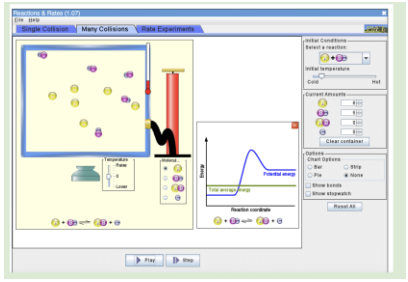
a way students could demonstrate the 3 dimensions of the performance expectation. The assessment might give you design ideas. Attach the assessment(s) to this document. You can find an assessment at *Wonder of Science* https://thewonderofscience.com/draft-assessment And / Or *New Mexico Science Instructional Scope* https://webnew.ped.state.nm.us/bureaus/curriculum-instruction/new-mexico-instructional-scope-nmis/nmis-science/

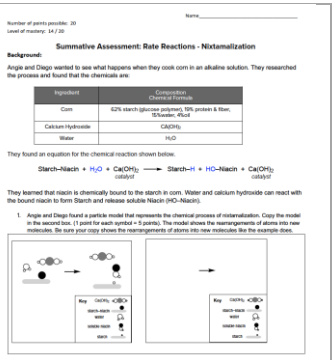
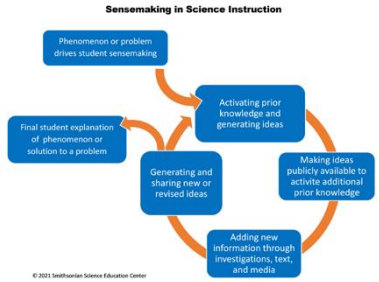
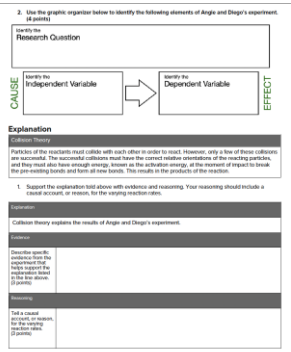
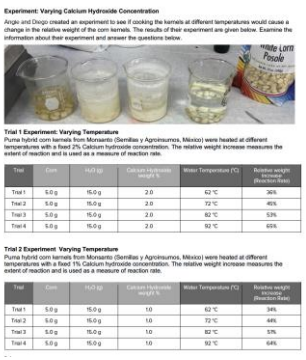
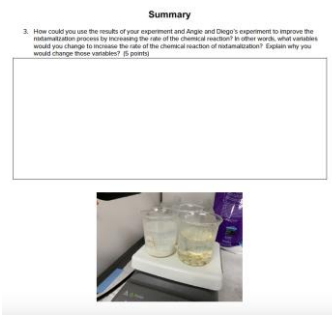
Student performance needs to demonstrate: 1. Articulating the explanation of phenomena (claim) 2. Evidence 3. Reasoning

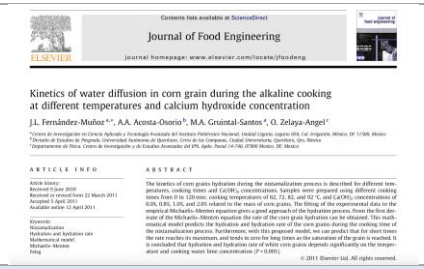
Lessons Sequence

Directions: Break down the performance expectation into a set, or series, of activities or lessons. Design each lesson around a phenomenon or design problem with a driving question. Tell what students will do (SEP), how they will think (CCC), and what they will know (DCI). Tell how students will represent what they know as artifacts or performances that can be shared with peers, that will show students' thinking and demonstrate their progress toward mastery of the PE.,

	Guiding Question	Phenomenon or Design Problem	How we do and figure out	How we represent
1	What are observable or known similarities and differences between dent corn and hominy?	Each student will sketch, label, record, and share observations of a kernel of dent corn. Each student will sketch, label, record, and share observations of a kernel of hominy.	Announce that your class is starting a unit on chemical reactions: every student will begin by making observations about some foods. Emphasize that the students should make detailed observations, which will help them figure out what is happening	Labeled sketches and observations and verbal descriptions. 
2	What do we know, guess, think, and wonder about the chemical process that changed dent corn to hominy?	The chemical process that changed the dent corn to hominy is called nixtamalization. Each student will respond to this question on sticky notes: What past experiences, observations, ideas, conjectures (guesses based on your observations or experiences), and questions do you have about this chemical process? Students will respond on sticky notes.	Announce that your class is starting a unit on chemical reactions with the following goal: every student will engage with a chemical reaction, make observations, and ask questions about what is happening. We will record our observations, background experiences, wonderings or questions, and learning which will help us figure out what is happening	Driving anchor chart for the investigation. The students' sticky notes will be added to a driving anchor chart in the categories of Observations, Wonderings, and Learnings. Sticky notes with similar themes will be grouped together. 

3	How did Indigenous people of the Americas 1500 BC, and how do chefs of today, change the dent corn to hominy?	Videos of Indigenous People of the Americas 1500BC, and of chefs today, showing and telling how and why they nixtamalize corn. *The Ancient Chemistry Inside Your Taco* by the Science History Institute. https://www.sciencehistory.org/stories/magazine/the-ancient-chemistry-inside-your-taco/ *How to Nixtamalize Corn with Wood ash by Sioux Chef Sean Sherman* (Oglala Lakota Sioux) https://www.youtube.com/watch?v=EiMWLFI-yd0	We will record our observations, background experiences, wonderings or questions, and learning which will help us figure out what is happening	
4	How can we measure and record one of the chemical reactions that is occurring in nixtamalization at the macroscopic level?	**Experiment** 	*Sensemaking* is a collaborative practice that includes students sharing initial ideas with peers and identifying inconsistencies or gaps in their shared understandings about the cause of phenomena (Odden and Russ 2019). While sensemaking, students are continually drawing on their existing knowledge and integrating it with new information. Therefore, the process of sensemaking in science classrooms includes building or revising explanations for phenomena.	
5	How can we investigate and change the reaction rate that is occurring in one of the chemical reactions in nixtamalization at the molecular level? What patterns do we observe in the data of our observations?		Once students have had a chance to use their existing knowledge to begin figuring out phenomena or solving problems, sensemaking includes identifying how another person's experiences or new information does not fit with initial ideas (Campbell, Windschitl, and Schwartz 2016; Phillips, Watkins, and Hammer 2018). Central to designing curriculum for sensemaking is making ideas publicly available so that, through discussion with peers, students may identify inconsistencies or gaps in their thinking about a phenomenon or problem. As students engage with new information through investigations, text, and media about a phenomenon or problem, they discuss what they notice. This provides opportunities to generate new ideas and sift through them in what Odden and Russ refer to as the	**Model what is happening** 

			“cultivation of a variety of alternative suggestions” (Odden and Russ 2019, 75). As new ideas proliferate among students, students activate additional prior knowledge they may not have considered relevant while developing their initial explanation of the phenomenon. From here, students generate revised ideas using the new information; additional prior knowledge activated during discussion; or by engaging with new information surfaced through investigations, text, and media. Sensemaking, therefore, is a cyclical, collaborative process of thinking, sharing, and revising.	
6	How can we use the patterns we observed to explain collision theory and the chemical reactions in nixtamalization at the molecular level?	**Examples of Questions That Support Sensemaking** • Requests for clarification about specific aspects of proposed explanations “Can you say more about what you mean by _____?” • Pressing students to use evidence to support explanations “What makes you think _____?” • Highlighting inconsistencies found across multiple explanations “I heard Hallie say _____ caused the phenomenon, but I heard Aman say _____ caused the phenomenon. Both can’t be true. How can we find out more about what happened?”		
7	How can we apply scientific principles to investigate, report, and explain the effects of changing the temperature or concentration of reacting particles on the rate at which a reaction occurs		Patterns During investigations, new information is generated through data students record and analyze. After analyzing the results of their investigations, students return to their initial ideas and revise them, incorporating the information or evidence that has emerged to better account for the cause of the phenomenon	

8	How can we read and analyze scientists' reports about chemical reactions involving corn?	 Contents lists available at ScienceDirect Journal of Food Engineering journal homepage: www.elsevier.com/locate/jfoodeng Kinetics of water diffusion in corn grain during the alkaline cooking at different temperatures and calcium hydroxide concentration J.L. Fernández-Muñoz, A.A. Acosta-Osorio, M.A. Gruintal-Santos, O. Zelaya-Angel ARTICLE INFO ABSTRACT		

Supporting Students' Identities

How can students bring who they are to this unit of lessons? Consider students' gender, race / ethnicity, tribe, SES status, language, community, talents, sexual orientation, mental / physical ability, etc. For example, what choices do students have in the lessons that might engage their identities and assets or support their interests?

Students tell their cultural and family experiences related to corn. The students' ideas and experiences related to corn are used as the foundation for the experiment and for the readings and activities of this unit of lessons. Students tell their life experiences related to corn and describe their experiment and the results of their experiments in their own words before they are taught other vocabulary and other ways of doing science and other ways of describing or explaining the science content. Corn is important to many cultures of New Mexico and the Southwest. Students have funds-of- knowledge about taking care of corn in fields and gardens and the many uses of corn for food, art, and for ceremonies. There are opportunities for students to choose to share topics of corn and nixtamalization that are of interest to them and to pursue questions they have about corn and chemical reactions.

Supporting Students' Leadership and / or Mission

How can students demonstrate their leadership for their community, tribe, people, or nation in this unit of lessons?
Ask, "What chemical processes do you think might be important for a leader to understand in order to make decisions about the health and well-being of a community, tribe, country, or civilization? How might you acquire this knowledge? Who has this knowledge in the community or society in which you live?

The Indigenous tribes of the Americas were the first to domesticate and cultivate corn. It is estimated to have began 8,700 years ago in Mexico. They domesticated the corn from the Teocinte wild grass. Over time there was cross pollination via trade across the different tribes of the Americas. The Indigenous tribes of the Americas were the first to nixtamalize corn for the health and well-being of their communities, tribes, and civilizations. Describe the science they developed. How do you use, or benefit from, this science today? The colonizers of the Americas did not compensate the Indigenous tribes of the Americas for this knowledge that we still use today. How valuable do you think this knowledge is? How might we recognize, thank, or compensate Indigenous people for the knowledge of corn and nixtamalization?

STEM Ecosystem Connection

How does this unit of lessons connect to STEM in New Mexico? What people and / or organizations does it connect with? How does it connect with the STEM ecosystem?
Local community members who have experience with nixtamalization.
Example: Chef Nathan Mayes of Santa Fe, New Mexico in Edible magazine https://ediblecommunities.com/stories/palomas-nathan-mayes-makes-masa/