Unit Title: About ceramics: Clay, Kilns, and Surface

Lesson Title:	Duration of Lesson (Days):	
Properties of Clay: How much does clay shrink from wet to fully mature?	**Unit:** Reoccurs during the year between large projects. **Lesson:** 5 sessions over two weeks.	

Essential Question:

How much does clay shrink from wet to fully mature (vitrified) and which stage produces the greatest change?

Design Question Focus of the Lesson

☒Helping students interact with new knowledge (DQ 2)	☐	☐

Deliberate Practices that I am addressing

☒ Organizing students to interact with new knowledge. (DP 7) Recording/Representing Knowledge (DP 12)	☒Examining Errors in reasoning (DP 18) Revising Knowledge (DP 20)	☒ Maintaining a lively pace (DP 28)

Standard(s):

MAFS.7.G.2 Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

MAFS.7.RP.1.3: Use proportional relationships to solve multistep ratio and percent problems. Examples: **percent** increase and **decrease**, percent error.

VA.912.C.1.7: Analyze challenges and identify solutions for three-dimensional structural problems.

VA.912.C.3.4: Use analytical skills to examine issues in non-visual art contexts.

VA.912.H.3.1: Synthesize knowledge and skills learned from non-art content areas to support the processes of creation, interpretation, and analysis.

VA.912.H.3.2: Apply the critical-thinking and problem-solving skills used in art to develop creative solutions for real-life issues

VA.912.H.3.3: Use materials, ideas, and/or equipment related to other content areas to generate ideas and processes for the creation of works of art.

Assessment and Monitoring:

Formative	Checking their data entries in Google classroom, verbally questioning teams about their experiments. (Note: I do not tell them if they are making mistakes, merely question their plan and process.)
Summative	Students will share their results in a “Round Robin” and then work in their teams to determine if their experiments worked, and if not, where they erred: in the design, in the measurements, or in the math. This will lead to the next experiment for them to design later in the unit.

Learning Goal: (based on Standards)

Students will design an experiment to prove what percentage a given clay body shrinks from wet to mature, and which stage produces the greatest change.

Learning Targets: (write in the scale below)

2.0 Simpler Content:	**3.0 Target (Objective/Learning Goal):**	**4.0 More Complex:**
Vocabulary/concepts: Greenware, Bisqueware, Vitrification (mature clay) Grog, Plasticity, Short (opposite of "plastic") Physical water vs Chemical water	Devise a means of measuring clay at 4 stages from wet to vitrified. Determine % shrinkage at each change.	Determine which clays shrink more or less given information about additives such as grog and sand. Determine why some clays are more suited to sculpture and raku.

Lesson Sequence

Day 1: (Full class period) Have students discuss WHY they think clay shrinks. In teams challenge students to devise an experiment to determine how much the clay body shrinks at each stage (Wet to bone dry, to bisque, to Cone 5) Students must create their clay test piece (s) and get first measurement in this class period.
Day 2: Teams measure, record and calculate any shrinkage to bone dry. (5-10 mins)
Day 3: (after bisque fire) Teams measure, record and calculate any shrinkage to bisque.
Day 4: (after high fire) Teams measure, record and calculate any shrinkage to Cone 5/mature Students must finalize all measurements, enter data and answer questions in chart in Google Classroom. (This may take 10 to 30 minutes depending on calculations.)
Day 5: (full class period, may run to next day for all teams to report analysis). Move students to teams and pass out chromebooks. PPT: Explain the Round Robin: One stays with chromebook to present. Others rotate together through the other teams' presentations. Timed rotation, then return to team.
PPT Questions: Determine if your experiments worked, and if not, where they erred: in the design, in the measurements, or in the math. Those with correct data will read a technical passage and try to answer a question based on their new knowledge. Exit ticket: Did your data differ from the control data presented? What reasons do you conclude most likely contributed to your results?

Resources and Materials (include technology):

Clay body, Clay tools, rulers, kiln, Chromebooks, Google docs, SmartBoard, PPT

Adaptations for Unique Student Needs: (ELL, Special Education, Gifted, Students who lack support for school)

One student receives extra time for assessment as well as questioning for understanding of directions. However, she has never required any extra assistance and tends to stay on top of all her work.

After Lesson – Teacher Reflection:

Students were caught up in the aesthetics of the object made to conduct the test. This is no doubt due to the fact that every clay project they have done has had strong design objectives. They are far more used to "form" than "function". Additionally, for those who did consider a simple shape to measure, they still made cubes which were not precise as they were handbuilt. Not one team used the slab roller to cut a simple measured slab.
Every team's mathematic plan was different. There were errors in measurement at various stages, and for some teams, errors in how they applied the math to their measurements.

The variation in results were astounding. When they were shown the basic 100 unit measurement on a slab and how the shrinkage was measured with no mathematical formula required, they were surprised. This lesson segues perfectly into their next experiment relating to different clay bodies and how much they shrink.