Thinking through a Lesson Protocol (TTLP) Planning Template

Modified for accessibility from:

> Smith, M., Bill, V., & Hughes, E. (2008). Thinking through a lesson protocol: A key for successfully implementing high-level tasks. *Mathematics Teaching in the Middle School, 14*(3), 132–38.

Learning Goals

EE4.MD.1. Identify the smaller measurement units that divide a larger unit within a measurement system. (4th grade standard)

5.MD. 2 Represent and interpret data. Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. (5th grade standard)

What understandings will students take away from this lesson?

- *Students will be able to accurately measure a standard lego piece and use this information to create a 3D lego.*
- *Students will make the correlation between lengths they are using on Tinkercad and real life (i.e: students may create something that is 7 inches long but really want it to be 7 cm long).*
- *Students will be able to create a 3D printed Lego using Tinkercad on the 3D printer using the measurements they determined.*
- *Students will understand what concave and convex and be able to explain it in regards to their lego.*

Evidence

What will students say, do, or produce that will give evidence of their understandings?

- *Students will show understanding of measurement through the creation of the lego.*
- *Students will create a Lego to fit specific measurements, and the Lego will snap together with another Lego.*

Task

What is the main activity that students will be working on in this lesson?

- *Students will be using Tinkercad to create a 3D lego to show understanding of 3D design and measurement.*

Instructional Support—Tools, Resources, Materials

What tools or resources will be available to give students entry to—and help them reason through—the activity?

- *Students will start by using Tinkercad Learning Lessons: https://www.tinkercad.com/learn/designs*
- *Students will be able to use YouTube videos and ask the teacher for assistance.*

Prior Knowledge

What prior knowledge and experience will students draw on in their work on this task?

- *Students will need to understand 3D concepts (3D shapes have previously been taught and I will introduce 3D concepts in regards)*
- *Students will need to understand measurement. (Prior to the introduction of Tinkercad, students will take measurements of a Lego. Based on this information, as a whole class, we set specifications for our 3D printed Lego).*

Essential Questions

What are the essential questions that I want students to be able to answer over the course of the lesson?

- *How do I take measurements of a lego? (Students will work in small groups or partners to take measurements. We will then as a whole class determine the specific measurements.)*
- *How can I use these measurements to create a 3D lego piece?*
- *What is the difference between mm, cm, inch, etc.*

Task Launch

How will you introduce and set up the task to ensure that students understand the task and can begin productive work, without diminishing the cognitive demand of the task?

I will launch the unit by showing examples of 3D printed objects I made and show a video. I will also show students how I use Tinkercad. Students will also explore with measurement. Then I will then set up

students with their own Tinkercad accounts and allow them to start Tinkering on https://www.tinkercad.com/learn/designs.

Anticipated Likely Solutions and Instructional Supports

What are the various ways that students might complete the activity? Be sure to include correct, incorrect and incomplete solutions.

- *Students will show how to create and manipulate shapes on Tinkercad while using Screencastify, or they can show learning to a peer who will be using the following rubric.*
- *Students will create a Lego piece based on the specific requirements.*
- *Students will not be able to create and manipulate shapes on Tinkercad while using Screencastify.*
- *Students Lego piece will not be to the correct specifications or will not link to another Lego piece.*

**Students will work with a partner to check peers Lego piece to determine if they have met the criteria. I will not be checking Lego pieces as I know students learn from "failure". If their Lego piece prints incorrectly (is floating in air rather than on the plaine) or doesn't fit the required dimensions they will have the opportunity to revise their Lego.*

What questions might you ask students that will support their exploration of the activity and bridge between what they did and what you want them to learn? These questions should assess what a student currently knows and advance her or him toward the goals of the lesson. Be sure to consider questions that you will ask students who cannot begin as well as students who finish quickly.
*Students may answer these questions in a Google Doc, on a piece of paper or by using Screencastify.

- *What do you know about Tinkercad?*
- *How do you manipulate shapes on Tinkercad?*
- *How do you create divots in a cube on Tinkercad?*
- *How do you create a cylindrical shape on Tinkercad?*
- *How are you able to figure out specific measurements on Tinkercad?*
- *What can you do if you are unsure how to create divots or a cylindrical shape?*
- *What can you do if you are unsure how to determine the length, height, width or your Lego piece?*
- *What could you do once you completed a Lego piece?*

Sharing and Discussing the Task

Selecting and Sequencing

Which solutions do you want students to share during the lesson? In what order? Why?
*Students will begin the unit with an exploration of Tinkercad (this exploration will take days. Once I feel students are ready to move on to the lego, we will proceed). Students will start their exploration in the **Learn** tab using the **Starters** lessons. They will learn to place, rotate, enlarge, shrink and add/take away elements on a basic cube. Once they feel they are comfortable:*

1. *Students will Screencastify to show how to manipulate a cube, create divots and a cylindrical shape.*
2. *Students will use the specific measurements we have taken to create a Lego piece. The teacher will be available to help as needed as will other "expert" students.*

Connecting Responses

What specific questions will you ask so that students make sense of the mathematical ideas that you want them to learn?
How do you know the length of the cube? How long is your cube?
How do you know the height of your cube? How long is your cube?
How do you know the width of your cube? What is the width of your cube?

What specific questions will you ask so that students make connections among the different strategies and solutions that are presented?
Does your lego meet the specifications we previously determined? Can you prove that it meets the specifications?

Assessment

Students will complete a 3D printed Lego, measure the lego to show that it complies to the required lengths and is able to connect with another Lego. See rubric.

Research

Research has shown using a 3D printer in the classroom can be beneficial for students (Gimbel, 2019). However, simply using a 3D printer without connecting it to content and pedagogy goes against the TPACK principle. I also know that when the student's lego doesn't initially print correctly,

students may be frustrated or feel they have failed, but with a growth mindset they can learn from this experience.

Sources Cited:

Noel, K. (2018, November 5). *How 3D Printers Work | How Things Work with Kamri Noel*. YouTube. https://www.youtube.com/watch?v=HlvK6DLwCz4

Gimbel, E. (2019, October 6). *The Resurgence of 3D Printers in Modern Learning Environments*. EdTech. https://edtechmagazine.com/k12/article/2019/06/resurgence-3d-printers-modern-learning-environments-perfcon