**Brief Lesson (format from Tweed, 2009) description of sinking and floating 2.0:**

Big Ideas: Engineering and investigations in sinking and floating using 3D printing.

Content Engineering processes using technology to solve a boat challenge, in Physical Science (2-PS1-1, 2-PS1-2, 2-PS1-3)

Language: Students will be able to identify engineering processes that can solve a challenge involving materials, shapes and properties throughout the boat challenge. They will use terms such as pilot, test, redesign, prototype, data and conclusions.

Key Questions:

* What shapes cause a boat to float?
* How do we use engineering to make a better boat?
* How do we put together a boat using a 3D printer?
* Can you make your own boat that does what you planned for it to do?

Activities:

Build and test boats using traditional materials such as clay, foil, and paper

Explore 3 D printed boat shapes

Evaluated pilot boat success and redesign a new boat for the challenge

Compete in the challenge

**Engagement-** The class is introduced to 3D printers and they started the machine printing.

**Exploration-** Students are assigned into small teams of 3-4. Safety and appropriate use and handling of the equipment is reviewed. Traditional sinking and floating activity. (Provide limited materials and time and ask students to create a boat that hold the most.) (DCI 2-PS1-3 and 2-PS1-2 and PE 2-PS1-1 and 2-PS1-2) While working with the boats the students are asked to review and pose questions. We have found that the initial experience takes about 30-45 minutes.

 **Explanation**- Following the construction of the pilot boats. The 3D printing nature of the project was explored. Students worked with pre-printed designs. They tested and collected data. Small group discussions and teacher facilitated discourse was encouraged. (Practices 1, 2, and 3) This takes 10-20 minutes based on the questioning and exploration process used with the group.

**Elaboration**- The students are next asked to design their own boat that will hold the maximum number of pennies. They demonstrate their understanding of materials and how the shape impacts penny load. Approximately 60 minutes over two days were given for this step.

**Evaluation**- Those used were all informal and formative. Observed discourse, team planning and designs were collected and evaluated. In this afterschool setting no summative assessment was implemented. But the final boat and challenge could be evaluated using a rubric of design and content understanding.