



S1 Integrated Science STEM Project II

THEME: Plasticine Boat Competition

PEDAGOGIES: Peer-learning (Group work), Inquiry-based Learning, Self-directed learning, Scientific Investigative Experiment, E-learning (Optional)

SCIENTIFIC ELEMENTS: STEM, Nature of Science, Scientific Investigation, Fair Tests

STEM:

- **Science:** Density
- **Technology:** Use of various tools and apparatuses for measurement
- **Engineering:** Design and make own plasticine boat models
- **Mathematics:** Measurement and Calculation of density of Plasticine boat models

MODEL: BSCS 5E Model

STAGE I: Engage

- Engage students by asking them a daily life scenario:
'Why a piece of steel sinks in water but a ship made up of steel floats on water?'



STAGE II: Explore

- Ask students the possible way(s) to test with limited materials and apparatuses in school laboratory
- Challenge students the importance and limitations of using models for testing (Nature of Science)
- Challenge students the possible way to change a piece of plasticine from sinking into floating on water
- Step-by-step guide students to work out (i) initial density of their plasticine boat models (ii) additional maximum mass of paper clips predicted to be added and (iii) number of paper clips predicted to be added
- Students work in groups to carry out their own investigation and compete with other groups



STAGE III: Explain

- Based on the experimental results collected, students are required to explain the results



STAGE IV: Elaborate

- Elaborate by interesting students:
 - (i) why there is a discrepancy between the theoretical calculated number and the actual number of paper clips to be held by their boats?
 - (ii) besides volume, is there any other factor(s) that also affects the no. of paper clips to be held by their boats?
- Relate the whole experiment as real-life stages of manufacturing of ship



STAGE V: Evaluate

- Encourage students to reflect on (i) systematic and (ii) random experimental error and further improvement in the design of the experiment

DETAILS OF MATHEMATICS' PART:

- For high caliber students, only key hinting questions are necessary
- For other students, step-by-step guiding should be provided to help students to work out the prediction

STEP 1: Measure the mass of the boat	✓ Use an electronic balance to measure the mass of the boat , e.g. 4 g.
STEP 2: Measure the volume of the boat	✓ Mold the plasticine into the boat shape ✓ Fill the inner cavity of the boat with tap water ✓ Pour the water filling the boat into a measuring cylinder to get a rough measurement of its volume
STEP 3: Calculate the total mass of paper clips to be held	$\text{Density} = \frac{\text{mass}}{\text{volume}}$ $1 \text{ g cm}^{-3} = \frac{(4 + ?) \text{ g}}{10 \text{ cm}^3}$ $\therefore \text{Mass of paper clips to be held is 6 g.}$
STEP 4: Calculate the total number of paper clips can be held	✓ If a paper clip has a mass of 1 g, the boat can hold: $(6 \div 1) = 6$ paper clips

LOGISTICS ARRANGEMENT:

- Divides into groups of three/four. Each group should carefully design their plasticine boat models. They should calculate the predicted number of paper clips to be held by their boat designed.

LESSON PLAN (SUGGESTED):

- 1 lesson (45 minutes) should be used to engage and prepare students for the experiment (including the mathematical part)
- 1 consecutive lesson (90 minutes) should be used for carrying out the competition
- 2 trials including interim reflection and evaluation period should be employed
- The following is the suggested time allocation for the consecutive lesson:

0:00 – 05:00 (5 minutes) Briefing	✓ Brief students about the task and key questions for thinking
05:00 – 25:00 (20 minutes) Construction of 1 st Draft	✓ Students construct their 1 st draft and make corresponding measurement
25:00 – 30:00 (5 minutes) Interim Evaluation	✓ Inspire students to think about some possible factors/ sources of errors causing the discrepancy between the predicted value and the actual value
30:00 – 50:00 (20 minutes) Construction of 2 nd Draft	✓ Students modify their 1 st draft to become a 2 nd draft and make corresponding measurements
50:00 – 80:00 (30 minutes) Competition Time	✓ All plasticine boats are weighed and tested with the no. of paper clips held on the teacher's bench
80:00 – 90:00 (10 minutes) Debriefing	✓ Summarize students' learning experience in the activity ✓ Elaborate the experiment by asking students related questions