Sinking and Floating Program of Study Daily Plans

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One *Possible* Instructional Path for Inquiring about SINKING AND FLOATING

Phase	dy	TEACHER Role	STUDENT Role
Engage	1	T says: *We'll spend next two weeks working to understand sinking/floating.* *What things do you know that sink or float?* [probe for whether has actually observed sinking/floating] *What things can you think of that sink AND float?* *So, what do you think makes something sink or float?* *Can you state a claim about that?* *What do you think is different about things that can sink AND float?* *What claims can you state about that?*	Ss offer ideas. Ss state claims.
		T says: *I have something for you to look at.* T describes Cartesian Diver System (CDS), shows drawing on transparency. T says: *I want you to watch what happens when I press down on the top, on the rubber sheet.* [presses down] *Now I am going to let up.* [lets up] *What did you see happen?* T says: *This is called a Cartesian Diver System. The small testtube (tt) inside is the diver. It is something that sinks AND floats. The question is, WHY or HOW can it do that?* *You will be exploring this system for the next few days. You will build one yourself, and work to explain why it behaves the way it does; that is, why the diver sinks and floats.*	Ss observe, describe what happened.
		T says: *Before we begin to work with the materials to make the CDS, we need to be sure that we know how we're going to: a) use the materials, b) record our thinking.* a) - enough materials for each S to make a CDS - have two types of divers, sm. tt, vial; in your pairs, you should each make a system with a different diver - put newspapers down (Table Captains monitor) - lg. beaker for holding CDS, sm. beaker for pouring water - eye dropper b) - have notebooks for this unit, loose paper in 3 ring binder - can use clipboards to hold paper and have off to the side so you can work with the system and then go over to your clipboard to write down your thinking and what you're finding out about the CDS *What do you think you might want to record of your thinking?* [probe for observations vs. claims; emphasize drawing, documenting at points in time, especially at point of floating, sinking]	Ss offer ideas about what they might document.
		T says: *One thing for you to know is that in order to best explore the CDS you need to make a very sensitive system. Here's what that means.* - shows diagram of sensitive system (lg. tt full of water, sm. tt floating right at water level) and one actual system that is sensitive vs. one that is insensitive (sm tt floating above rim of lg. tt) Who can tell all of us how we tell if we have a sensitive system? T says: *We're about ready to begin to work with the materials.* *Since you're going to make a very sensitive system, you can explore to figure out EXACTLY how to make the most sensitive system. So, think about doing that.* *Second, like we've done before, after we investigate we report our ideas by sharing them with one another in the class. So, let's make sure that we all remember what we're trying to find out that we want to share with one another. Who can tell us what we're trying to find out*? [probe for tasks of describing how make the CDS, especially how to make a sensitive CDS, then explaining how CDS behaves]	Ss describe a sensitive system. Ss state tasks.

Phase	dy	TEACHER Role	STUDENT Role
Investigate - procedures	1	Offer T system to observe to help Ss make own CDS. Monitor for making sensitive system. Press for recording observations, explanations, in notebooks. Press for comparison with different divers. [If needed, can use Australian version with some Ss, but only after they have recorded obs. & explanations that are sufficiently detailed.	Make sensitive system Study changes in system; document obsrvtns. Describe thinking to explain behavior.
- patterns		Scaffold Ss in generating claims (by group).	Generate claims about floating/sinking.
		Prompt for clean up. - dismantle systems - place rubber sheeting on paper towels to dry	Table Captains lead and monitor.
Reporting prepare to share	2	T asks: - what do you need to share? (claims) - where will you get the information from which you will share (notebooks)	Ss respond.
public sharing		Check to see how many are ready to share; take volunteers - review audience roles (accuracy of observations, clear presentation of evidence, claims, link of evidence and claims) [prompt for comparison of CDSs with diff. divers, monitor for level of description (e.g., measurement) and explanation for sinking and floating]	Present to class, answer questions. Ask appropriate questions of presenters. - statement of claim - accuracy of representation - presentation of evidence - coordination of evidence and claim
		Generate/revise *class* claims?	Indicate which claims they could "live with."
Engage	3	Australian version of CDS (A-CDS) - describe differences, show picture (trans.) - make predictions about: a) what will happen if press up; b) what will happen when let go	Write out predictions; describe reasoning.
		T says:*What are your ideas about how to make this system?* *A challenge will be to make this a sensitive system. How can we tell if it is?* • *Is there a way to tell if the diver is sensitive <u>before</u> putting it inside the system?* • *Do you think the diver will float by itself outside of the system?* • *Does anyone know of a way that we can get the lg. tt filled with water & upside down <u>before</u> we take it out of the water? (show position)* If Ss come up with idea, demonstrate what they're saying and draw on board. If Ss don't come up with idea, show them how a full lg. tt can be lifted as long as lip of tt stays under water. • *What do you think will happen if we put the diver underneath this (mouth of lg. tt)?* *- Do you think it will float? If so, where do you think it will float?* • *I won't do it now because you can try this yourself and see.*	Ss offer ideas. Ss make predictions.
		T says: *Again, when you make this system, make it with both sizes of divers.* Emphasize comparison, w/ orig. CDS, with types of A-CDS; measuring for specificity of information about systems and info that will help us explain behavior. *Have balances available if you want to weigh something* (need to review use with Ss?)	Ss indicate familiarity with using a balance.
Investigate - procedures	3	Offer T system to observe to help Ss make own A-CDS. Monitor for sensitive system (have Ss check one another). Press for more accuracy in recording observations, e.g., use of eye dropper to determine exact amt. water in sensitive system for each diver, use of other measuring devices to determine condition when in floating state, sinking state.	Build A-CDS. Measure to determine most sensitive system. measure to determine nature of conditions with in floating state, sunken state
- patterns		Scaffold Ss in making claims about sinking/floating - amt water in diver vs. size of diver; weight of diver (tt alone, vol. of water) 1 ml of H_2O has mass of 1 g; 1 ml of H_2O = 1 cm^3 (if det. by H_2O displacement)	Focus on similarities and differences in sm. tt & vial wrt getting them to float and point at which each begins to sink or is sunken.
		Prompt for clean up (dismantle systems, rub. shtng. on paper towel)	Table Captains organize.

Phase	dy	TEACHER Role	STUDENT Role
Report - prepare	4	Prepare to share. T says: *What conventions should we follow as we prepare to share?* *What information can you share?* [prompt for attention to numeric data]	 Focus on how to present w/ accuracy, clarity, ease of understanding.
- pub. sharing		Select volunteers to share by types of claims. Focus on relationship to class claims, i.e., whether the claims being shared represent refinements, revisions, completely new ideas.	 Present to class, answer questions. Ask appropriate questions of presenters.
	5	Continue with public sharing. Revisit class claims; revise, refine, etc.	 Indicate support of specific claims.
Engage	6	T says: *Our claims about sinking and floating were derived from the CDS. Do you think they would hold for another situation?* *I have a collection of objects for you to work with. Given our claims, what would you predict about whether each object sinks or floats? I would like you to record your thinking on this sheet of paper, which you will then place in your notebook.* T shows/describes each object, one at a time.	 Ss make predictions.
		T says: *Now, of course, there is more that you can do to make a good prediction before putting the objects in water. What can you do?* • *What might you measure to help you make a good prediction?* • *What kinds of properties did you measure of the CDS or A-CDS?* • *How did you measure those properties?* If needed: - *How would you measure the mass of these objects?* [if not enough balances, provide mass info.] How would you measure their volume? [if Ss haven't used displcmnt. tech., show Ss] T says: *Each of you will have several objects to measure, and we will share the information with the class. Several of you will have the same object, and we will compare that data, but no one will have all the objects so we'll need the data from everyone in the class in order to have what we need to know about all the objects.* *I have a chart here for you to use to enter your data when you have it.* *Does everyone know what they are to do with the objects and the data?*	 Ss offer ideas. Ss share knowledge. Ss restate task.
Investigate - procedures - patterns	6	Monitor for accuracy in using materials and procedures for measuring. Monitor for data being in "ballpark." Monitor for strategies to combine data. Monitor for how Ss handle outliers.	Meas. mass & vol. for 2-3 objects. Ss record data on chart. Ss examine data on chart. Ss discuss in groups the best value for each data point.
Report	6	(whole class) Monitor for strategies used, rationale for best value.	Determine best values to use.
Engage	7	Make new prediction regarding which items will sink, float, neither. Ask Ss how they will you use the data to help them make good predictions T says: *Now you will have the chance to test the items to see whether they sink or float. Think about what data you will record and how you will record it. The next step is to reexamine your claims about sinking and floating, and to come up with the best explanation you can about those phenomena.*	Ss share ideas. Use previous sheet to record new predictns.
Investigate	7	Monitor for comparison of predictions and observations; gen. explanations. Prompt Ss to compare predications with actual events & what means about claims.	Ss test items for sinking/floating.
Explanation		Introduce notion of crowdedness as a way to think about putting together the mass and volume data and explain sinking/floating.	

