Liquid Lenses Created in Space – Lesson/Activity Plan for Elementary School Teacher

Flying Physics into Space

Content: Physics, multidisciplinary

Age range: Elementary school, grades 4-6 (fun and educational for junior high school as well)

Activity duration: 90 minutes (double lesson)

Location of lesson: Classroom or laboratory

Rationale

A class activity comprised of demonstrations conducted by the teacher and experiments conducted by the children to understand the following concepts: density and buoyancy, surface tension of liquids, polymers, and polymerization. Learning about these concepts, which elementary school pupils are not familiar with, will enable the pupils to watch Eytan Stibbe conduct the liquid lens experiment and to understand it.

Description of the activity

This is a double lesson with three parts: In the first part, use a presentation to present the experiment that Eytan will conduct in space with liquid lenses. In the second part, select from several options in the lesson plan, either demonstration or experiment that demonstrates the physical principles. We recommend to select one experiment for each physical principle. The lesson plan also has suggestions for a fun and simple building activity that applies the scientific principle to produce a tangible product. In the third part, summarize the principles learned together with the pupils, and tie them to the anticipated experiment in space.

Objectives

1. To learn about and understand the following fundamental physics concepts: density, buoyancy, surface tension, and polymer (demonstration).
2. To facilitate hands-on learning (demonstration and experiment).
3. To apply the scientific ideas learned in a tangible product (building).
4. To learn about the liquid lens experiment that was sent to space as part of the Rakia Mission (presentations).

Key concepts: density, buoyancy, surface tension, polymer, and polymerization

Learning method: A combination of in-person teaching and independent learning

- Computer, projector and screen
- Prepare the **presentation on the liquid lens experiment – Eytan Stibbe,** and the **summary presentation** in advance.
- We recommend setting up the classroom in advance so that there is a central table on which the teacher can perform the scientific demonstration, and the children can comfortably perform experiments in pairs or small groups.

The Activity

Time	Stage	Topic	Aids
15 minutes	Introduction	Use the introductory presentation to present the liquid lens experiment that Eytan will conduct in space.	**The presentation on the liquid lens experiment: Eytan Stibbe** **The presentation:** Slides 1-7
60 minutes	Demonstration and research	Give a lesson with several experiment options that are either demonstrated or performed by the pupils. The experiments demonstrate the physical ideas underlying the concepts of density, buoyancy, surface tension, and polymer. An estimated duration for the activity is displayed next to each experiment. The lesson plan also contains recommendations for products the pupils will build, that reflect the scientific principles. We recommend adding an additional lesson to a building activity.	**The lesson plan** contains different links from the Davidson Institute for Science Education website, where there is a video with instructions for each experiment, as well as a list of supplies, and explanations for the teacher about the scientific background.
15 minutes	Summary	Summarize the principles learned together with the pupils, and connect them to the anticipated experiment.	**Summary presentation** for the teacher: Each scientific concept is addressed and defined, and how it ties in with Eytan's experiment. **The presentation:** Slides 8-12

Options for Demonstrations and Experiments

Topic	Breakdown	Experiment	Building activity
Buoyancy and density	To know whether a substance will float or sink in another substance we only need to know one characteristic, called **density** or specific gravity. Density, as its name implies, measures how dense the substance is, meaning how much mass it has relative to its volume, and is therefore measured in units of mass per volume, like g/cm^2. A less dense substance (which we would commonly call "a light substance") will float on a substance that is denser – and conversely: a dense substance will sink in a less dense substance.	Teacher demonstration: floating ice cube + ice cube in alcohol (15 minutes) Pupil experiment: Floating hardboiled egg (15 minutes) Pupil experiment: Dancing raisins (15 minutes)	Lava lamp (30 minutes)
Surface tension	All liquids in the world possess something called **surface tension**, which is a very thin and invisible membrane comprised of the liquid's elementary particles (atoms or molecules). It's created because the particles in the outermost part of the liquid are not surrounded on all sides by other particles. This causes an imbalance in the forces of attraction that they "feel", resulting in the formation of a hard "membrane" on the surface of the liquid.	Teacher demonstration: Milk drawings (15 minutes) Pupil experiment: Water vortex (10 minutes) Pupil experiment: Teacher demonstration of floating clothespin (10 minutes) Pupil experiment: Fill a cup of water with paper clip challenge Each group has a cup full of water and a package of paper clips (at least 100). First, the pupils need to guess how many paper clips they'll manage to place in the water before it spills out of the cup. Then	Soap boat (30 minutes)

		It's possible to place around 100 paper clips into a full cup when the pressure exerted by the surface tension of the water prevents the water from spilling out of the cup.	
Polymer and polymerization	The word polymer means "many parts" in Greek ("polys" = many, "meros" = parts).In chemistry, the concept refers to a long chain or macromolecule (huge molecule) that is made up of repeating units of a specific molecule. The chain or long molecule is called a polymer, while the small individual molecule that repeats in a chain is called a monomer (mono = one). The process whereby monomers combine chemically to produce a very large chainlike or network molecule is called a "polymerization reaction".	Pupil experiment: Glue drawings (15 minutes)	Climbing slime (30-40 minutes) How to make plastic from milk (30-40 minutes)

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