NIPISSING UNIVERSITY

UNIT PLAN FORMAT

TITLE OF THIS UNIT: Fluids-Viscosity, Density & Buoyancy
GRADE LEVEL(S): Grade 8
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BOARD: Peel Board of Education
PANEL (EI/Sec): Elementary
LENGTH OF UNIT: 12 hours (16 lessons x 45 minutes)
EDU Course Code:

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TASK CONTEXT

The study of fluids, which can be either liquids or gases, introduces students to fluid mechanics, an area of knowledge important in many industries (such as aeronautics, engineering, meteorology, and oceanography). Fluids, including air and water, are essential to many industrial processes and form the basis of hydraulic and pneumatic devices. Students will learn about the properties of fluids by experimenting with and investigating the viscosity and density of different liquids and ways in which these properties affect objects placed in those liquids. Students will explore the implications of Archimedes' principle by investigating and measuring the buoyant forces on different objects. As well, they will learn about the diverse applications of the principles involved in fluid mechanics, including industrial applications such as jet propulsion, and everyday applications such as ensuring that sauces are cooked to the right consistency (degree of viscosity).

This unit follows the unit of optics and life systems. As the fluids unit will discuss the functioning of the heart and other life systems using fluids, its placement in the school year after the life systems is essential. Furthermore, students will look at how viscosity and density can affect daily living from food to transportation. Students will be asked to recall material learned in previous units and from previous years (the Particle Theory for example.) The unit will be taught using written notes, brainstorming, experimentation and research to meet the needs of students of various learning styles and abilities. Group work will be prevalent to encourage co-operation, enquiry skills and the practice of correct laboratory methods. In addition, group work will help ESL students in the class to participate in classroom activities and to learn from their peers. The inclusion of demonstrations (discrepant events) and class discussions should help peak student interest and curiosity.

TASK SUMMARY

The unit will begin with an introduction to fluids where students will brainstorm different kinds of fluids, their uses in daily living, industry and life systems. Students will explore three properties of fluids- viscosity, density and buoyancy in terms of the Particle Theory of Matter. Students will explain, using the Particle Theory, how the viscosities, densities and buoyancies of various fluids differ and why. Demonstrations and notes will be given to describe the spaces between particles, movement of particles and the attraction between particles in solids, liquids and gases.

Laboratory experimentation in conjunction with a written note will help students compare viscosities of different fluids and investigate the effects of temperature on viscosity. The importance of flow rate in daily living will be discussed both in written and oral form. Next, students will use the Particle Theory to explain densities of different substances and they will be asked to relate viscosity levels to density. Using both

demonstrations and experimentation, students will discover first hand how fluids of differing densities interact. Once the concept of density is introduced, students will be asked to calculate density, mass and volume using the equation D=M/V. The final task of this unit will be to discuss buoyancy while relating it to density. Students will participate in a Science Olympics in which they will be asked to construct the most buoyant aluminium foil boat using their knowledge of density and displacement. Applications of buoyancy, namely ballasts and swim bladders, will be also be discussed.

The students will have completed a unit on life systems that will be essential if students are to make connections between fluids and life processes such as respiration and heart function. Furthermore, introduction of these three properties of fluids will establish a basis for the second part of the fluids unit- hydraulics and fluid mechanics.

OVERALL UNIT EXPECTATIONS

1. Demonstrate an understanding of the properties (e.g., viscosity) and the buoyant force of fluids
2. Investigate the buoyant force and other properties (e.g., viscosity) of fluids, and design and construct pneumatic or hydraulic systems that solve a problem in a given situation;
3. Describe how knowledge of the properties of fluids can help us to understand and influence organisms in the natural world

Understanding Basic Concepts
By the end of Grade 8, students will:

4. Compare various liquids in terms of their viscosity (e.g., water, syrup, oil, detergent, ketchup);
5. Compare qualitatively the densities of solids, liquids, and gases;
6. Predict how the flow rate (an indicator of viscosity) of different liquids is affected by temperature;
7. Describe qualitatively the relationship between mass and weight (e.g., the mass of an object is constant but the weight of an object varies as the pull of gravity on the object changes);
8. Describe qualitatively the relationship between viscosity and density (e.g., with some exceptions, the greater the viscosity, the greater the density);
9. Determine, through experimentation, the mass-to-volume ratio of different amounts of the same substance (e.g., copper pennies);
10. Describe the relationship between the mass, volume, and density of solids, liquids, and gases, using the particle theory;
11. Compare fluids in terms of their compressibility or incompressibility (e.g., gases versus liquids);
12. Recognize and state the relationship between gravity and buoyancy (e.g., without gravity there is no buoyancy);
13. Explain the effects of changes in temperature on the density of solids, liquids, and gases, and relate their findings to the particle model of matter;

Developing Skills of Inquiry, Design, and Communication
By the end of Grade 8, students will:

14. Formulate questions about and identify needs and problems related to the properties of fluids, and explore possible answers and solutions (e.g., design a fair test to determine whether oil, water, or glycerol has the greatest viscosity);
15. Plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions;
16. Use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results (e.g., use terms such as *flow rate, viscosity, compressibility, fluid, density, pneumatics, hydraulics*);
17. Compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, graphs, and stem-and-leaf plots produced by hand or with a computer (e.g., accurately measure and record the density of different

liquids using a hydrometer);

18. Communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., create a table to show the relationship between the buoyant force and size of object);

Relating Science and Technology to the World Outside the School

By the end of Grade 8, students will:

19. Describe situations in which the density of a substance changes naturally (e.g., molten lava as it cools; air when mirages form) or is intentionally altered (e.g., air in a hot-air balloon; cream when it is churned and cooled);
20. Identify some design features (e.g., of aircraft, cars, submarines) and explain how the design makes use of one or more of the properties of fluids;

identify industries in which the principles of fluid dynamics play a central role (e.g., aeronautics, shipping).

PRIOR KNOWLEDGE

LEARNERS

At the start of this unit, students should be familiar with the Particle Theory of Matter and basic knowledge about the different states of matter. They should know terms including solution, mechanical mixtures, particles. A brainstorming activity that will ask students to list all they know about fluids (different kinds, uses, occupations related to fluids, application in industry, homes, environment and the human body) will serve as a pre-assessment tool. Students in the class will be coming from different academic backgrounds and different language abilities as well. The pre-assessment will help determine the time allotted to review and the overall progression of the unit.

LEARNING ENVIRONMENT

SPACE

- Classes will be held in a science laboratory with movable desk and chair, sinks and side lab benches.
- Students will be seated at desks in groups of three. As the desks are movable, they will be rearranged for laboratories and for the Science Olympics. Desks will be pushed to the sides of the room to make space for the Olympics.
- Tables are available at the back of the room to arrange materials for labs
- A computer and projector will need to be reserved for a PowerPoint presentation for the subtask on density
- The room is very spacious and comfortably seats up to 25 students

TIME

- Each 6-day cycle will consist of two 45 minute lessons and one 90 minute double period reserved for laboratories (three will be required in this unit)
- Settling students in, taking attendance and collecting assignments generally takes 10 minutes so each lesson should run 35 minutes

CULMINATING ACTIVITIES

Throughout the unit, students will be asked to submit laboratory reports and density word problems for evaluation.

The final assessment will consist of a one period long unit test. Students will complete a unit test that will assess knowledge and understanding, problem solving and application skills acquired over the course of the unit. The test will consist of multiple choice, true/false, short answer questions and diagram labelling. Students will be asked to recall knowledge of relevant terms (fluids, density, flow rate, buoyancy, gravity, displacement, potential energy viscosity.)

UNIT-WIDE RESOURCES

- Nelson Textbook and Teacher Resource Book –Fluids Unit (only one class set is available so work must be completed in-class)
- PowerPoint and computer
- Internet/Web pages – http://school.discovery.com/teachingtools/teachingtools.html (for activities)
  http://camillasenior3.homestead.com/fluids.html (Links and Fluids Information)
  http://www.marcopolo-education.org/ (Brain teasers and lesson ideas)
  http://www.eiu.edu/~scienced/3290/science/discrepant/wannacoke.html (Coke discrepant event)
  http://tiger.coe.missouri.edu/~pgermann/DiscEvent/ (Discrepant events –alcohol and water)

- Assessment tools: formal lab report rubric, unit test, homework checklist, peer/self evaluation checklist
- Handouts: Viscosity lab instructions, density worksheet, density word problems, Science Olympics Instruction Sheet
- Materials – rubbing alcohol
  - food colouring
  - beakers
  - test tubes
  - card board ramps
  - stop watches
  - liquids for testing (corn syrup, shampoo, ketchup, chocolate, corn starch)
  - salt
  - eggs
  - foil paper
  - large basin
  - oil
  - vinegar
  - seasonings

TEACHER PLANNING SHEET – LIST OF SUBTASKS

DAY	SUBTASK DESCRIPTION	SPECIFIC EXPECTATIONS	TEACHING/ LEARNING STRATEGIES	RESOURCES	ASSESSMENT EVALUATION Type - Strategy Tool	PLANNING NOTES
1	(45 minutes) Introduction to Fluids A brief introduction to fluids will be given. As a preassesement, students will be asked to brainstorm all they know about fluids (kinds, uses, applications, occupations.) The ideas will be presented to the rest of the class.	1 3 19 20	1. Socratic dialogue: The teacher will begin by asking students what the term fluids means to them. This will lead into a discussion about the states of matter and the particle theory. 2. Brainstorming: In groups of three students will brainstorm using a web set-up all they know about fluids. Each group will briefly share their ideas. Using the knowledge from the brainstorming, a short note on the Particle theory of Matter will be given. 3. Lecture: Students will copy a short note on fluids that will be written on the board	Teacher will refer to the Nelson text and teacher resource book. Chart paper and markers for brainstorming	The scope and detail of the brainstorming ideas will be used to assess background knowledge. Questions will be asked throughout the lesson to determine student understanding.	Several ESL students are in each of the four classes being taught. Allow for extra time for students to copy note or provide a handout that students just need to fill in Seat ESL students with top students who would be willing to help out.
2	(45 minutes) Fluids-Lesson Two Review Particle Theory of Matter and add more detail. Students will dramatize the behaviour of particles in each state of matter. Topics such as turbulence, streamline flow, air/wind resistance will be introduced. Students will read and complete questions on these topics	1 3 4 13 14 16 20	1. Demo: Class will begin with a demo using ketchup, fries and vinegar. Students will be asked to explain the behaviours of the three substances using the particle theory. 2. Activities: Dividing the class into three groups, each group will dramatize one of the 3 states of matter. Students will read and complete questions on turbulence, streamline flow, resistance. Teacher will be available to offer extra help for struggling students and to keep students on task.	Overhead/ blackboard Nelson Text	Informal evaluation of dramatization Answers to questions will be collected and checked for completeness and accuracy	During the dramatization, be aware of volume levels, off task behaviours and uncooperative behaviour Desks may be rearranged for dramatization Analogy- best friends (solids), acquaintances (liquids), enemies (gases) Although students cannot take texts home, a few photocopies of the material should be made for ESL and LD students who will require extra time to complete the assigned work

3	(45 minutes) Introduction to Viscosity Demo of "disappearing liquids" using rubbing alcohol and water to explain the space between particles. Conduct a discussion asking students to explain the loss of volume. This will lead to viscosity and how the space between the particles and low attraction between particles leads to flow and viscosity. Short written note on viscosity	1 4 5 10 13 14 16	1. Demo: The teacher will measure out equal volumes of water and alcohol. I will talk through my procedure, asking students to form hypotheses about what will happen if equal volumes of alcohol and water are combined. Discussion about how particles move past each other 2. Lecture: Ask students to describe the movement of particles in a thick fluid versus a thin one. Get volunteers to dramatize particles in think fluid (ketchup) and thin (vinegar).Define viscosity, and provide a short note on the board or overhead projector. Students will take notes Prepare students for lab class	Vinegar Colouring 1 L container Water/sink Overhead projector or black board Internet Cross word puzzle for homework	Informal assessment based on discussion Teacher must prepare guided questions for discussion Take up homework questions next day	Students will need to gather around the back sink. They may stand or move their chairs to the back. Be prepared for much discussion. This is an opportunity to challenge gifted students with a brief intro to chemical structures of molecules Teacher should practice demo prior to class (different concentrations of alcohol will affect results) Make note brief. Students will discover details in the lab next class. Tips: **H**igh viscosity=**H**ard to pour OR **L**ow viscosity= **L**iquidy
4	(90 minutes) Viscosity Race Lab Students will conduct an experiment in groups to investigate the relationship between viscosity and flow rate of various liquids	1 3 4 6 13 14 15 16 17 18 20	1. Socratic Dialogue: Take up homework as a short review of last class and to introduce the lab activity. 2. Investigation: Students will work in the assigned groups of 3-4 to complete a lab on viscosity and flow rate. The teacher will review classroom rules and monitor on task behaviour and answer questions. Students will have time to copy out lab procedures, questions etc prior to the end of class. (see attached)	Ramps Tape Shampoo Ketchup Corn syrup Corn starch for extension Stop watches Rulers Wax paper Lab sheet handout	Students will submit a formal lab report to be marked out of 100 marks. Teacher may wish to include a peer/ self evaluation in the assessment	Ensure that groups include students of different academic levels and ESL students. Each group should assign tasks to each group member to promote a sense of responsibility and co-operation Students need to be reminded to clean up after the lab. You may wish to include a mark for this to ensure it gets done.
5	(45 minutes) Viscosity and Temperature Collect lab reports Quiz-Fluids and the Particle Theory (short and with recall or recognition questions only)	1 3 4 6 13 16 20	1. Assessment: A short quiz will be distributed and will be taken up in class 2. Demo and Dialogue: Teacher will demonstrate the effects of increased temperature on the flow rate of fluids. Students will be asked to	Quiz Hot plate Blow Waxed paper Ramp Stop watch	Peer marked quizzes collected and marks recorded Informal assessment during discussion	In some classes, peer marking may not be advised either due to history of cheating or the time it takes for students to mark If a hot plate is not available,

	Chocolate demo showing the effects of temperature on flow rate followed by note. As heat is added, particles gain energy, move quicker, have more space and less attractive forces. Therefore lower viscosity results		explain what is happening at the particle level 3. Lecture: The dialogue will be summarized in a short note 4. Homework questions assigned	Chocolate Blackboard	Take up homework next class	use a microwave prior to class then keep it in a hot water bath If time permits, try using dark vs milk chocolate
6	(45 minutes) <u>Introducing Density</u> Take up homework Density Demo using Regular and Diet Coke-introduce ideas of displacement, mass, volume and refer back to the Particle Theory. PowerPoint Presentation and note. Discuss density in everyday life	1 3 5 8 9 10 16 19	1. Homework question taken up 2. Demo: Students will examine cans of pop, will be asked to list similarities and differences. Teacher may record ideas on the board. Draw attention to volume of the cans. Place both cans in basin and discuss results. 3. Lecture: Using PowerPoint presentation provide an introduction to density using animation, notes and applications. Introduce finding volume using displacement and calculations	Pop cans Water Basin Computer Projector PowerPoint file	Homework Participation checklist	Some classes may require more guidance to reach correct conclusions about varying densities. You could bring in Nutra Sweet and sugar to show the different volumes, weigh the cans after the demo Have a written version of the powerpoint available in case of technical difficulties
7	(45 minutes x 2) <u>Density Lab</u> Quiz- viscosity Salad Dressing lab-students will investigate the effects of mixing fluids with different densities Comparing weight vs mass. Discuss change of mass on the moon etc. Recall appropriate units for mass and conversion (g->kg or kg-> g)	1 3 5 7 8 9 10 13 14 15 16 17 18	1. Assessment: A short quiz will be distributed and will be taken up in class 2. Investigation: In pre assigned groups students will make “salad dressing” using vinegar, oil, salt, pepper in a test tube. They will shake the mixture then let sit for ten minutes while they copy discussion questions. They will observe the test tube after allotted time 3. Lecture and demo: Will weigh a lump of clay in air and in water. Discuss mass versus weight and provide a note for the students.	Oil Vinegar Seasonings Test tubes Test tube holders Clay Beaker with water Spring scale	Peer marked quizzes collected and marks recorded Collect discussion questions for evaluation	This lesson works well in a double period but can also be split into two classes with the topic of weight and mass being the second lesson ESL students may require more time for short answer quiz. Limiting questions to m/c, t/f or fill in the blanks may facilitate flow of lesson

8	(45 minutes x 2) <u>Density Word Problems</u> Lesson 1: Review definition of density and volume equations Complete several word problems with increasing difficulty Assign homework Lesson 2: Quiz on density (no word problems) Take up homework	1 3 5 7 9 16 18	Lesson 1: 1. Socratic Dialogue: Have a beaker with oil and water. Ask students to remind you why the layering occurs in terms of density. How can density be quantified? 2. Lecture: In a note, state the equations for volume and density. Starting with simple word problems and progressing to more difficult questions, complete sample problems with students. 3. Activity: Assign 3 word problems for homework. Students can begin working on them in class Lesson 2: 1. Quiz: Students will complete a 10 minute quiz on density (no word problems) Quiz will be corrected in class 2. Homework: Homework questions will be taken up in class. Ask students to help you work through problems on the board 3. Activity: Give students time to copy out questions for their density assignment. Those that finish copying can begin answering word problems.	Beaker Oil Water Colouring (optional) Black board Question sheet	Take up homework questions Peer marked quizzes collected and marks recorded Word problems will be collected and marks will be recorded	Some students will struggle with the mathematics involved in this section. Be sure to review volume problems. Be clear on the proper format for answering such problems (given. unknown, solution, therefore statement)
10	(90 minutes) <u>Buoyancy Science Olympics</u> Using their knowledge of density and displacement, students will construct the most buoyant boat using limited materials A brief introduction of buoyancy will be given to help students identify the relationship between buoyancy and density	1 3 9 10 14 15 16	1. Socratic Dialogue: Review the results of the pop can demo. Ask students what allowed one can to float but not the other. Review displacement and how comparisons of density are made 2. Investigation: Distribute activity sheet and materials. Outline the activity expectations to the whole class. Ensure students are not cheating and be available to answer questions. Students will present their boat and compete. (see attached)	Foil paper Ruler Scissors Basin Sinks Pennies	Collect a written rationale for the boat design (one copy from each group) for evaluation or to determine level of understanding. This may help in planning the detail for the next lesson	Make an Olympic symbol on the blackboard, medals, have a prize available Be clear on instructions and timing will be key Be prepared for high noise levels. Perhaps establish consequences for out of hand behaviour (no prize)

11	(45 minutes) <u>Buoyancy , Gravity and Density</u> By discussing the results of the Science Olympics, we will define buoyancy and its relationship with density Discussion of gravitational and buoyant forces in fluids Positive, neutral and negative buoyancy	1 3 9 10 12 13 16 18	1. Socratic Dialogue: Have sample boats displayed at front. Discuss the results of the Olympics and ask why students believe the winning group won. Guide them to think about displacement, density, area/volume. Use examples 2. Lecture: On the blackboard, summarize the discussion and provide a note including the definition of buoyancy. Explain the role of gravity and its relationship with buoyancy. Give examples of hot air balloons, helium balloons. Include negative, neutral and positive buoyancy.	Aluminium boats Blackboard	Informal assessment through discussion	This is a great place to review density and the particle theory. Guide discussions to include relevant terms
12	(45 minutes) <u>Application of Buoyancy</u> Students will learn about the application of buoyancy in nature and technology Will look at swim bladders, ships, ballasts	1 3 9 10 12 16 18	1. Demo: Egg floating in salt water and sinking in tap water-ask questions to promote a discussion 2. Socratic Dialogue: Short discussion/review of buoyancy. Use a brain tester to stimulate thinking 3. Activity: Students will read the section entitled “Ballasts and Bladders” in their textbooks and will complete questions from the text. Answers will be submitted for evaluation. 4. Take up some questions in class to ensure students are on the right track	Nelson text-fluids unit Beakers Salt eggs	Collect answers to questions at the end of the section	
13	(45 minutes) Unit Test Students will complete a 35 minute unit test that will assess their knowledge and understanding of fluids. The test will assess their problem solving skills, and case study applications. The test consists of m/c, t/f, matching, short answer, labelling, and word problems for density.		Distribute tests- students have the bulk of the period to complete the test. Students who finish can work on fluids brain teasers	Test papers Calculators Pencils	Test marking scheme	Ensure the correct number of tests are photo copied LD students may require extra time as directed by resource teacher

ACCOMODATIONS

SPECIAL NEEDS

Seating Plan: Students with LD or ESL students will be seated near or with stronger students in this subject area. It is important to ask the stronger students if they are willing to help struggling students with their work. Choose only those students who have shown themselves to be consistently helpful, respectful and considerate to school and classroom rooms. Also visually or hearing impaired students will be seated near the centre and front of the class.

Teaching Strategies: The lessons will be broken down into shorter segments to help maintain student interest and attention. Because there are several ESL students in my classes, notes are short and explained verbally prior to writing on the board. Many visual cues and demonstrations are included in most lessons. Also, with the advice of resource and ESL teachers, these students will be given extra time to complete test/quizzes and assignments.

Extra Help: All students have been told they may come in for help. Computers and the internet are also available on the 2 classroom computers.

DIVERSITY ISSUES

A variety of teaching strategies are employed in this unit. Using visual cues, demonstrations, dramatic representations, written notes, hands on activities and labs not only helps the teacher maintain interest on the part of students, it also helps accommodate students with different learning styles.

Being sensitive to cultural diversity in the classroom is essential. Try to encourage students of different backgrounds to express their opinions and bring different examples into discussions. Also, the female students need to be encouraged to part take in classroom discussions. A zero tolerance on derogatory statements needs to be established in order to create a classroom environment where risk taking is promoted.