GRADE 8

Unit A: Mix and Flow of Matter (Science and Technology Emphasis)

Overview: The materials that we use—including natural and manufactured ones—often take the form of fluids. Students learn that such diverse substances as air, natural gas, water and oil are fluids. In further investigations, they discover that many common household materials are aqueous solutions or suspensions in which the main component is water. Students learn that the properties of individual fluids are important to their use, including such properties as density, buoyancy, viscosity and the fluid's response to changes in temperature and pressure. The particle model of matter is introduced to help students make a conceptual link between the nature of matter and the specific behaviour of fluids.

Focusing Questions: What are fluids? What are they made of and how do we use them? What properties of fluids are important to their use?

Key Concepts

The following concepts are developed in this unit and may also be addressed in other units at other grade levels. The intended level and scope of treatment is defined by the outcomes below.

- WHMIS symbols and nomenclature
- pure substances, mixtures and solutions
- solute and solvent
- concentration
- solubility and saturation points
- particle model of matter
- properties of fluids
- viscosity and flow rate
- mass, volume, density
- pressure
- buoyancy

Outcomes for Science, Technology and Society (STS) and Knowledge

Students will:

1. Investigate and describe fluids used in technological devices and everyday materials
   - investigate and identify examples of fluids in household materials, technological devices, living things and natural environments
   - explain the Workplace Hazardous Materials Information System (WHMIS) symbols for labelling substances; and describe the safety precautions to follow when handling, storing and disposing of substances at home and in the laboratory
   - describe examples in which materials are prepared as fluids in order to facilitate transport, processing or use *(e.g., converting mineral ores to liquids or slurries to facilitate transport, use of paint solvents to facilitate mixing and application of pigments, use of soapy water to carry away unwanted particles of material)*
   - identify properties of fluids that are important in their selection and use *(e.g., lubricant properties of oils, compressibility of gases used in tires)*

2. Investigate and describe the composition of fluids, and interpret the behaviour of materials in solution
   - distinguish among pure substances, mixtures and solutions, using common examples *(e.g., identify examples found in households)*
   - investigate the solubility of different materials, and describe their concentration *(e.g., describe concentration in grams of solute per 100 mL of solution)*
   - investigate and identify factors that affect solubility and the rate of dissolving a solute in a solvent *(e.g., identify the effect of temperature on solubility; identify the effect of particle size and agitation on rate of dissolving)*

- relate the properties of mixtures and solutions to the particle model of matter *(e.g., recognize that the attraction between particles of solute and particles of solvent helps keep materials in solution)*

3. Investigate and compare the properties of gases and liquids; and relate variations in their viscosity, density, buoyancy and compressibility to the particle model of matter
   - investigate and compare fluids, based on their viscosity and flow rate, and describe the effects of temperature change on liquid flow
   - observe the mass and volume of a liquid, and calculate its density using the formula d = m/v *[Note: This outcome does not require students to perform formula manipulations or solve for unknown terms other than the density.]*
   - compare densities of materials; and explain differences in the density of solids, liquids and gases, using the particle model of matter
   - describe methods of altering the density of a fluid, and identify and interpret related practical applications *(e.g., describe changes in buoyancy resulting from increasing the concentration of salt in water)*
   - describe pressure as a force per unit area by using the formula p = F/A, and describe applications of pressure in fluids and everyday situations *(e.g., describe pressure exerted by water in hoses, air in tires, carbon dioxide in fire extinguishers; explain the effects of flat heels and stiletto heels, using the concept of pressure)*
   - investigate and compare the compressibility of liquids and gases

4. Identify, interpret and apply technologies based on properties of fluids
   - describe technologies based on the solubility of materials *(e.g., mining salt or potash by dissolving)*
   - describe and interpret technologies based on flow rate and viscosity *(e.g., heavy oil extraction from tar sands, development of motor oils for different seasons, ketchup/mustard squeeze bottles)*
   - describe and interpret technologies for moving fluids from one place to another *(e.g., intravenous lines, pumps and valves, oil and gas pipelines)*
   - construct a device that uses the transfer of fluids to apply a force or to control motion *(e.g., construct a model hydraulic lift; construct a submersible that can be made to sink or float by transfer of a fluid; construct a model of a pump)*

Skill Outcomes (focus on problem solving)

Initiating and Planning

Students will:

Ask questions about the relationships between and among observable variables, and plan investigations to address those questions

- define practical problems *(e.g., How can we remove a salt coating from a bicycle or vehicle?)*
- identify questions to investigate, arising from practical problems and issues *(e.g., identify questions, such as: "What factors affect the speed with which a material dissolves?")*
- phrase questions in a testable form, and clearly define practical problems *(e.g., rephrase a question, such as: "Is salt very soluble?" to become "What is the most salt that can be dissolved in one litre of water at 23ºC?")*
- design an experiment, and identify the major variables *(e.g., design or apply a procedure for measuring the solubility of different materials)*

Performing and Recording

Students will:

Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

- carry out procedures, controlling the major variables *(e.g., carry out a test of the viscosity of different fluids)*
- use instruments effectively and accurately for collecting data *(e.g., measure the mass and volume of a given sample of liquid)*
- construct and test prototype designs and systems *(e.g., construct a model submarine that is controlled by an air hose connected to a syringe)*
- use tools and apparatus safely *(e.g., wear safety goggles during investigations of solution properties)*
- organize data, using a format that is appropriate to the task or experiment *(e.g., demonstrate the use of a database or spreadsheet for organizing information)*

Analyzing and Interpreting

Students will:

Analyze qualitative and quantitative data, and develop and assess possible explanations

- identify and suggest explanations for discrepancies in data *(e.g., explain a loss in the volume of a liquid, by identifying such factors as evaporation or absorption by a filtering material)*
- predict the value of a variable, by interpolating or extrapolating from graphical data *(e.g., extrapolate results to predict how much solute will dissolve in a given solvent at a given temperature)*
- identify new questions and problems that arise from what was learned *(e.g., identify questions, such as: "What techniques are used to remove pollutants from air and water?")*
- identify and evaluate potential applications of findings

Communication and Teamwork

Students will:

Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results

- identify and correct practical problems in the way a prototype or constructed device functions *(e.g., identify and seal leaks in a model fluid system)*
- work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means *(e.g., show the differences in flow rate, using a data table and diagrams)*

Attitude Outcomes

Interest in Science

Students will be encouraged to:

Show interest in science-related questions and issues, and pursue personal interests and career possibilities within science-related fields *(e.g., attempt at home to repeat or extend a science investigation done at school; investigate applications of fluid properties in technologies used in the local community)*

Mutual Respect

Students will be encouraged to:

Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., show awareness that knowledge of fluid characteristics has developed in many societies and cultures, based on practical experience with materials in the environment)*

Scientific Inquiry

Students will be encouraged to:

Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., regularly repeat measurements or observations to increase the precision of evidence)*

Collaboration

Students will be encouraged to:

Work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)*

Stewardship

Students will be encouraged to:

Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that the disposal of materials through drains creates needs for waste water treatment and may result in downstream environmental impacts)*

Safety

Students will be encouraged to:

Show concern for safety in planning, carrying out and reviewing activities *(e.g., take the time to organize their work area so that accidents can be prevented; read the labels on materials before using them, and ask for help if safety symbols are not clear or understood; clean their work area during and after an activity)*