Grade Eight Science

Aligned to the Alberta Curriculum

Written by Tracy Bellaire, Sandra Appleby and Andrew Gilchrist

The lessons and experiments in this book fall under 5 main topics that relate to the Alberta curriculum for Grade 8 Science – Unit A: Mix and Flow of Water, Unit B: Cells and Systems, Unit C: Light and Optical Systems, Unit D: Mechanical Systems and Unit E: Freshwater and Saltwater Systems. In each lesson you will find teacher notes designed to provide guidance with the learning intentions, the success criteria, materials needed and a lesson outline. As well, the notes will provide some insights on what results to expect when the experiments are conducted. Suggestions for differentiation or accommodation are also included so that all students can be successful in the learning environment.

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AT A GLANCE

FOUNDATIONS

This resource is structured to address the four program foundations of science literacy.

Foundation 1: Science, Technology and Society (STS)
Students will develop an understanding of the nature of science and technology, the relationships between science and technology, and the social and environmental contexts of science and technology.

Nature of Science: *learning about the nature of things, based on observation and evidence.Scientific activity provides a conceptual and theoretical base that is used in predicting, interpreting and explaining natural and technological phenomena. Science-based ideas are continually being tested, modified and improved as new knowledge and explanations supersede existing knowledge and explanations.*

Science and Technology: *solving practical problems that arise from human needs. In technology the focus is on the development of solutions, involving devices and systems that meet a given need within the constraints of the problem. The test of science knowledge is that it helps us explain, interpret and predict; the test of technology is that it works - it enables us to achieve a given purpose.*

Social and Environmental Contexts of Science and Technology: *Many new technologies have influenced, solved or given rise to complex social and environmental issues. The potential of science to inform and empower decision making by individuals, communities and society is a central role of scientific literacy in a democratic society.*

Foundation 2: Knowledge
Students will construct knowledge and understandings of concepts in life science, physical science and Earth and space science, and apply these understandings to interpret, integrate and extend their knowledge.

Life Science: *The growth and interactions of life forms within their environments reflect their uniqueness, diversity, genetic continuity and changing nature. Life science includes such fields of study as ecosystems, biological diversity, the study of organisms, the study of the cell, biochemistry, genetic engineering and biotechnology.*

Physical Science: *Chemistry and physics deal with matter, energy and forces. Matter has structure, and there are interactions among its components. Energy links matter to gravitational, electromagnetic and nuclear forces in the universe. The conservation laws of mass and energy, momentum and charge, are addressed in physical science.*

Earth and Space Science: *Earth and space science brings global and universal perspectives to student knowledge. Earth, our home planet, exhibits form, structure and patterns of change, as does our surrounding solar system and the physical universe beyond it. Earth and space science includes such fields of study as geology, meteorology and astronomy.*

Foundation 3: Skills
Skills - *Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively and for making informed decisions.*

Expectations in Each Unit of Study: *Students will ask questions about the relationships between and among observable variables, and plan investigations to address those questions. Students will conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data. Students will analyze qualitative and quantitative data, and develop and assess possible explanations. Students will work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results.*

Foundation 4: Attitudes
Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society and the environment.

Expectations in Each Unit of Study: *Students will be encouraged to show interest and appreciation, seek and apply evidence, work collaboratively with others, demonstrate a responsibility in pursuing a balance between the needs of humans and a sustainable environment and show a concern for safety.*

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UNIT A – MIX AND FLOW OF MATTER

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? *Students will investigate and describe fluids used in technological devices and everyday materials. Students will investigate and describe the composition of fluids, and interpret the behaviour of materials in solution. Students will 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. Students will identify, interpret and apply technologies based on properties of fluids.*

UNIT B – CELLS AND SYSTEMS

Focusing Questions: How can we make sense of the vast diversity of living things? What do living things have in common—from the smallest to the largest—and what variations do we find in the structure and function of living things? *Students will investigate living things; and identify and apply scientific ideas used to interpret their general structure, function and organization. Students will investigate and describe the role of cells within living things. Students will interpret the healthy function of human body systems, and illustrate ways the body reacts to internal and external stimuli. Students will describe areas of scientific investigation leading to new knowledge about body systems and to new medical applications.*

UNIT C – LIGHT AND OPTICAL SYSTEMS

Focusing Questions: What do we know about the nature of light? What technologies have been developed that use light, and what principles of light do they show? *Students will investigate the nature of light and vision; and describe the role of invention, explanation and inquiry in developing our current knowledge. Students will investigate the transmission of light, and describe its behaviour using a geometric ray model. Students will investigate and explain the science of image formation and vision, and interpret related technologies.*

UNIT D – MECHANICAL SYSTEMS

Focusing Questions: How is energy transferred in mechanical devices? How do mechanical devices provide for controlled application of energy in ways that are efficient, effective and responsible? *Students will illustrate the development of science and technology by describing, comparing and interpreting mechanical devices that have been improved over time. Students will analyze machines by describing the structures and functions of the overall system, the subsystems and the component parts. Students will investigate and describe the transmission of force and energy between parts of a mechanical system. Students will analyze the social and environmental contexts of science and technology, as they apply to the development of mechanical devices.*

UNIT E – FRESHWATER AND SALTWATER SYSTEMS

Focusing Questions: How do water, land and climate interact? What are the characteristics of freshwater and saltwater systems, and how do they affect living things, including humans? *Students will describe the distribution and characteristics of water in local and global environments, and identify the significance of water supply and quality to the needs of humans and other living things. Students will investigate and interpret linkages among landforms, water and climate. Students will analyze factors affecting productivity and species distribution in marine and freshwater environments. Students will analyze human impacts on aquatic systems; and identify the roles of science and technology in addressing related questions, problems and issues.*

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PROPERTIES OF FLUIDS – VISCOSITY AND PRESSURE

Learning Intention:

Students will 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.

Success Criteria:

- investigate and compare fluids, based on their viscosity and flow rate, and describe the effects of temperature change on liquid flow
- 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
- investigate and compare the compressibility of liquids and gases

Materials Needed:

- a copy of ***What is Viscosity?*** Worksheet 1 for each student
- a copy of ***The Answer is in the Suction!*** Worksheet 2 for each student
- a copy of ***The Marble Drop Experiment*** Worksheet 3 for each student
- a copy of ***Shear-ly Viscous!*** Worksheet 4 for each student
- a copy of ***Factoring in the Heat!*** Worksheets 5 and 6 for each student
- a copy of ***Pascal's Law*** Worksheets 7 and 8 for each student
- a copy of ***Pressure Test*** Worksheets 9, 10, 11, 12, 13 and 14 for each student
- small cups, straws, beakers, transparent graduated cylinders
- water
- small cups or glasses of ice cream, fresh from the freezer
- honey, ketchup, shampoo, corn syrup, sunflower oil, vegetable oil
- stop watches, thermometers, microwaves or hot plates
- marbles
- sheets of polymer or sponge rubber (letter sized)
- hole puncher
- butter knives or spreaders
- a spring scale
- small syringes, medium syringes, large syringes
- different lengths of plastic tubing (e.g., 30 cm, 50 cm)
- pens, pencils, pencil crayons, notebooks, clipboards, binders, rulers, scissors
- internet access, video equipment

Procedure:

***This lesson can be done as one long lesson, or be divided into shorter lessons.**

1. Divide students into pairs and give them Worksheet 1 and 2. Read as a class and check for understanding. The Think-Pair-Share exercise can be done at seats in partners or as a class discussion. Upon completion of this task, come back together as a large group and discuss to ensure students' understanding of the concept. Give each student the materials to conduct the experiment about viscosity.
2. Students will work in groups to further explore viscosity. Give them Worksheet 3 and Worksheet 4 and the materials to conduct the explorations.
3. Explain to students that they will investigate how temperature can affect the viscosity of a fluid. Give them the materials needed to conduct the experiment on Worksheets 5 and 6. Upon completion of the experiment, students are to understand that a fluid like corn syrup is more viscous when it is cold than when it is at room temperature or heated.

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4. Give students Worksheets 7 and 8. Read through the information and discuss with students the concept of Pascal's Law and how it can be interpreted in a hydraulic system and in a pneumatic system. As a class, brainstorm examples of hydraulic and pneumatic systems used around the home or in public places. Record the ideas on chart paper.
5. Group students in pairs. Give them Worksheet 9 and 10 and the materials to construct simple hydraulic and pneumatic systems to experiment with the effects of pressure. Upon completion of the experiments, students are to understand that:
   a) Water is not compressible. The volume doesn't change when it is pushed from one syringe into another. In a hydraulic system, the molecules are closer together so it is harder to compress them, making the response of pressure almost instant. Air is compressible. The volume of air decreases when it is pushed from one syringe into another. In a pneumatic system there is a delay as the air compresses and then expands. The second syringe doesn't immediately rise when the first syringe is compressed.
   b) It takes less force to push in a small syringe than it does to push in a large syringe in a system. When you push down the plunger of a smaller syringe, the plunger of the larger one will rise a smaller distance but with greater force.
6. Explain to students that they will investigate how pressure is calculated in a hydraulic system. A teaching option is to display the formula to calculate pressure ($P = F \div A$), then give an example of how to measure the area of a syringe, choose a measurement of force in Newtons as an example, in order to demonstrate how to calculate pressure.

   Once students have an understanding, divide students into partners. Give them Worksheets 11, 12, 13 and 14 and the materials to conduct the experiments. Upon completion, students are to understand that:
   a) It takes less force to push down on a small syringe in order to lift a load sitting on a large syringe. When the same load is on the small syringe, it takes a lot of force to push down on the large syringe to lift the load.
   b) The ratio of force to area means that a small force over a small area can generate a large force over a large area. If an effort force of 1 Newton is applied to a small area of 1 cm^2 the output force over a large area of 100 cm^2 in the same system will be 100 Newtons.

Note: Some of these activities contain material and investigations that can also apply to Unit D: Mechanical Systems

Differentiation:

Slower learners and students in need of accommodations may benefit by the reduced expectation of forgoing the experiment on the worksheets. An additional accommodation would be working in a small group with teacher direction to complete worksheet material. Viscosity can be easily demonstrated using a ramp and sample fluids. For a visual aid, set up an "Investigation Station" on a ramp where students can test fluids with or without supervision.

For enrichment or extension, faster learners could graph the results they recorded on the investigation worksheets. An additional accommodation would be for these learners to research different technologies based on flow rate and viscosity (e.g., oil extraction from oil sands, different motor oils for different seasons).

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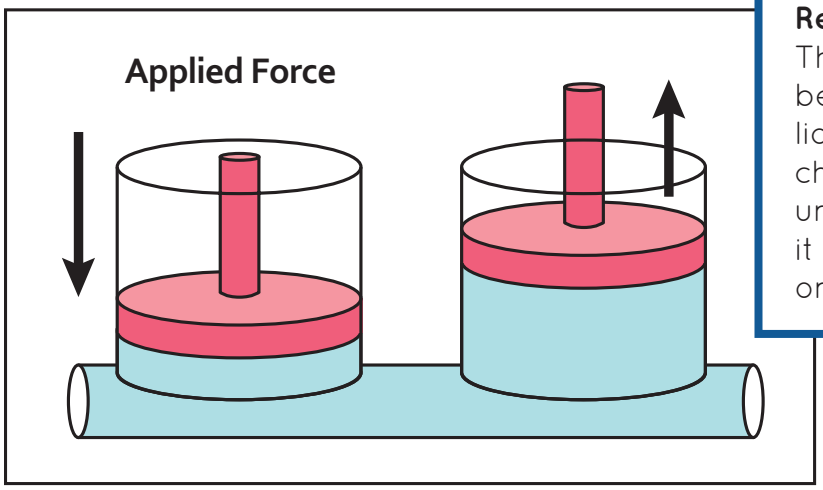
Name: _____

Pascal's Law

Blaise Pascal was a mathematician and physicist who conducted many scientific investigations to determine that forces can be transferred in all directions in fluids.

Pascal's Law states that when pressure is applied to confined fluids, the fluids transmit the same pressure in all directions within its container, at the same rate.



Remember! In the Particle Theory of Matter, the spaces between the particles in a liquid are relatively small. The change in volume of a liquid under pressure is very little, so it can be said that liquids are only slightly compressible.

A **hydraulic system** used by a lot of mechanical machinery, is based on the concept of Pascal's Law. A car hoist in a mechanic's garage is an example of a hydraulic system. The hydraulic fluid in this type of lift, which is petroleum oil with additives, cannot be compressed. It flows through the hydraulic system and exerts a force to move a cylinder that raises the car off the ground.

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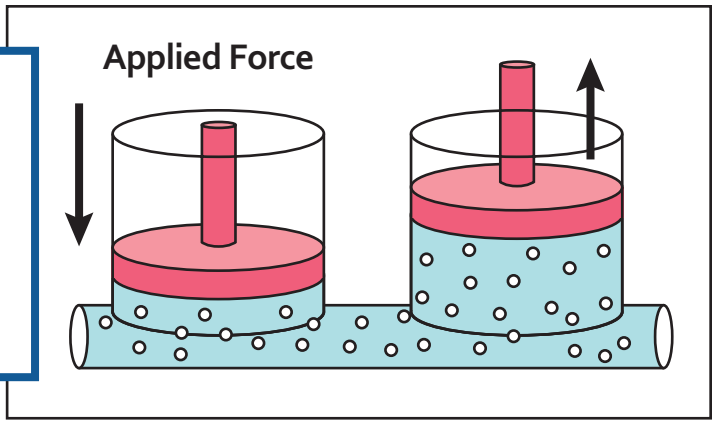
A **pneumatic system** works similarly to the hydraulic system, except this system uses a gas as the working fluid. In a pneumatic system, a gas (usually air) is compressed in order to get a mechanical motion effect.

Remember! In the Particle Theory of Matter, the spaces between the particles in a gas are very large. The change in volume of a gas under pressure is very significant, so it can be said that a gas is very compressible.



How does it work exactly?

Pneumatic tools work by use of air pressure that is provided by an air compressor. An air compressor has a gas powered pump mechanism that continually forces air into a steel container tank until the air becomes pressurized. The air from this air compressor is under **constant pressure**.

A pneumatic tool is connected to a hose that is attached to the tank with an air valve. Once connected, it opens the valve and pressurized air escapes under great force into the hose.

Each pneumatic tool, whether it is a hammer, ratchet, sand blaster or other air powered tool, has its own release valve or firing pin. When the trigger is pulled on the pneumatic tool, this firing pin opens a valve and pressurized air flows through the tool. The compressed air forces mechanical parts such as pistons, shafts, and cylinders to move.

A pneumatic system is often used for different kinds of hand tools and for machines doing repetitive motion. A nail gun is a good example of a pneumatic tool.

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Pressure Test

Let's do some investigating of the force caused by pressure from the compressibility of fluids, in liquid form as water, and in a gas form as air!

What you need

- 2 small syringes
- 2 medium syringes
- 2 large syringes
- a beaker of water
- different lengths of plastic tubing (e.g. 30 cm, 50 cm)

What to do

1. Put the tip of one syringe into the beaker of water and slowly pull the plunger out in order to fill it.
2. Attach it to one end of a piece of tubing. Push in the syringe plunger all the way to fill the tubing with water and empty the syringe.
3. Attach a second syringe (of a different size), full of water to the other end of the water-filled tubing.

**One syringe should be pushed out all the way and the other should be pushed in. When using two syringes of different sizes, have the small syringe full of water and the large syringe pushed out to begin with.*

4. Operate the completed hydraulic system by pushing down on one of the plungers. Record your observations on the worksheet.
5. Repeat steps 1–4 using different lengths of tubing.
6. Repeat steps 1–5 using syringes that are both the same size.
7. Repeat steps 1–6 using only **air** as the moving fluid.
8. Make a conclusion about your observations on the worksheet.

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Name: _____

Let's Observe

A Hydraulic System (water-filled)	A Pneumatic System (air-filled)
What effect did a small syringe have on a large one?	What effect did a small syringe have on a large one?
What effect did a large syringe have on a small one?	What effect did a large syringe have on a small one?
What difference did it make using two syringes of the same size?	What difference did it make using two syringes of the same size?

Let's Conclude

What conclusion can you make about the effect of pressure on the volume of water compared to the effect of pressure on the volume of air?

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