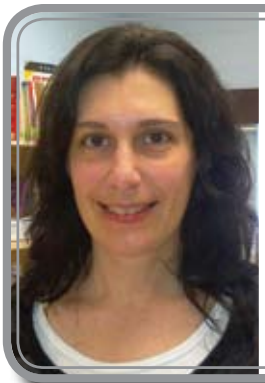
Physical Science

Grade 8

Written by Tracy Bellaire

About this Book

The experiments in this book fall under eleven topics that relate to three aspects of physical science: **Fluids and Dynamics, Systems in Action,** and **Light and Optical Systems.** In each section you will find teacher notes designed to provide you guidance with the learning intention, the success criteria, materials needed, a lesson outline, as well as provide some insight on what results to expect when the experiments are conducted. Suggestions for differentiation are also included so that all students can be successful in the learning environment.



About the Author:

Tracy Bellaire is an experienced teacher who continues to be involved in various levels of education in her role as Differentiated Learning Resource Teacher in an elementary school in Ontario. She enjoys creating educational materials for all types of learners, and providing tools for teachers to further develop their skill set in the classroom. She hopes that these lessons help all to discover their love of science!

Published in Canada by:
On The Mark Press
15 Dairy Avenue, Napanee, Ontario, K7R 1M4
www.onthemarkpress.com

OTM-2151 ISBN: 9781770788657

At A Glance

Learning Intentions	Solutions and Mixtures	Mass, Volume, Density	Viscosity	Under Pressure	Systems in Action	Work	Working Advantage	Behavior of Light	Transmission of Light	On the Spectrum	Optical Systems
Knowledge and Understanding Content											
• distinguish pure substances, mixtures, and solutions; use the particle theory to identify factors that affect solubility	•										
• describe the relationship between mass, volume, and density as a property of matter; determine buoyancy		•									
• describe the viscosity of various fluids and the affect of temperature on viscosity of these fluids			•								
• determine the relationship between force, area, and pressure for different fluids as related to Pascal's Law				•							
• identify various types of systems; describe their purposes, and components					•						
• investigate the relationship between work, force, and distance moved						•					
• determine the mechanical advantage in a variety of mechanisms and simple machines							•				
• investigate the behavior of light in terms of its travel, reflection, absorption, and refraction								•			
• distinguish between translucent, transparent, and opaque materials by examining their shadow effects									•		
• investigate the visible spectrum of color; place it among other light energies along the electromagnetic spectrum										•	
• describe the features and functions of the human eye, and other optical devices											•
Thinking Skills and Investigation Process											
• make predictions, formulate questions, and plan an investigation	•	•	•	•	•	•	•	•	•	•	•
• gather and record observations and findings using drawings, tables, written descriptions	•	•	•	•	•	•	•	•	•	•	•
• recognize and apply safety procedures in the classroom	•	•	•	•	•	•	•	•	•	•	•
Communication											
• communicate the procedure and conclusions of investigations using demonstrations, drawings, and oral or written descriptions, with use of science and technology vocabulary	•	•	•	•	•	•	•	•	•	•	•
Application of Knowledge and Skills to Society and the Environment											
• assess the social, economical, and environmental impacts of technologies that are based on the properties of fluids	•	•		•							
• assess the economic, social, and environmental factors that influence the evolution of a system					•	•					
• assess the impact of automation on society, the economy, and the environment							•				
• assess the impacts on personal health and safety of devices that apply the properties of light									•		

OTM-2151 ISBN: 9781770788657

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Student's Name: _____ Date: _____

Teacher Assessment Rubric

Success Criteria	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding Content				
Demonstrate an understanding of the concepts, ideas, terminology definitions, procedures and the safe use of equipment and materials	Demonstrates limited knowledge and understanding of the content	Demonstrates some knowledge and understanding of the content	Demonstrates considerable knowledge and understanding of the content	Demonstrates thorough knowledge and understanding of the content
Thinking Skills and Investigation Process				
Develop hypothesis, formulate questions, select strategies, plan an investigation	Uses planning and critical thinking skills with limited effectiveness	Uses planning and critical thinking skills with some effectiveness	Uses planning and critical thinking skills with considerable effectiveness	Uses planning and critical thinking skills with a high degree of effectiveness
Gather and record data, and make observations, using safety equipment	Uses investigative processing skills with limited effectiveness	Uses investigative processing skills with some effectiveness	Uses investigative processing skills with considerable effectiveness	Uses investigative processing skills with a high degree of effectiveness
Communication				
Organize and communicate ideas and information in oral, visual, and/or written forms	Organizes and communicates ideas and information with limited effectiveness	Organizes and communicates ideas and information with some effectiveness	Organizes and communicates ideas and information with considerable effectiveness	Organizes and communicates ideas and information with a high degree of effectiveness
Use science and technology vocabulary in the communication of ideas and information	Uses vocabulary and terminology with limited effectiveness	Uses vocabulary and terminology with some effectiveness	Uses vocabulary and terminology with considerable effectiveness	Uses vocabulary and terminology with a high degree of effectiveness
Application of Knowledge and Skills to Society and Environment				
Apply knowledge and skills to make connections between science and technology to society and the environment	Makes connections with limited effectiveness	Makes connections with some effectiveness	Makes connections with considerable effectiveness	Makes connections with a high degree of effectiveness
Propose action plans to address problems relating to science and technology, society, and environment	Proposes action plans with limited effectiveness	Proposes action plans with some effectiveness	Proposes action plans with considerable effectiveness	Proposes action plans with a high degree of effectiveness

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Name: _____ Date: _____

Student Self-Assessment Rubric

Put a check mark (✓) in the box that best describes you:

	Always	Frequently	Sometimes	Seldom
• I listened to instructions.				
• I was focused and stayed on task.				
• I worked safely.				
• My answers show thought, planning, and good effort.				
• I reported the results of my experiment.				
• I discussed the results of my experiment.				
• I used science and technology vocabulary in my communication.				
• I connected the material to my own life and the real world.				
• I know what I need to improve.				

1. I liked _____

_____

2. I learned _____

_____

3. I want to learn more about _____

_____

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Introduction

The activities in this book have two intentions: to teach concepts related to physical science and to provide students with the opportunity to apply necessary skills needed for mastery of science and technology curriculum objectives.

Throughout the experiments, the scientific method is used. The scientific method is an investigative process which follows five steps to guide students to discover if evidence supports a hypothesis.

1. **Consider a question to investigate.**
   For each experiment, a question is provided for students to consider. For example, "How is the degree of refraction affected, as light passes through mediums of different densities?"

2. **Predict what you think will happen.**
   A hypothesis is an educated guess about the answer to the question being investigated. For example, "I believe that the angle of refraction of a light ray will be smaller in a denser medium than in a less dense medium". A group discussion is ideal at this point.

3. **Create a plan or procedure to investigate the hypothesis.**
   The plan will include a list of materials and a list of steps to follow. It forms the "experiment."

4. **Record all the observations of the investigation.**
   Results may be recorded in written, table, or diagram format.

5. **Draw a conclusion.**
   Do the results support the hypothesis? Encourage students to share their conclusions with their classmates, or in a large group discussion format.

The experiments in this book fall under eleven topics that relate to three aspects of physical science: **Fluids and Dynamics, Systems in Action,** and **Light and Optical Systems.** In each section you will find teacher notes designed to provide you guidance with the learning intention, the success criteria, materials needed, a lesson outline, as well as provide some insight on what results to expect when the experiments are conducted. Suggestions for differentiation are also included so that all students can be successful in the learning environment.

Assessment and Evaluation:

Students can complete the Student Self-Assessment Rubric in order to determine their own strengths and areas for improvement. Assessment can be determined by observation of student participation in the investigation process. The classroom teacher can refer to the Teacher Assessment Rubric and complete it for each student to determine if the success criteria outlined in the lesson plan has been achieved. Determining an overall level of success for evaluation purposes can be done by viewing each student's rubric to see what level of achievement predominantly appears throughout the rubric.

Solutions and Mixtures

Learning Intention:

Students will learn to distinguish pure substances, mixtures, and solutions; and use the Particle Theory of Matter to identify factors that affect solubility.

Success Criteria:

- identify and describe the parts of a solution, then determine the usage of some solutions
- describe the effects of temperature on a solution in relation to the Particle Theory, using diagrams and written descriptions
- identify and describe characteristics of different mixtures
- distinguish pure substances from mixtures
- accurately sort household products into substances, mechanical mixtures, suspensions, emulsions, and solutions

Materials Needed:

- a copy of "The States of Matter" Worksheet 1 for each student
- a copy of "The Particle Theory of Matter" Worksheet 2 for each student
- a copy of "The Matter Game" Worksheet 3 for each student
- a copy of "A Matter of Solutions" Worksheet 4 for each student
- a copy of "Finding These Solutions" Worksheet 5 for each student
- a copy of "A Saturated Solution" Worksheet 6 and 7 for each student
- a copy of "Mixtures" Worksheet 8 for each student
- a copy of "Pure or Mixed?" Worksheet 9 for each student
- a copy of "Sorting It All Out" Worksheet 10 for each student
- sugar cubes, glass of cold water, glass of hot water, spoon (for each pair of students)
- pencils, masking tape

Procedure:

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

1. Give students Worksheets 1 and 2. Read and discuss the information to ensure students' understanding of the concepts of matter, changes in states, and the particle theory. Explain to students that they will play out the states of matter. In a large space such as a gym, use masking tape to outline a large area on the floor that is large enough to fit all students when they are standing about an arm's length from one another.

   a) Based on their knowledge of properties of solids, instruct students to move like they are molecules in a solid. (Students should be bunched together, barely moving, in a defined shape that is not the shape of their container).

   b) Based on their knowledge of properties of liquids, tell the students that the sun is coming out and they are melting. (Students should move in a fluid like fashion, taking the shape of their container, but not filling it).

   c) Based on their knowledge of properties of gases, tell students that more heat is being added and they are boiling. (Students should move in a straight line until they reach the wall or until **carefully** bumping into another "student particle." They should fill the container).

   *Teaching options at this point are to have a group discussion about how this exercise relates to the particle theory. Or, students can complete Worksheet 3 in order to show what they have learned throughout the exercise about the particle theory.

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2. Give students Worksheet 4. Read the information and discuss to ensure students' understanding of what makes a solution. With access to the internet, students can research some examples of solutions. Using Worksheet 5, they can record the solute, solvent, solution type, and its use. An option at this point is to come back as a large group in order for students to share some of their findings.

3. Explain to students that they will experiment with saturated solutions. Give them Worksheets 6 and 7 and the materials needed. After reading about what a saturated solution is, students will make a prediction to the question asked, conduct the experiment, record results, and make conclusions in relation to the Particle Theory of Matter.

   (The cold water isn't able to dissolve as much sugar as the hot water. The reason the hot water dissolves more is because it has faster moving molecules which are spread further apart than the molecules in the cold water. With bigger gaps between the molecules in the hot water, more sugar molecules can fit in between.)

4. Give students Worksheet 8. Read the information and discuss to ensure students' understanding of substances and mixtures. Using Worksheet 9, they will sort the items in the box into the categories of pure substances or mixtures.

5. Worksheet 10 is to be completed as homework. Explain to students that they must also come prepared to share similarities and differences of two of their items in a small group discussion.

Differentiation:

Slower learners may benefit by working in a small group with teacher direction to make conclusions on Worksheet 7. This would allow opportunity to review the Particle Theory of Matter and connect its postulates to a conclusion in the Saturated Solutions investigation. An additional accommodation would be to offer a reduced expectation of locating and recording only one example of each heading on Worksheet 10.

For enrichment, faster learners could choose one of their household items from Worksheet 10 and use the internet to research its ingredients and exactly how it is manufactured.

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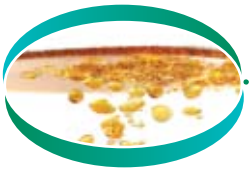


Worksheet 1

Name: _____

States of Matter

Matter is everything that has mass and takes up space. There are three states of matter, these being solid, liquid, and gas. How do states of matter change? Simply put, if you heat a material, it will change its state. This will usually happen from solid to liquid to gas. Sometimes solids change into a gas and are never a liquid. Carbon dioxide is such a material under atmospheric conditions.

There are six changes of state:

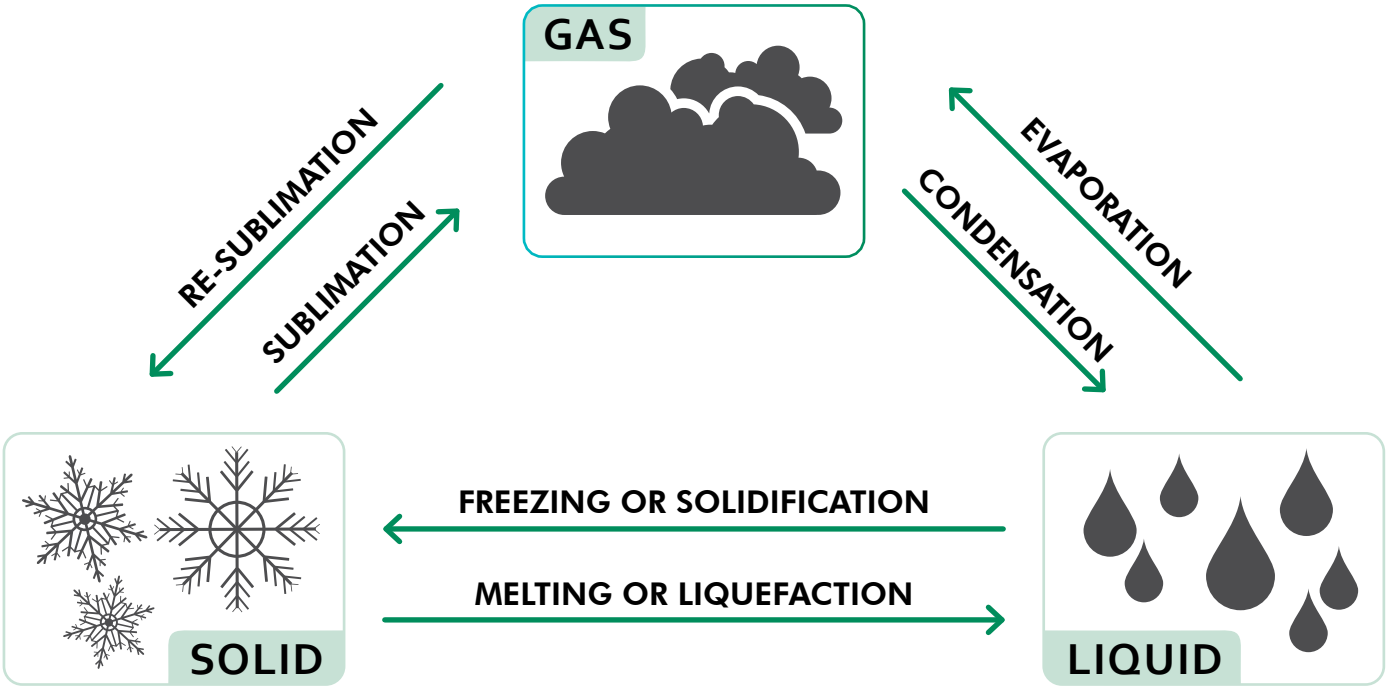
EVAPORATION is the change from a liquid to a gas.

CONDENSATION is the change from a gas to a liquid.

MELTING is the change from a solid to a liquid.

SOLIDIFICATION or freezing is the change from a liquid to a solid.

SUBLIMATION is either the change from a solid directly to a gas, or the change from a gas to a solid.



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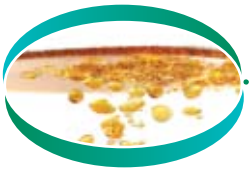


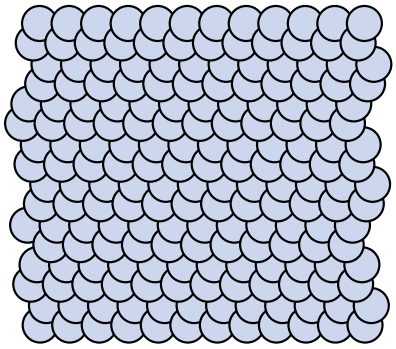
Worksheet 2

Name: _____

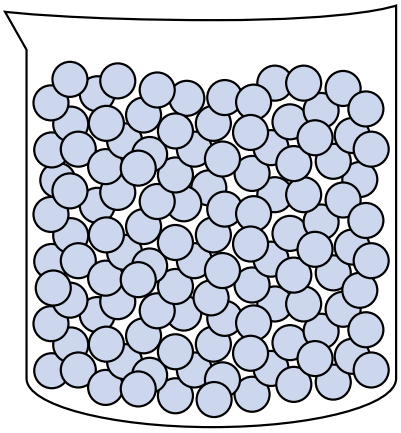
The Particle Theory

All three states of matter contain small particles. Imagine the particles as small spheres. In solids, the particles stay tightly together. In liquids, the particles interact loosely. In gases, the molecules travel in random directions at a variety of speeds, some are fast and some are slow. Sometimes these molecules collide with each other. These particles are called atoms or molecules. Molecules are several atoms clumped together. At higher temperatures, the particles move faster.

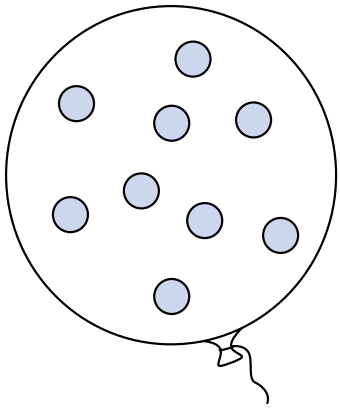
Solid



Liquid

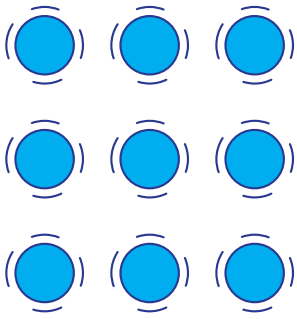


Gas

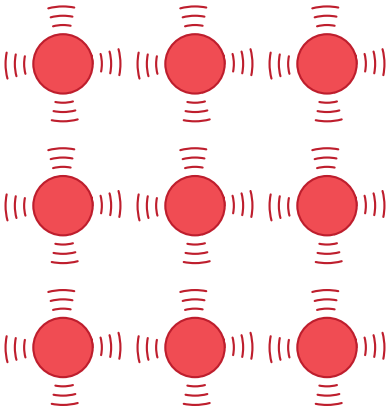


The particle theory also explains why substances expand when they are heated and contract when they are cooled. At high temperatures, particles have more energy, move more quickly, and have more collisions. As a result, they take up more space, and the substance expands. At lower temperatures, particles have less energy, move more slowly, and have fewer collisions. They take up less space, and the substance contracts.

Contraction



Expansion



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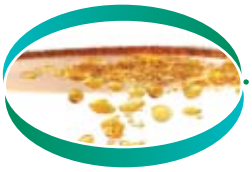


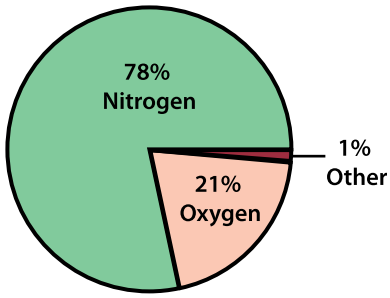
Name: _____

A Matter of Solutions

In chemistry, a solution is made of one phase where a solute, which is a substance, is dissolved into a solvent, which is another substance. Because the solute dissolves into the solvent and becomes one phase, it can be called a "homogenous" mixture. The particles of solute can no longer be seen once it has been dissolved into the solvent, and it cannot be separated back to its original state.

Solutions can be made up of gases, liquids, or solids. If the solvent is a gas, then only gases can be dissolved under a set of conditions. If the solvent is a liquid or a solid, then gases, liquids, and solids can act as solutes and can be dissolved into them.

When a solute like salt is added and mixed into a solvent like water, it becomes a homogeneous solution.



An example of a gaseous solution is air, which is oxygen and other gases dissolved in nitrogen.

Brass is an example of two solids being mixed together to create a solution. Brass consists of about 67% copper and 33% zinc.

Kool-aid is an example of solid flavored crystals being dissolved into water to create a solution, and a refreshing drink!

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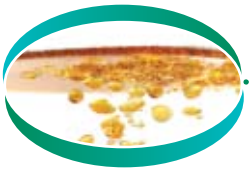


Worksheet 5

Name: _____

Finding These Solutions

Get on Task!

Your task now is to research some useful solutions.

- identify the solute
- identify the solvent
- determine the solution type (e.g., solid-liquid) *solute first, then solvent
- describe its usefulness

Solutions	Solute	Solvent	Type	Use

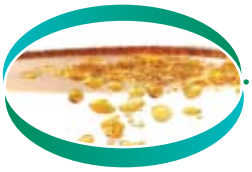
Challenge:

Why is water considered to be the universal solvent? _____

_____

_____

_____



Worksheet 8

Name: _____

Mixtures

A pure substance is made up of one type of particle. They cannot be separated into simpler substances by sifting, filtering, crystallization, or distillation. Pure substances will have a constant appearance, color, and density. Some examples of pure substances are sugar, salt, copper, and distilled water.

A solution is a combination of two things and it is well mixed. Salt water is a solution. The salt will never fall to the bottom of the water. It's stable. A heterogeneous mixture will settle. Chocolate milk is a heterogeneous mixture. If you wait, you will see the chocolate syrup settle at the bottom of the milk.

A mechanical mixture contains two or more pure substances. They can be any combination of solids, liquids, and gases. These mixtures can be separated into the pure substances making them up by physical or mechanical means because each pure substance retains its own properties. Some methods for separating the components of a mixture include sifting, filtering, crystallization, or distillation.

A **suspension** is a heterogeneous mixture of a solid and a liquid in which the solid does not dissolve. Suspensions will settle when left standing undisturbed. An example of a suspension is sand and water.

An **emulsion** is a heterogeneous mixture that consists of two liquids that do not mix. Emulsions will settle into layers when they are left standing undisturbed. An example of an emulsion is oil and vinegar.

Mixtures can be described as homogeneous, meaning they look the same throughout, like a solution. Or, they can be heterogeneous, where more than one type of matter can be seen.

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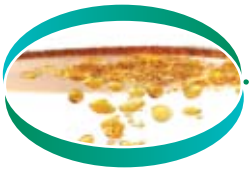

Worksheet 9

Name: _____

Pure or Mixed?

Categorize It!

Sort the matter listed in the box into the correct category. ***Add three of your own ideas into each category.**

bread	salt	gold	butter	baking soda
vinegar	steel	aluminum	sea water	salad dressing
oxygen	chocolate	milk	silver	
tap water	diamond	soda pop	distilled water	

Pure Substances	Mixtures
*	*
*	*
*	*

Optical Systems

Learning Intention:

Students will learn about the features and functions of the human eye, and other optical devices.

Success Criteria:

- describe the parts of the human eye, and common defects in human vision
- demonstrate how the convex lens of a human eye accommodates to focus on an object
- record observations and conclusions about the eye's ability to produce a clear image
- acknowledge and experiment with different optical systems that work to correct or enhance human vision

Materials Needed:

- 3 convex lenses of different thicknesses, a sheet of white paper 28 cm x 35 cm), a transparency with a drawing or large sticker on it, a ruler (a set for each pair of students)
- sunlight
- magnifying glasses, microscopes, telescope (optional), binoculars (a few of each)
- iPods, iPads, Macbooks, or video camera (optional), access to internet for research
- a copy of "The Human Eye" Worksheet 1 and 2 for each student
- a copy of "Bringing it into Focus!" Worksheet 3 and 4 for each student
- a copy of "Insightful Information" Worksheet 5 and 6 for each student
- pencils, pencil crayons

Procedure: *This lesson can be done as one long lesson, or in three shorter lessons.

1. Give students Worksheet 1 and 2. Read through with students and discuss the information about the human eye, how it works to achieve focus, and common defects.
2. Divide students into pairs. Give them Worksheet 3 and 4, and the materials to conduct the experiment with convex lenses. Upon completion of the investigation, students should understand that the thicker the convex lens is, the shorter the focal distance will be, and the image will be sharper. This is comparable to the human eye as when the eye sees an image up close, the lens' ciliary muscles work to curve the lens, causing it to become thicker, so that it can focus the image onto the retina.
3. Give students Worksheet 5 and 6. Explain to them that they will use what they have learned and access the internet to research the features and functions of the human eye and a camera, in order to compare and contrast them. Worksheet 5 could be completed in point form, with a detailed, descriptive, diagram of each on Worksheet 6.
4. Allow students to explore with optical systems such as magnifying glasses, microscopes, binoculars, or telescope. Using an iPod, iPad, Macbook, or video camera set up an oral response recording station. Students can record interesting findings about the optical device that they explored. Video clips could be viewed later, and discussed.

Differentiation:

Slower learners may work in small groups with teacher direction to complete the comparison of features and functions of optical devices on Worksheet 5 and 6. **For enrichment,** faster learners could research ways of correcting human vision (e.g., corrective lenses, laser surgery). A further extension for these learners would be to prepare a power point presentation to share their findings with the rest of the class. An alternative activity would be for these learners to compare the mammalian eye with that of other vertebrates and invertebrates.

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Worksheet 1

Name: _____

The Human Eye

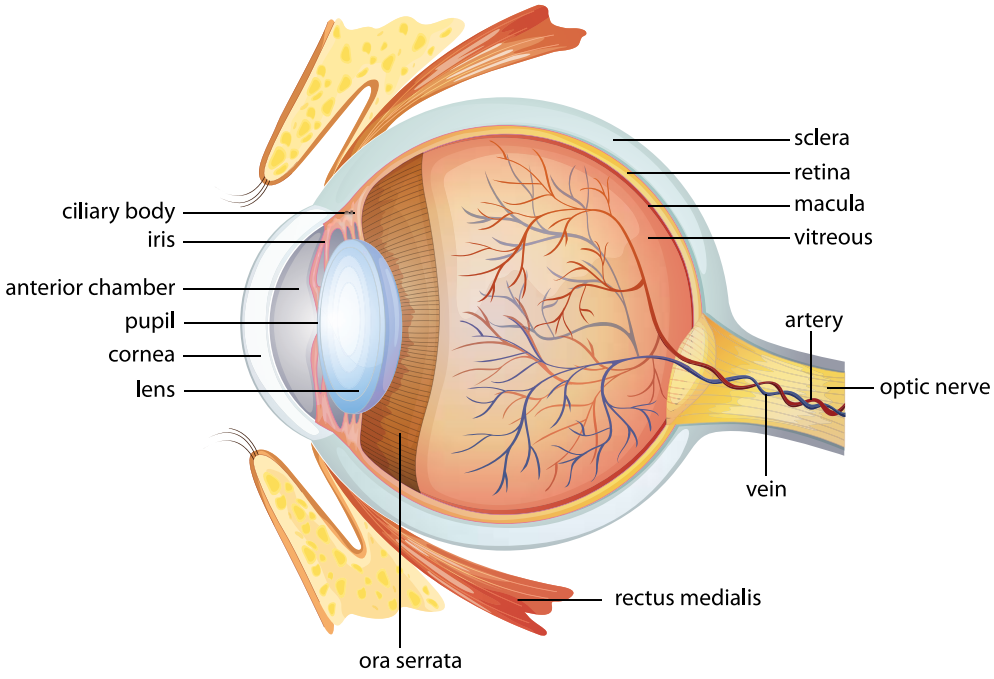
The human eye is an organ that responds to light. This optical system has many parts that work together to gather and control light, to gain focus, and to produce an image for the brain to register as an object within its sight.

The iris is the part of the eye that works to control the amount of light that enters the eye. In dim conditions, more light is allowed to enter so that a clear image can be formed on the retina. In order to let more light in, the radial muscles in the iris expand to open up the iris, which makes the pupil larger. In bright conditions less light is allowed to enter because the circular muscles in the iris contract to close up the iris, which makes the pupil smaller. This prevents damage to the retina.

As light enters the pupil, it is focused by the cornea and the lens onto the retina. In order for the image to come into sharp focus at the retina, the ciliary muscles in the eye work to change the shape of the lens by making the lens bulge in the middle if the image is close, and stretch if the image is farther away from the eye.

Once an image is formed on the retina, the optical nerve works to send electrical impulses to the brain, in order for it to register the image within sight, as an object.

Anatomy of the Human Eye



Worksheet 4

Name: _____

Let's Observe

In the chart below, record the focal distances of the image in focus for each of the convex lenses.

Convex Lenses	Focal distances measured (cm)
Thickest lens	
Thinner lens	
Thinnest lens	

Let's Conclude

Use the data that you collected in the chart to make a conclusion about the thickness of a convex lens and its focal distance. _____

_____

_____

_____

_____

_____

Let's Connect It!

How do your findings in this experiment connect with the knowledge you have already gained about the human eye's ability to see and focus objects at various distances?

_____

_____

_____

_____

_____

_____