Quinton Township School
5th Grade-Unit 1
Science

Unit 1 Summary- September/ October
Properties of Matter

When matter changes, does its weight change?

In this unit of study, students describe that matter is made of particles too small to be seen by developing a model. The crosscutting concept of *scale, proportion, and quantity* is called out as an organizing concept for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in *developing and using models*, *planning and carrying out investigations*, and use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives

Make observations and measurements to identify materials based on their properties. *[Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]* **(5-PS1-3)**

Develop a model to describe that matter is made of particles too small to be seen. *[Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]* **(5-PS1-1)**

Objectives Aligned with National Geographic Resources: Approximate Time Frame: 30 days

- Define matter as having mass and taking up space, and Describe matter as consisting of particles (2 days)
- Compare and contrast the properties of solids, liquids, and gases (2 days)
- Infer that a solution contains particles to small to see (2 days)
- Develop a model to describe that matter is made of particles too small to be seen (4 days)
- Construct and test a model (4 days)
- Evaluate the validity of a model (4 days)
- Use a model to successfully communicate a concept (4 days)
- Identify seven physical properties of matter (2 days)
- Describe hardness (2 days)

- Order the degrees of hardness of various materials (1 day)
- Determine the hardness order of materials by performing scratch tests (2 days)
- Describe magnetism (1 day)
- Identify substances that are attracted to a magnet (1 day)
- Explain how the property of magnetism can be tested (1 day)
- Classify matter based on its ability to conduct or insulate electrical energy (1 day)
- Identify materials that conduct and do not conduct electricity (1 day)
- Classify matter based on its ability to conduct or insulate thermal energy (1 day)
- Determine the solubility in water of various materials (1 day)

Quick Links

Unit Sequence	
Part A: *How can properties be used to identify materials?*	
Concepts	**Formative Assessments Record**

· Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. · Measurements of a variety of properties can be used to identify materials. *(At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)*	*Students who understand the concepts can:* · Measure, describe, and record physical quantities such as weight, time, temperature, and volume. · Make observations and record measurements to produce data that can serve as the basis for evidence for an explanation of a phenomenon. · Make observations and record measurements to identify materials based on their properties. Examples of materials to be identified could include: ü Baking soda and other powders ü Metals ü Minerals ü Liquids Examples of properties could include: ü Color ü Hardness ü Reflectivity ü Electrical conductivity ü Thermal conductivity ü Response to magnetic forces ü Solubility ● Exit Tickets ● Journal Responses ● End of Unit Assessment

Unit Sequence	
Part B: *What kind of model would best represent/describe matter as made of particles that are too small to be seen?*	
Concepts	**Formative Assessments**

· Natural objects exist from the very small to the immensely large. · Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by means other than seeing. · A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.	*Students who understand the concepts can:* · Develop a model to describe phenomena. · Develop a model to describe that matter is made of particles too small to be seen. (Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.) Examples of evidence could include: ü Adding air to expand a basketball ü Compressing air in a syringe ü Dissolving sugar in water ü Evaporating salt water	

What It Looks Like in the Classroom

The concepts and practices in this unit are foundational for understanding the relationship between changes to matter and its weight. During this unit of study, students will observe, measure, and identify materials based on their properties and begin to get a conceptual understanding of the particle nature of matter (i.e., all matter is made of particles too small to be seen).

In the first portion of the unit, students will focus on measuring and describing a variety of physical properties, including color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces and solubility. These observations and measurements are used to produce data that serves as the basis for evidence that can be used to identify materials. Students need opportunities to observe, measure, and describe a variety of types of matter, such as baking soda and other powders; metals; minerals; and liquids. Standard units should be used to measure the properties of weight, time, temperature, and volume; however, at this grade level, mass and weight are not distinguished. In addition, students are not expected to understand density as a physical property, and no attempt should be made to define unseen particles or explain the atomic-scale mechanism of evaporation and condensation.

In the second portion of the unit, students make observations, gather evidence, and develop models in order to understand that matter is made up of particles too small to be seen. Matter of any type can be subdivided into small particles. In planning and carrying out simple investigations, students will produce data to be used as evidence to support the idea that even though matter is made of particles too small to be seen, matter can still exist and can be detected by means other than seeing. This evidence will be used to support students' thinking as they develop models that depict matter. For

example, a model that represents solids at the particle level would show particles tightly packed, while a model that represents gases would show particles moving freely around in space. Observing such phenomena as adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, or evaporating salt water could help students to understand matter at the particle level and to build models that represent this phenomenon.

Although engineering design is not explicitly called out in this unit, students could incorporate engineering design in a number of ways as they explore the particle nature of matter.

ü Students can design ways/tools to measure a given physical property, such as hardness, reflectivity, electrical or thermal conductivity, or response to magnetic forces.

ü The engineering design process can be used to analyze students' models using criteria. Then students can improve their designs based on analysis.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts

In order to integrate literacy into this unit of study, students can conduct research by using text and media resources to build their knowledge of the physical properties of matter. In researching this topic, students can recall and gather information by summarizing or paraphrasing their research as they take notes in their science journals. Students can also draw evidence from informational texts to support their design choices as they build and share their models of matter at the particle level. They can also create foldables, charts, or PowerPoint presentations to accompany their models. In addition, if students use research to support their work, they should provide a list of the sources used.

Mathematics

Mathematics is integrated into this unit when students use appropriate tools, such as balances, thermometers, and graduated cylinders, to measure properties of matter like mass, temperature, and volume. In addition, students reason quantitatively and abstractly when analyzing and interpreting data collected when measuring physical properties of matter. Students also model with mathematics as they attempt to understand that matter exists even though it is made of particles too small to be seen. They interpret mathematical data in the context of the situation, reflect on how the data helps explain the particle nature of matter, and modify or improve their models if they do not adequately represent the phenomenon they are meant to represent.

Modifications

(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)

· Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.

· Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

· Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).

· Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

· Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.

· Use project-based science learning to connect science with observable phenomena.

· Structure the learning around explaining or solving a social or community-based issue.

· Provide ELL students with multiple literacy strategies.

· Collaborate with after-school programs or clubs to extend learning opportunities.

· Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

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Research on Student Learning

Elementary school students may think everything that exists is matter, including heat, light, and electricity. Alternatively, they may believe that matter does not include liquids and gases or that they are weightless materials (NSDL, 2015).

Prior Learning

Grade 2 Unit 2: Properties of Matter

- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.

Future Learning

Grade 7 Unit 1: Structure and Properties of Matter

· Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

· Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.

· Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

· Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.)

· Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

Grade 7 Unit 2: Interactions of Matter

· Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.

· In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)

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· In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced out except when they happen to collide. In a solid, atoms are closely spaced and they vibrate in position but do not change relative locations.

· Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

· The changes of state that occur with variations and temperature or pressure can be described and predicted using these models of matter.

Connections to Other Units

In **Unit 2, Changes to Matter**, students will use mathematical and computational thinking to understand the cause-and-effect relationship between physical changes in matter and conservation of weight.

Sample of Open Education Resources

National Geographic Learning- Teacher's Guide- "Matter" pages 2-3 (2 days)

National Geographic Learning- Teacher's Guide- "States of Matter" pages 6-7 (2 days)

National Geographic Learning- Teacher's Guide- "Investigate Matter" pages 8-9 (2 days)

National Geographic Learning- Teacher's Guide- "Develop a Model" pages 10-11 (4 days)

National Geographic Learning- Teacher's Guide- "Properties of Matter" pages 12-13 (2 days)

National Geographic Learning- Teacher's Guide- "Hardness" pages 16-17 (2 days)

National Geographic Learning- Teacher's Guide- "Magnetism" pages 18-19 (2 days)

National Geographic Learning- Teacher's Guide- "Electrical Conductivity" pages 20-23 (2 days)

National Geographic Learning- Teacher's Guide- "Thermal Conductivity" pages 24-25 (2 days)

National Geographic Learning- Teacher's Guide- "Solubility" pages 26-27 (2 days)

National Geographic Learning- Teacher's Guide- "Heating" pages 28-29 (2 days)

National Geographic Learning- Teacher's Guide- "Cooling" pages 30-31 (2 days)

Enhancement Lessons:

Material Properties: The dangerous Androvax has crash-landed on Earth! Sabotage his escape plans by tricking him into building a spaceship out of the wrong materials.

Teacher Professional Learning Resources

Resources from the National Geographic Kit:

Sand

Plastic Spoons

Salt

Lemon juice

Vegetable oil

Balloons

Droppers

Hand lens

Mineral samples- A, B, C, D

Copper penny

Iron nail

Magnet

Lightbulb

Battery

2 wires

Cups

Metal spoon

Resealable bags

Balance

Graduated cylinder

Gram masses

Baking soda

effervescent tablet

Enhancement Resources:

Water

Materials to test

Classroom objects

NSTA Web Seminar: Teaching NGSS in Elementary School—Fifth Grade

Carla Zembal-Saul, Professor of Science Education at Penn State University, Mary Starr, Executive Director of Michigan Mathematics and Science Centers Network, and Kathy Renfrew, K-5 Science Coordinator for VT Agency of Education, shared an overview of the NGSS for Fifth Grade level students. Strategies, such as Claims, Evidence and, Reasoning (CER) and Know, Learning, Evidence, Wondering and Science (KLEWS) were discussed. The bundling of performance expectations with a focus on scientific practices, disciplinary core ideas, and cross-cutting concepts was also presented as a strategy for pulling it all together.

View the resource collection.

Continue discussing this topic in the community forums.

NSTA Web Seminar: Teaching NGSS in K-5: Constructing Explanations from Evidence

Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the *NGSS* for K-5th grade. The web seminar focused on the three dimensional learning of the *NGSS*, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena.

View the resource collection.

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NSTA Web Seminar: NGSS Core Ideas: Matter and Its Interactions

Dr. Krajcik began the presentation by defining disciplinary core ideas and discussing the value of using core ideas to build understanding across time. He also talked about the way disciplinary core ideas work together with the other components of *NGSS*: scientific and engineering practices and crosscutting concepts. The program featured strategies for teaching about physical science concepts that answer questions such as "How do particles combine to form the variety of matter one observes?" and "How do substances combine or change (react) to make new substances?" Dr. Krajcik talked about the disciplinary core ideas for Properties of Matter and shared examples of student work. Participants had the opportunity to ask questions and discuss ideas for classroom application with other participating teachers.

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Appendix A: NGSS and Foundations for the Unit		
Make observations and measurements to identify materials based on their properties. *[Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]* **(5-PS1-3)**		
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The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**

Planning and Carrying Out Investigations • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3) **Developing and Using Models** • Use models to describe phenomena. (5-PS1-1)	**PS1.A: Structure and Properties of Matter** • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-3) • Natural objects exist from the very small to the immensely large. (5-PS1-1)

English Language Arts	Mathematics

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-PS1-1) **RI.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-3) **W.5.7** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-3) **W.5.8** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-3) **W.5.9**	Reason abstractly and quantitatively. (5-PS1-1) (5-PS1-3) **MP.2** Model with mathematics. (5-PS1-1) **MP.4** Use appropriate tools strategically. (5-PS1-3) **MP.5** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1) **5.NBT.A.1** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1) **5.NF.B.7** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1) **5.MD.C.3** Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft., and improvised units. (5-PS1-1) **5.MD.C.4**