

Unit 3: Changes in Matter

Content Area: **Science**
Course(s): **Integrated Science 5**
Time Period: **1 marking period**
Length: **8 Weeks**
Status: **Published**

Unit Overview

Matter is made up of tiny particles that are too small to see. Some objects are made of smaller pieces, just like matter is made up of smaller particles. There are millions of different materials all around you. Materials are a form of matter, and so they are made of particles. However, these particles can be very different. The types of particles that a material is made of determine many of the properties of that material. Substances have different properties that you can observe and measure to identify those substances. Some properties like color, size, or shape can be seen just by looking at the substance. Others are harder to see. And some properties may eventually cause the substance to change into a new substance. Substances' properties can change. Some of these changes can happen without the substance itself changing, like when solid ice melts into liquid water. Other changes form new substances, like mixing vinegar and baking soda. Heating or cooling a substance can cause its properties to change. So can mixing many substances together. In many cases, cooling matter can slow how quickly reactions occur. Matter is always conserved, no matter what changes happen to it. When matter is heated, cooled, or mixed with other matter, changes can occur. However, the weight of matter always remains the same because matter is conserved. Engineers are able to make entirely new materials by mixing together old materials or even by rearranging the particles that make up matter. The new materials are tested to see how they function, and if they are successful, they are used to solve various problems.

Transfer

Students will be able to independently use their learning to...

- Identify matter in everyday life based on its properties.
- Understand how matter can change states by adding or removing heat (cooking, cleaning, household projects).
- Identify a substance using the sense of smell to identify an unknown substance.
- Identify objects made up of plasma that they see in everyday life.
- Explain how to extend the life of glowing objects such as glowsticks.
- Discuss why it is important to refrigerate food.
- Use the engineering process to design a new material

For more information, read the following article by Grant Wiggins.

Meaning

Understandings

Students will understand that...

- Matter is made of particles.
- There is a cause and effect relationship to explain how substances change.
- The total weight of a substance does not change during a chemical or physical change.
- Matter is all around you even if you cannot see it.
- Matter is always changing from one material to another.

Essential Questions

Students will keep considering...

- Lesson 1: What is matter made of?
- Lesson 2: Why are materials different?
- Lesson 3: How can substances be identified?
- Lesson 4: How do scientists know when substances change?
- Lesson 5: What causes substances to change?
- Lesson 6: How do changes to substances affect their weights?
- Lesson 7: How do engineers improve materials?

Application of Knowledge and Skill

Students will know...

Students will know...

- 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 shows that gases are made from matter particles that are too small to see and are moving freely around in space can explain main observations, including the inflation of a balloon, the effects of air on larger particles or objects.
- Measurements of a variety of properties can be used to identify materials.
- When two or more different substances are mixed, a new substance with different properties may be formed.
- Science uses tools and technologies to make accurate measurements and observations.
- Matter is made of particles.
- Scientific knowledge is open to revision in light of new evidence.
- The amount (weight) of matter is conserved when it changes form, even in transition in which it seems to vanish.
- No matter what reaction or change in properties occurs, the total weight of the substance does not change.
- Scientific knowledge assumes order and consistency in natural systems.
- Scientific knowledge is based on empirical evidence.
- Possible solutions to a problem are limited by available materials and resources (constraints).
- The success of a designed solution is determined by considering the designed features of a solution (criteria).
- Different proposals for solutions can be compared to the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Students will be skilled at...

Students will be skilled at...

- Develop and use models.
- Analyze and interpret data.
- Constructing explanations and designing solutions.
- Planning and carrying out investigations.
- Engaging in argument from evidence.
- Defining and delimiting engineering problems.
- Using mathematical and computational thinking.

- Asking questions and defining problems.

Academic Vocabulary

Lesson 1	Lesson 5
Dissolve	contract
Matter	expand
Particles	
Solution	
State of Matter	

Lesson 2	Lesson 6
Mixture	conserve
Property	
Substance	

Lesson 3	Lesson 7
electrical conductivity	constraint
solubility	criteria
thermal conductivity	

Lesson 4
reaction
state change

Learning Goal 1

Students will be able to develop a model to describe that matter is made of particles too small to be seen.

SCI.5-PS1-1

Develop a model to describe that matter is made of particles too small to be seen.

Target 1 (Lesson 1)

Students will be able to define the term "matter".

Target 2 (Lesson 1)

Students will be able to differentiate between the three states of matter.

Target 3 (Lesson 4)

Students will be able to explain how matter changes state.

Learning Goal 2

Make observations and measurements to identify materials based on their properties.

SCI.5-PS1-3

Make observations and measurements to identify materials based on their properties.

Target 1 (Lesson 3)

Students will be able to list and describe the different types of properties of matter.

Target 2 (Lesson 3)

Students will be able to utilize scientific tools and methods to identify properties of matter that cannot be observed.

Learning Goal 3

Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances the total weight of matter is conserved.

SCI.5-PS1-2

Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

Target 1 (Lesson 5)

Students will be able to differentiate between chemical and physical changes.

Target 2 (Lesson 5)

Students will be able to explain ways to cause a chemical or physical change.

Target 3 (Lesson 6)

Students will be able to calculate the weight of a substance before and after a chemical or physical change to prove that matter is conserved.

Learning Goal 4

Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

SCI.5-PS1-4

Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Target 1 (Lesson 2)

Students will be able to model a mixture.

Target 2 (Lesson 2)

Students will be able to differentiate between a mixture and a solution.

Target 3 (Lesson 2)

Students will be able to identify ways to separate a mixture or a solution.

Learning Goal 5

Define a simple design problem reflecting a need or a want that includes specified criteria for success and

constraints on materials, time, or cost.

SCI.3-5-ETS1-1

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

Target 1 (Lesson 7)

Students will be able to explain that because properties have different uses, engineers must choose the best material to solve their problem.

Target 2 (Lesson 7)

Students will be able to discuss why engineers need to create new materials.

Target 3 (Lesson 7)

Students will be able to design their own investigation to solve their problem using constraints and criteria.

Formative Assessment and Performance Opportunities

- notebook checks
- quiz
- science notebook
- student displays & presentations
- student experiments
- student observations
- student sheets
- teacher observations
- test
- think/pair/share
- web concept map

Summative Assessment

All assessments are differentiated and aligned to the science standards and curriculum. Alternate assessment may include projects or presentations, or a common paper/pencil assessment, or both.

Common summative assessments, which include inquiry reflection are developed based on corresponding TCI Units and are computer based (LinkIt).

Accommodations/Modifications

Accommodations available through the TCI program include read aloud, Spanish text and presentations, leveled text, text highlighting, and notetaking.

English Language Learners

- Create a role card for the modeling activity in Lesson 2
- For Lesson 3, clarify the Four Tests in a large group setting before proceeding
- For Lesson 5, demonstrate a glowstick for those who may be unfamiliar with them.
- For Lesson 6, preteach the term conserved
- In Lesson 4, adjust the debrief process by allowing students to discuss in pairs
- Provide students with sentence starters for the investigation in Lesson 1
- Provide students with sentence starters for the investigation in Lesson 7

Special Needs Students

- Conduct the investigation in Lesson 7 as a class.
- For Lesson 3, have the student only test two substances.
- For Lesson 3, make sure students have correct results for the mystery power identification.
- For Lesson 4, reduce the number of placards to only A-F
- For Lesson 5, reduce the number of mixtures to four instead of eight.
- Have students use the interactive tutorial for Lesson 6.
- Provide completed diagrams in Lesson 2
- Skip the Flying Wood demonstration in Lesson 1

Talented and Gifted Students

- Conduct additional research on matter.
- Conduct additional research on states of matter.

- For Lesson 3, mix two of the mystery substances together.
- For Lesson 4, have the students conduct a scavenger hunt.
- For Lesson 5, have students design an investigation on heating and cooling.
- For Lesson 6, have students conduct an investigation on heat loss.
- For Lesson 7, allow students to actually build, test, and refine solutions to the problem they defined in the processing assignment.
- For Lesson 7, have students develop and test more recipes.

Unit Resources

Lesson 1

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 186-199.

Materials

- Balloons
- Balsa Wood
- Food Coloring
- Interactive Student Notebook
- Lesson Guide
- Newspaper
- Non-Iodized Salt
- Notebook Answer Key
- Plastic Spoon
- Rulers
- Scissors
- Spanish Interactive Student Notebook
- Tape
- Yarn

Links

All About States of Matter (website)

<http://easyscienceforkids.com/all-about-states-of-matter/>

This fun site has illustrations of the different states of matter, showing both how water in different states may appear, and how it would look when displayed as particles. Use this site as an additional resource for discussing states of matter.

States of Matter: Basics (simulation)

<http://phet.colorado.edu/en/simulation/states-of-matter-basics>

This simulation from PhET allows students to explore and visualize the different states of matter from a particle perspective. This simulation allows for students to explore different substances (depicted by their molecular structure). This may be confusing, as students have yet to learn about atoms and how they combine to form molecules. Use it as a way to visualize particle movement in different states.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

The Solid Truth about Matter by Mark Weakland. Illustrations by Bernice Lum. (Manheto, MN: Capstone Publishing, 2012)

Matter is all around us, in many different states. Learn about different types of matter and how much matter matters with this goofy book.

Energy from Nuclear Fission: Splitting the Atom (Next Generation Energy) by Nancy Dickmann. (New York, NY: Crabtree Publishing Company, 2015)

If you break down matter, you'll find atoms, which scientists used to think were indivisible. Learn about how atoms can be split, and how matter can be used to create energy!

Lesson 2

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 200-209.

Materials

- Black Construction Paper
- Interactive Student Notebook
- Lesson Guide
- Masking Tape
- Meterstick
- Notebook Answer Key
- Spanish Interactive Student Notebook
- White Construction Paper
- White Paper

Links

http://www.chem4kids.com/files/matter_mixture.html

This website discusses mixtures, showing how a mixture of tap water differentiates from distilled water with a colorful diagram. Use this to help students understand that mixtures can occur at a particle level

Additional Reading

The following books offer opportunities to extend the content in these lessons.

Properties of Matter (Physical Science) by Aaron Carr and Lesley Evans Ogden. (New York, NY: Weigl Publishers, 2011)

Learn all about different properties of matter and why some materials are different from others with this book full of bright photos and diagrams.

Explore Solids and Liquids!: With 25 Great Projects (Explore Your World) by Kathleen M. Reilly. Illustrations by Bryan Stone. (White River Junction, VT: Nomad Press, 2014)

What's similar, and what changes, when matter changes state? Learn all about properties of solids and liquids with this book full of fun experiments for you to try.

Lesson 3

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 210-221.

Materials

- 100 mL Graduated Cylinder
- 100 mL Iodine Solution (.05%)
- 250 mL beaker
- 30 mL Plastic Medicine Cup
- Baking Powder
- Baking Soda
- Eyedropper
- Flour
- Granulated Sugar
- Hand Lens
- Interactive Student Notebook
- Lesson Guide
- Non Iodized Salt
- Notebook Answer Key
- Paper Towels
- Plastic Bin (Shoe Box Size)
- Plastic Jar
- Plastic Spoon
- Safety Gloves
- Spanish Interactive Student Notebook
- Talc Powder
- Vinegar
- Vinyl Apron
- Water

Links

Sid's Collection Jar (simulation)

<http://pbskids.org/sid/collectionjar.html>

This simulation lets students carefully observe different materials and then try to categorize them. They can use a magnet to sort the magnetic objects. Use it as a warm-up to familiarize students with the ideas of categorizing and identifying objects by their properties.

Soluble and Insoluble Materials (video)

<http://www.youtube.com/watch?v=IhQtqouEv1U>

This video describes soluble and insoluble substances, and different ways to tell if two substances are insoluble in each other. Use it to assist students to understand the property of solubility.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Rubber vs. Glass (I Wonder Why) by Lawrence F. Lowery. (Arlington, VA: NSTA Kids, 2014)

Follow the story of twins Bill and Mary as they try to compare objects made of rubber to those made of glass to learn about different properties of objects that help us identify materials.

Marveling at Minerals (Searchlight Books: Do You Dig Earth Science?) by Sally M. Walker. (Minneapolis, MN: Lerner Publishing Group, 2013)

How can you tell one mineral from another? Read this book to learn what different types of minerals are, how they can be used, and how to identify them!

Lesson 4

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 222-233.

Materials

- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Placards A-L
- Spanish Interactive Student Notebook

Links

Changing State (simulation)

http://www.bbc.co.uk/schools/scienceclips/ages/9_10/changing_state.shtml

This simulation allows students to experiment with heating and cooling water to see how it changes state. Use it as a way to allow students to explore state changes from a macroscopic perspective.

Chemical Reactions (website)

http://www.lovemyscience.com/cat_reaction.html

This website contains many chemical reactions that can be performed with basic household materials. Allow students to explore these chemical reactions and record the changes that they can observe.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Radioactive!: How Irène Curie and Lise Meitner Revolutionized Science and Changed the World by Winifred Conkling. Chapel Hill, NC: Algonquin Young Readers, 2016)

Have you ever heard of Irène Curie or Lise Meitner? These two women may not be well known, but their discoveries certainly are! Read this biography of the two women whose work led to many advances in science, eventually including the atom bomb.

Nuclear Energy: Power From the Atom (Energy Revolution) by Troon Harrison. (New York, NY: Crabtree Publishing Company, 2010)

Nuclear Energy is not a new technology, but scientists are constantly finding ways to improve it. Learn about

the different types of nuclear reactions, and how scientists use their reactions to help develop more sustainable forms of energy.

Lesson 5

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 234-245.

Materials

- 100 mL Graduated Cylinder
- Baking Soda
- Calcium Chloride
- Handout: Group Assignments
- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Paper Cup
- Plastic Bin (Shoe Box Size)
- Plastic Spoon
- Safety Gloves
- Sandwich Size Ziplock Bags
- Spanish Handout: Group Assignments
- Spanish Interactive Student Notebook
- Vinegar
- Vinyl Apron
- Water

Links

ACS Reactions (Everyday Chemistry) (video)

<http://www.youtube.com/user/ACSReactions>

This YouTube channel is run by the American Chemical Society, and contains many videos of various everyday reactions. Students may enjoy videos “Is it OK to Pee in the Ocean?”, “Why Does Bacon Smell So Good?”, and “The Chemistry of Fireworks”. Some videos may be too advanced for students, so make sure to preview them beforehand.

Reversible and Irreversible Changes (simulation)

http://www.bbc.co.uk/schools/scienceclips/ages/10_11/rev_irrev_changes.shtml

This simulation allows students to heat, cool, and mix substances. Use it to discuss how to cause changes in matter.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Crazy Concoctions: A Mad Scientist's Guide to Messy Mixtures by Jordan D. Brown. Illustrations by Anthony Owsley. (Watertown, MA: Imagine Publishing, 2012)

Learn about how substances can be mixed and changed with this book full of messy projects for young scientists!

Incredible Experiments with Chemical Reactions & Mixtures (Magic Science) by Paula Navarro and Angels Jimenez. Illustrations by Bernadette Guxart. (Huappauge, NY: Barron's Educational Series, 2014)

Chemical reactions that cause substances to change are fun, but they aren't always safe to try at home. Luckily for aspiring scientists, this book comes with sixteen different experiments that use household objects.

Lesson 6

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 246-257.

Materials

- Antacid Tablet
- Interactive Student Notebook
- Lesson Guide
- Non-Iodized Salt
- Notebook Answer Key
- Paper Bowl
- Paper Cup
- Plastic Jar
- Spanish Interactive Student Notebook
- Triple Beam Balance
- Water
- Whipping Cream

Links

The Law of Conservation of Matter (website)

http://home.utah.edu/~u0577548/Conservation%20of%20Matter/sum_of_parts.htm

This site includes various examples of matter being conserved, even as the matter changes. Use it as an additional resource for students to explore how matter is conserved.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Mass and Weight (Measure It!) by Barbara A. Somervill. (Chicago, IL: Heinemann Library, 2010)

What's the difference between mass and weight? Learn about these similar, but distinct properties of matter and how to measure them in this fun book that combines science with math.

Mass & Matter (Mysteries of the Universe) by Jim Whiting. (Mankato, MN: The Creative Company, 2012)

How are mass and matter connected? Learn all about different properties of matter, including its mass, and how scientists study and measure mass.

Lesson 7

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 258-273.

Materials

- 100 mL Graduated Cylinder
- 3/4" Metal Washer
- Craft Sticks
- Flour
- Interactive Student Notebook
- Lesson Guide
- Newspaper
- Notebook Answer Key
- Plastic Bin (Shoe Box Size)
- Plastic Spoon
- Sandwich Size Ziplock Bag
- Spanish Interactive Student Notebook

Links

Chemical Engineer (career) and Materials Scientist and Engineer (career) (website)

<http://www.sciencebuddies.org/>

This site contains both science project information and information about different careers. Use it as a resource to discuss how students can explore the profession. Use the search bar to locate the chemical engineer or materials scientist and engineer career page, and the tabs to find different science projects students can explore.

Additional Reading

The following books offer opportunities to extend the content in this lesson.

What Makes Sports Gear Safer? (Engineering Keeps Us Safe) by Kevin Kurtz. (Minneapolis, MN: Lerner

Publishing Group, 2015)

Football and other sports can be really dangerous, but some people who play them don't get hurt. How? Safety gear! Read about how engineers keep improving their materials to make sports gear from helmets to airbags even safer than they already are.

Bridges and Tunnels: Investigate Feats of Engineering with 25 Projects (Build it Yourself) by Donna Latham. Illustrations by Jenn Vaughn. (White River Junction, VT: Nomad Press, 2012)

Bridges and tunnels are really complex structures, but it's not hard to build simple ones on your own! Learn how engineers first made bridges and tunnels and the technology that they keep using to make them safer, and try creating your own with the engineering projects included in this book.

21st Century Life and Careers

CAEP.9.2.8.B.1	Research careers within the 16 Career Clusters [®] and determine attributes of career success.
CAEP.9.2.8.B.2	Develop a Personalized Student Learning Plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.
CAEP.9.2.8.B.3	Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.
CAEP.9.2.8.B.4	Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.
CAEP.9.2.8.B.5	Analyze labor market trends using state and federal labor market information and other resources available online.
CAEP.9.2.8.B.6	Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.
CAEP.9.2.8.B.7	Evaluate the impact of online activities and social media on employer decisions.

Performance Assessment

Materials

- 100 mL Graduated Cylinder
- 30 mL Plastic Medicine Cup
- Baking Powder
- Beaker
- Flour

- Granulated Sugar
- Hand Lens
- Handout A: Ingredient Investigation
- Handout B: Pancake Recipe
- Heat Sources
- Non-Iodized Salt
- Paper Cup
- Paper Towels
- Performance Assessment
- Performance Assessment Rubric
- Plastic Bin (Shoe Box Size)
- Plastic Jar
- Plastic Teaspoon
- Roll of Aluminum Foil
- Safety Gloves
- Spanish Handout A: Ingredient Investigation
- Spanish Handout B: Pancake Recipe
- Spanish Performance Assessment
- Spanish Performance Assessment Rubric
- Triple Beam Balance
- Vegetable Oil
- Vinyl Apron

Interdisciplinary Connections

LA.W.5.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
LA.RF.5.4.A	Read grade-level text with purpose and understanding.
LA.RF.5.4.C	Use context to confirm or self-correct word recognition and understanding, rereading as necessary.
LA.RI.5.1	Quote accurately from a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
LA.RI.5.2	Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
LA.RI.5.3	Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
LA.RI.5.4	Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
LA.RI.5.7	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.
LA.RI.5.9	Integrate and reflect on (e.g., practical knowledge, historical/cultural context, and

background knowledge) information from several texts on the same topic in order to write or speak about the subject knowledgeably.

LA.RI.5.10	By the end of year, read and comprehend literary nonfiction at grade level text-complexity or above, with scaffolding as needed.
LA.RL.5.1	Quote accurately from a text, and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
LA.SL.5.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.
LA.SL.5.1.A	Explicitly draw on previously read text or material and other information known about the topic to explore ideas under discussion.
LA.SL.5.1.B	Follow agreed-upon rules for discussions and carry out assigned roles.
LA.SL.5.1.C	Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.
LA.SL.5.1.D	Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.
LA.SL.5.2	Summarize a written text read aloud or information presented in diverse media and formats (e.g., visually, quantitatively, and orally).
LA.SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.
MA.5.MD.B	Represent and interpret data.
MA.5.OA.A.2	Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.
MA.5.OA.B	Analyze patterns and relationships.
TECH.8.1.5.A.2	Format a document using a word processing application to enhance text and include graphics, symbols and/or pictures.
TECH.8.1.5.A.4	Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data.
TECH.8.1.5.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.5.D.4	Understand digital citizenship and demonstrate an understanding of the personal consequences of inappropriate use of technology and social media.
TECH.8.1.5.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.5.E.1	Use digital tools to research and evaluate the accuracy of, relevance to, and appropriateness of using print and non-print electronic information sources to complete a variety of tasks.