Second Grade Companion Document

2-Unit 1: Measurement of Properties

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Introduction to the K-7 Companion Document
An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. . The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing “hands-on” activities.
e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
f. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

Second Grade Unit:
Measurement of Properties

Content Statements and Expectations

Code	Statements & Expectations	Page
P.PM.E.1	**Physical Properties – All objects and substances have physical properties that can be measured.**	1
P.PM.02.12	Describe objects and substances according to their properties (color, size, shape, texture, hardness, liquid or solid, sinking or floating).	1
P.PM.02.13	Measure the length of objects using rulers (centimeters) and meter sticks (meters).	2
P.PM.02.14	Measure the volume of liquids using common measuring tools (measuring cups, measuring spoons, graduated cylinders and beakers)	2
P.PM.01.22	Demonstrate that water as a liquid takes on the shape of various containers	2
P.PM.02.15	Compare objects using a balance.	3
P.PM.E.4	**Material Composition – Some objects are composed of a single substance, while other objects are composed of more than one substance.**	3
P.PM.02.41	Recognize that some objects are composed of single substances (water, sugar, salt) and others are composed of more than one substance (salt and pepper, mixed dry beans).	3

2 – Unit 1: Measurement of Properties

Big Ideas (Key Concepts)

- Objects and substances can be described by their properties and through measurement.
- Objects and substances can be classified as single substances or mixtures and single substances can be combined to make mixtures.

Clarification of Content Expectations

Standard: Properties of Matter

Content Statement - P.PM.E.1
Physical Properties - All objects and substances have physical properties that can be measured.

Content Expectations

P.PM.02.12 Describe objects and substances according to their properties (color, size, shape, texture, hardness, liquid or solid, sinking or floating).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words the properties of objects and substances.
2. Properties include color, size, shape, texture, hardness, liquid or solid, sinking or floating.
3. Texture descriptions include rough and smooth.
4. Hardness descriptions are limited to the sense of touch. Words that may be used to describe hardness may include: hard, soft, stiff, and flexible.
5. Second grade description of solids and liquids includes: solids keep own shape and liquids take shape of container.
6. Sinking or floating is limited to trial and error investigations of objects sinking and floating in water.

Assessment Clarifications

1. Properties include color, size, shape, texture, hardness, liquid or solid, sinking or floating.
2. Texture descriptions include rough and smooth.
3. Hardness descriptions are limited to sense of touch. Words that may be used to describe hardness may include: hard, soft, stiff, and flexible.
4. Sinking or floating is limited to trial and error investigations of objects sinking and floating in water.

P.PM.02.13 Measure the length of objects using rulers (centimeters) and meter sticks (meters).

Instructional Clarifications

1. Measure means to use standard units to determine the length of objects.
2. The metric system is the unit of measure most often used in science.
3. This physical science expectation is linked to two Inquiry Process expectations (S.IP.02.14 and S.IP.02.15). The emphasis at the second grade level is the ability to choose the appropriate tool and read the appropriate unit of measurement for the tool.
4. Students' practice of measurement is not limited to measuring the length of objects. Students' measurement abilities expand to measuring the distance something travels, the height of objects, etc.

Assessment Clarifications

1. Assessment is limited to measurement of length in meters and centimeters.
2. Use the appropriate tool (ruler or meter stick) to measure length and link the appropriate unit of measure (centimeter or meter) to the tool.

P.PM.02.14 Measure the volume of liquids using common measuring tools (measuring cups, measuring spoons, graduated cylinders and beakers)

Instructional Clarifications

1. Volume is the measurement of the amount of space taken up by a substance or an object regardless of its shape. All matter has volume.
2. Students at this age have issues with the conservation of liquids – specifically a liquid in a tall thin container versus a short squat container and will not recognize that they could be equal.
3. Common measuring tools for volume include but are not limited to measuring cups and measuring spoons. Students may benefit from the introduction of graduated beakers and cylinders in measuring volume.
4. Measuring the volume of solid objects through water displacement, such as marbles, washers, bolts, etc. is not expected at this grade. However, students can make comparisons and accurate measurement of volume of a liquid and a solid such as sand, sugar, or soil.
5. The expectation does not refer to the unit of measurement for volume. Students are expected to continue to measure in the metric system and measure the volume of substances using milliliters and liters.
6. The emphasis in this expectation is the ability to choose the appropriate tool to measure volume.
7. The expectation provides the opportunity to introduce measurement of volume of a substance using milliliters and liters. (The use of milliliters and liters is addressed in the 4^{th} grade)

Assessment Clarification

1. Assessment is restricted to measurement of volume using graduated measuring cups and measuring spoons.

P.PM.02.15 Compare objects using a balance.

Instructional Clarifications

1. Compare is to note similarities and differences of objects using a balance.
2. The use of the balance as a tool for measurement collection is to compare the mass of different objects
3. The use of the term weight with the balance perpetuates the misconception that weight and mass are interchangeable or are measuring the same thing. A better way to introduce the students to the balance is to introduce the term mass.
4. Mass is defined as the amount of matter in an object. Weight is the force on an object due to gravity.
5. The emphasis in this expectation is the ability to use the balance to compare objects and recognize objects that are heavier (because of more mass), lighter (because of less mass), or the same on the balance.

Assessment Clarification

1. Compare the mass of objects using a balance. (Heavier-more mass, lighter-less mass, the same-equal mass)

Content Statement - P.PM.E.4
Material Composition – Some objects are composed of a single substance, while other objects are composed of more than one substance.

Content Expectation

P.PM.02.41 Recognize that some objects are composed of single substances (water, sugar, salt) and others are composed of more than one substance (salt and pepper, mixed dry beans).

Instructional Clarifications

1. Recognize is to identify or point out single substances or mixtures through observation.
2. Each substance has its own chemical composition and physical properties.
3. Single substances are made up of only one thing, such as water, salt, and sugar.
4. Combining single substances can make mixtures and the substances that make up a mixture keep their physical properties.
5. Mixtures can be separated into their single substances.

Single substances	Mixture
Water	Salt and pepper
Sugar	Beans and peas
Salt	Salt water
Pepper	Sugar water

Assessment Clarification

1. Recognition of objects that are made up of single substances and objects that are made up of more than one substance.

Inquiry Process, Inquiry Analysis and Communication, Reflection, and social Implications

Inquiry Processes
S.IP.02.11 Make purposeful observations of various objects according to their properties.
S.IP.02.12 Generate questions based on observations of objects according to their properties and of single substances and mixtures.
S.IP.02.13 Plan and conduct simple investigations of objects or substances to determine whether they sink or float and to compare objects using a balance.
S.IP.02.14 Manipulate simple tools (metric rulers and meter sticks) to determine the length of objects and the volume of liquids (measuring cups and measuring spoons)
S.IP.02.15 Make accurate measurements of length of objects in appropriate units (meter, centimeter)
S.IP.02.16 Construct simple charts and graphs from data and observations of properties of objects and substances.
Inquiry Analysis and Communication
S.IA.02.12 Share ideas about the properties of objects and the classification of single substances and mixtures.
S.IA.02.13 Communicate and present findings about the properties of objects or substances and the classification of single substances and mixtures.
S.IA.02.14 Develop strategies and skills for gathering information about the properties of objects or substances.
Reflection and Social Implication
S.RS.02.11 Demonstrate a means of classifying objects as single substances or mixtures through various illustrations, performances, exhibits, or activities.
S.RS.02.13 Recognize that when a science investigation on sinking and floating of objects or substances is done the way it was done before, similar results are expected.
S.RS.02.15 Use evidence when communicating ideas about the classification of single substances and mixtures.
S.RS.02.16 Identify technology used to compare objects that is used in everyday life.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
balance classify color liquid mixture properties ruler shape size texture hardness solid sink float length meter stick centimeter (cm) meter (m) volume measuring cup measuring spoon compare single substance mass	chart data observations weight liters (L) milliliters (mL)

Instruments, Measurements, and Representations

Measurement	Tools	Units
length	ruler	centimeter (cm)
	meter stick	centimeter (cm), meter (m)
volume	measuring cup	milliliter* (mL), liter* (L)
	measuring spoon	milliliter* (mL)
weight (mass*)	balance	heavier, lighter, same

*To be mastered and assessed in the 4th grade.

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is NOT a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.

Instructional Examples

Physical Properties: P.PM.02.12, P.PM.02.13, P.PM.02.14, P.PM.02.15
Material Composition: P.PM.02.41

Objectives

- Make observations of a variety of objects and describe the objects by their physical properties.
- Focus on the property of size and introduce the measurement of length, volume, and mass of objects to add quantitative data for the size of objects.
- Make observations of a variety of objects and classify them as single substances and mixtures.

Engage and Explore

- Before attaching the criteria of properties of matter, students observe, sort, and describe a variety of objects based on their own classification. (P.PM.02.12, S.IP.02.11)
- Only after students have sorted and described the objects on their own, introduce the terms color, size, shape, texture, hardness, liquid or solid, sinking or floating. (P.PM.02.12, S.IP.02.11, S.IA.02.12)
- Students repeat their descriptions using the properties listed by constructing a chart that organizes the objects by their properties, share ideas about properties through purposeful conversation and communicate and present their findings. (P.PM.02.12, S.IP.02.11)
- Students brainstorm the meaning of the term property. (P.PM.02.12, S.IA.02.12)

Explain and Define

- Students will come to consensus on the term property and the descriptive terms used to describe properties of objects (color, size, shape, texture, hardness, liquid or solid, sinking or floating). (P.PM.02.12, S.IA.02.12, S.IA.02.13)
- Students present their sorting and descriptions of a variety of objects to the class. Collectively the class makes sense of identifying objects by their observable properties. (P.PM.02.12, S.IA.02.12, S.IA.02.13)
- Explain the term size and introduce measurement tools and units that give quantitative data to the properties of the objects. (Length, weight, and volume) (P.PM.02.13, S.IP.02.14, S.IP.02.15)
- Demonstrate and practice using the measurement tools to measure a variety of objects and materials. (P.PM.02.13, S.IP.02.14, S.IP.02.15)

Elaborate and Apply

- Organize a measuring scavenger hunt and have students work with a partner to find objects that measure specific lengths in centimeters and meters. (P.PM.02.13, S.IP.02.14, S.IP.02.15)
- Expand the measurement of centimeters and meters and students measure distance of objects that have moved. Construct simple charts and graphs from data and observations through measurement of distance. (P.PM.02.13, S.IP.02.16, S.IP.02.14, S.IP.02.15)
- Using a variety of measurements and measuring tools, students measure the volume of liquids. Expand their measurement of volume to the volume of solids, such as flour, sand, soil, and pebbles. Have students experiment with conservation of liquids by pouring 100mL from a graduated cylinder into a graduated beaker and draw a conclusion about the comparative volume. (P.PM.02.14, S.IP.02.14, S.IP.02.15)
- Make observations comparing objects using a balance. Construct simple charts and graphs from data and observations of the comparison of objects. (P.PM.02.15, S.IP.02.11, S.IP.02.12, S.IP.02.13, S.IP.02.14, S.IP.02.16)
- Introduce the concept of identifying substances as solids and liquids. Explore liquid water as it takes the shape of a variety of containers and solid water keeps its own shape. Elaborate on the concept of liquid and solid. Observe how liquid water takes the shape of its container using a variety of volumes of water. (P.PM.02.14, P.PM.02.15, S.IP.02.11, S.IP.02.14, S.IP.02.15)
- Expand student thinking about the properties to include mixtures and single substances. Students observe substances and objects and classify them as single substances and mixtures. Using a variety of single substances (salt, pepper, beans, peas, paper clips, water, etc.), students combine single substances to make mixtures. (P.PM.02.41, S.IP.02.11, S.IP.02.12, S.IP.02.13)

- Introduce students to soil as a mixture and given the opportunity to observe and identify the single substances that make up soil as a mixture. (P.PM.02.41, S.IP.02.11, S.IP.02.12)
- Students generate questions regarding the separation of mixtures based on their observations of single substances and mixtures. Students plan and conduct simple investigations into separating their mixtures to single substances to answer their questions. Introduce simple tools, such as filter paper, sieves, magnets, and forceps for students to use to separate mixtures. Identify technology used to separate mixtures that is used in everyday situations. (P.PM.02.41, S.IP.02.11, S.IP.02.12, S.IP.02.13, S.IP.02.14, S.IP.02.15, S.IA.02.13)
- Demonstrate the student separation procedures through illustrations and models and communicate and present findings to others. (P.PM.02.41, S.IA.02.12, S.IA.02.13)
- Plan and conduct a sink and float investigation and identify sink or float as a property of objects. Students predict and test their items for the ability to sink or float in water. Students perform multiple trials and recognize that when a science investigation on sinking and floating of objects or substances is done the way it was done before, similar results are expected. (P.PM.02.12, S.IP.02.11, S.IP.02.13, S.IP.02.16)

Evaluate Student Understanding

Formative Assessment Examples
- Use the student presentations and discussion to assess the students' ability to describe objects by their properties. (P.PM.02.12)
- Use the students' sink and float investigations to assess student ability to raise questions and plan simple investigations. (P.PM.02.12)
- Use student investigations into the separation of mixtures to assess their ability to raise questions based on observations. (P.PM.02.41)

Summative Assessment Examples
- Circle the objects that have the same texture. (P.PM.02.12)
- Circle the objects that have similar properties. Write what properties and the same and what properties are different. (P.PM.02.12)
- Jane wanted to measure the length of her desk. Circle the BEST tool for Jane to use. Circle the best unit of measure for Jane to use. (P.PM.02.13, P.PM.02.14)
- Choose the best measuring tool for John to measure the amount of water to place in the pot. (P.PM.02.13, P.PM.02.14)
- Circle the object that is the heaviest. Write how you know which object is heaviest. (P.PM.02.15)
- Circle the picture that BEST shows a mixture. Write how you know that. (P.PM.02.41)
- Choose the tool that you would use to separate the mixture. (P.PM.02.41)

Enrichment

- Students plan and conduct simple investigations into separating mixtures to single substances, including the use of evaporation to separate water from salt.
- Investigate, using the balance, measuring cup, and measuring spoon if different substances with the same volume have the same mass.
- Students combine their measurement skills by measuring the same volume of two substances (water and sand) and making a comparison using the balance.
- Students use magnetic and nonmagnetic to describe properties.

Intervention

- Students are given the opportunity to explore a variety of solids to make mixtures and use different tools to separate a variety of solids of different shapes and sizes.
- Students use non-standard units for measurement to begin thinking in terms of quantitatively measuring objects and then relate to metric units of measurement.
- Set up stations in the classroom for students to continue their explorations into measurement.

Examples, Observations, and Phenomena (Real World Context)

Classification and measurement are everyday skills. Students are involved in measurement of growth (height and weight), recipes, and distance. They classify common objects by color, shape and size at an early age; the stop sign, yield sign, traffic signals, toy blocks, dishes, pencils, crayons, etc. all provide real world opportunities to use their sorting by properties skills. The recognition of sinking and floating as an important property is demonstrated through the material used in life jackets, life rings, and boat building. Students recognize that a rock will sink and a piece of wood will float.

Mixing materials (single substances to make a mixture) is a common activity for young learners. They mix their morning cereal with milk and fruit, mix foods on their plates, make instant fruit flavored drinks, create a mixture of blocks and toys in the toy box, and a mixture of crayons, markers, and pencils in their school supplies.

Literacy Integration

Reading

R.WS.02.11 in context, determine the meaning of words and phrases including objects, actions, concepts, content vocabulary, and literary terms, using strategies and resources including context clues, mental pictures, and questioning.

R.IT.02.02 discuss informational text patterns including descriptive, sequential, enumerative, and compare/contrast.

R.IT.02.04 respond to individual and multiple texts by finding evidence, discussing, illustrating, and/or writing to reflect, make connections, take a position, and/or show understanding.

R.CM.02.01 make text-to-self and text-to-text connections and comparisons by activating prior knowledge, connecting personal knowledge, experience, and understanding of others to ideas in text through oral and written responses.

R.CM.02.04 apply significant knowledge from grade-level science, social studies, and mathematics texts.

Examples of trade books available for learning about properties of matter and measurement:

Measuring Penny, Loreen Leedy, 1998
How Big Is A Foot?, Rolf Myller, 1991

- Activate prior knowledge of measurement before reading the book, *Measuring Penny.*
- Connect personal knowledge, experience, and understanding of measurement to ideas in the text and through oral and written response.
- Retell relevant details of the units of measurement, measuring tools, and length, volume, and weight as described in the book.

Writing

W.GN.02.03 write an informational piece including a magazine feature article using an organizational pattern such as description, enumeration, sequence, or compare/contrast that may include graphs, diagrams, or charts to enhance the understanding of central and key ideas.

W.GN.02.04 use the writing process to produce and present a research project, develop two research questions related to a teacher-selected topic;

gather electronic or print resources and organize the information using key ideas with teacher assistance.

W.GR.02.01 in the context of writing, correctly use more complex complete sentences, nouns, and verbs, commas, contractions, colons to denote time, and capitalization of proper nouns.

- Write about a measuring experience (similar to the experience in *Measuring Penny*) and why the use of measurement helped in understanding a concept or answering a question.
- Include the measuring tool and unit of measurement that were used and display the measurement in the form of a graph. Tell why you chose that tool and unit of measurement.

Speaking

S.CN.02.02 explore and use language to communicate effectively with a variety of audiences and for different purposes including questions and answers, discussions, and social interactions.

S.DS.02.01 engage in substantive conversations, remaining focused on subject matter, with interchanges building on prior responses in book discussions, peer conferencing, or other interactions.

S.DS.02.03 respond to multiple text types by reflecting, making connections, taking a position, and/or showing understanding.

- Engage in substantive conversation remaining focused on the subject matter, with interchange building on prior responses, and in the context of the book discussion and the scientific investigations.

Mathematics Integration

M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft. yd.

M.UN.02.02 Compare lengths; add and subtract lengths (no conversion of units).

M.PS.02.10 Solve simple word problems involving length and money.

- Connect the writing experience and math skills (See Writing)