Grade 3: What are Things in My World Make Of? How Much is There?

Dear Workshop Leader

6-HOUR IMPLEMENTATION WORKSHOP

These materials will help you get ready to lead an Implementation Workshop for the Grade 3 **Inquiry curriculum, What are Things in My World Make Of? How Much is There?** This curriculum is a carefully crafted, research-based progression about Matter for grades 3-5. The curriculum includes a detailed **Teacher's Guide** and additional resources for teachers. Why hold an implementation workshop? A teacher who is about to use the Inquiry curriculum for the first time has a lot to think about and will have many questions:

FIRST TIME QUESTIONS

- big picture questions about the key science ideas,
- logistical questions about managing materials,
- pedagogical questions about how students work with data or learn to reason scientifically.

WORKSHOP EXPERIENCE

This workshop

- helps teachers answer some of these questions.
- illustrates the "architecture" of **The Inquiry Project** website.
- facilitates teachers' own firsthand experience of some of the key investigations, using materials from the kit.
- models ways to answer questions, work with data, and lead discussions.
- highlights resources available for teachers when they want to know more about specific science content or children's ideas about these same topics.

In our experience, teachers like to be active explorers. They like experiencing some of the investigations firsthand. They like the combination of the theoretical and the practical information and the tight connection between the workshop content and what they are about to teach.

The workshop requires 6-hours. The time could be organized as a full day workshop, two three-hour, or three two-hour workshops.

MODIFY AS NECESSARY

You can use these materials as is or modify them to meet the needs of your group of participants. It is essential that you become very familiar with the curriculum, the organization and contents of the **Teacher's Guide**, **The Child and the Scientist** essays, and the **Concept Cartoons**.

TRY ACTIVITIES BEFOREHAND

Be sure to try the firsthand activities yourself before you ask participants to experience them in the workshop.

As you begin planning, print out (in color if possible) this **Grade 3 Implementation Workshop Leader's Guide** (pdf)

1 Workshop Goals

By the end of the workshop, participants will

1. **be familiar with the conceptual flow of *The Inquiry Project* curriculum** Grades 3-5 and see where the Grade 3 curriculum fits in the progression
2. **know their way around *The Inquiry Project* curriculum website,** the Grade 3 curriculum, and resources for teachers
3. **have firsthand experience with some key science investigations**
4. **know how to find resources** they can use to deepen their understanding of the science content of the curriculum and children's ideas about these topics

2 Before the Workshop

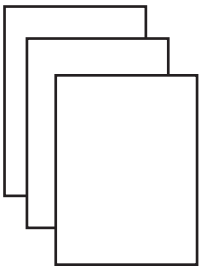
This workshop leader guide is based on the assumption that you are familiar with The Inquiry Project materials and have specific knowledge and understanding of the investigations in the Grade 3, What are Things in My World Make Of? How Much is There? curriculum. If the curriculum is new to you, it is critical that you read the Teacher's Guide carefully, try the firsthand investigations that are part of the workshop yourself, review the video classroom and Scientist Cases, and follow links that are provided in these workshop notes.

TIP Working with materials for groups of 4 will model what happens in the classroom; having materials for every pair will allow more first-hand experience in a shorter amount of time.

1. **Workshop space.** Arrange for a workshop space where participants can work in groups around a table or cluster of desks and everyone can see a screen or SMARTBoard.
2. **Lap top or tablet for everyone.** Check to be sure everyone – you and participants – can connect to the Internet and there's a screen or SMARTBoard. where you can project The Inquiry Project website. You will want to encourage participants to bring a lap top or tablet to the workshop and to follow along as you guide them through the curriculum and professional development resources on the website.
3. **Materials.** Gather and organize materials (see Implementation Workshops, Grade 3, Master Workshop Materials List at the end of this document). Materials are also listed where they are called for in the workshop.

   Provide a scale and set of materials for every 2, 3, or 4 participants.

HANDOUTS



4. **Agenda and Goals.** Post an agenda and a list of workshops goals that will be visible throughout the workshop. See Workshop Goals above. Your agenda will depend on how you organize the 6 hours, e.g., full-day workshop, two 3-hour or three 2-hour workshops.
5. **Data tables.** Prepare group data tables and charts participants will use to record group data during the workshop.
6. **Handouts.** Print out the Grade 3 Workshop Handout packet. There are few Handouts needed for this workshop. Throughout the workshop, participants have access to the Teacher's Guide on their lap tops or tablets that contains examples of all data tables and Notebook pages (pdfs) that they can use as models.

3 The Workshop

SET THE STAGE Project a slide show of images from the three Inquiry Curricula (Implementation Workshops on the Home Page)

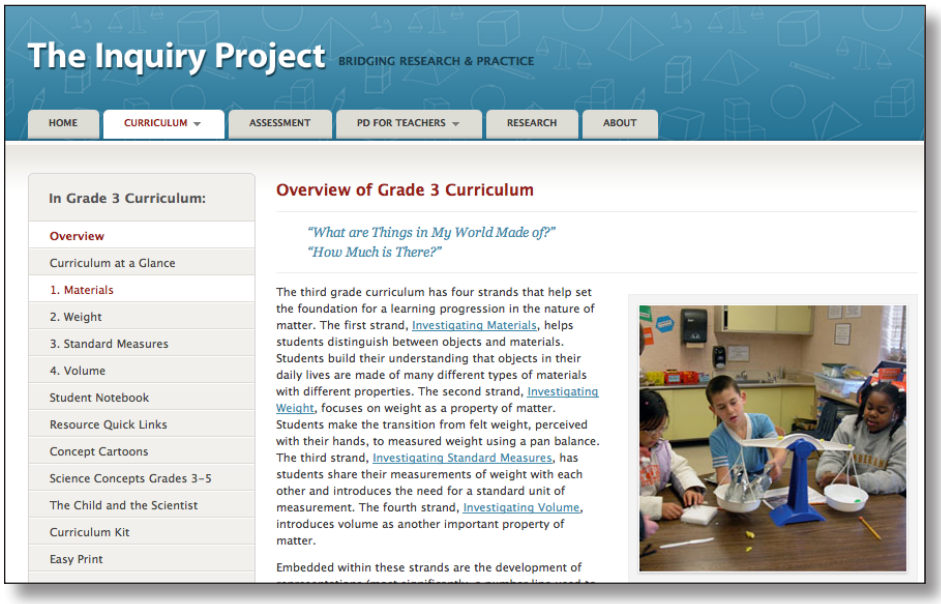
WELCOME Tailor your welcome to your group of participants and particular setting.

Workshop leader and participants introduce themselves - briefly.

Introduce the Home Page

INTRODUCE THE HOME PAGE

Click Curriculum Grade 3



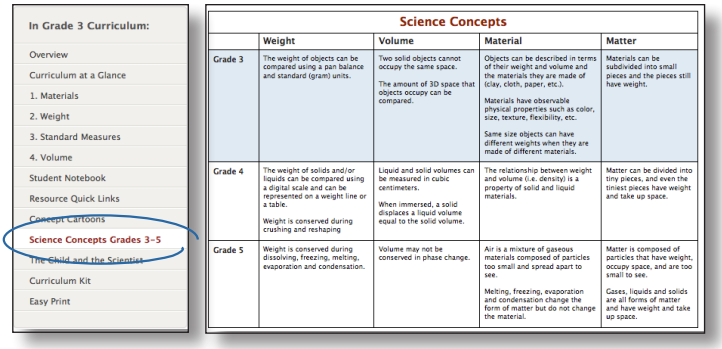
SMALL GROUP ACTIVITY

Time: 10 Mins

What are the core ideas and science concepts in this curriculum? (~10 min.)

Click Science Concepts Grades 3-5 (sidebar menu).

Ask participants to use a copy of this chart found in the Handout packet.



Handout
Grades 3-5 Science Concepts Chart

And take 5 minutes to discuss the question below:

" " What can we expect our students to understand about the nature of matter as they wrap up Grade 3 What are Things in my World Made of? How Much is There? How are these ideas developed in Grades 4 and 5?

Take a few minutes to find out what participants noticed and what questions they have.

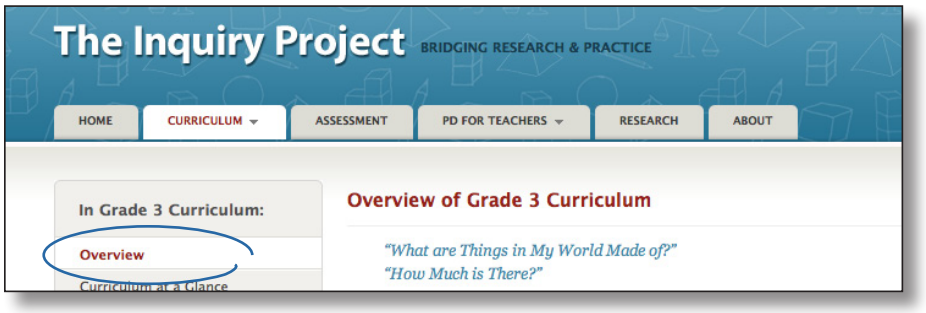
Emphasize that students learn about matter through a coherent sequence of investigations across the three grades and learn to use the eight practices described in **A Framework for K-8 Science Education** (2012)

1. Asking questions
2. Designing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

4 Overview of the Grade 3 Curriculum

Explain that you'll now look more closely at the Grade 3 curriculum.

Click **Overview** on the sidebar menu and make the points below.



" " This curriculum is called What are Things in My World Make Of? How Much is There? There are 17 Investigations grouped in 4 clusters.

These investigations provide evidence to support students' understanding of five very important science ideas about matter. The first two are about weight: the weight of solids and/or liquids can be compared using a digital scale and can be represented on a weight line or data table; weight is conserved during crushing and reshaping.

The next big ideas are about volume: liquid and solid volumes can be measured in cubic centimeters; when immersed, a solid displaces a liquid volume equal to the solid volume.

The next idea is about material: the relationship between weight and volume (i.e., density) is a property of solid and liquid materials.

The last idea is about matter: matter can be divided into tiny pieces, and even the tiniest pieces have weight and take up space..

5 Get to know the Grade 3 Website

Tell participants that **The Inquiry Project** includes a detailed **Teacher's Guide** to the curriculum plus a rich set of resources for teachers that are all closely tied to the classroom investigations. Links to resources are embedded in the online **Teacher's Guide** and also can be accessed from the sidebar menu on the left. These materials can be used online or printed out.

Explain that to get started becoming familiar with the navigation and resources of the Grade 3 website, you'll take them on a quick tour of what's they'll find when they use the sidebar menu.

Encourage participants to follow the tour on their own laptops or tablets and say you hope they'll explore the web site throughout the workshop.

Play the movie. You can pause the video tour at any point.

Click **PD FOR TEACHERS/Implementation Workshops/Grade 3 Workshop/Sidebar Tour**

Grade 3 Curriculum Sidebar Tour

Grade 3 Curriculum at a Glance

What are Things in My World Made Of? How Much Is There?

1. INVESTIGATING MATERIAL	2. INVESTIGATING WEIGHT	3. INVESTIGATING STANDARD MEASURE	4. INVESTIGATING VOLUME
1. What are things in my world made of? Learn to distinguish between an object and the material it is made of. Sort a collection of everyday objects by the materials they are made of. Then look generally at materials that make up the classroom.	**1. How good are our senses at comparing the weights of cubes?** Order the materials cubes by felt weight. Create need for measurement and introduce the pan balance.	**1. How can grams help us compare weights?** Introduce standard gram weights and practice using grams to weigh the cubes and other objects. Place objects on a gram weight line. Focus on the relationship between weight and size of objects.	**1. What does it mean to take up space?** Discuss the meaning of "taking up space" and contrast it with measurements such as length or height. Arrange a diverse set of objects in order by the amount of space they take up. Groups arrange their personal objects by estimated volume.
2. What kind of material makes an object work well? Describe objects by the kind(s) of material they are made of. Think about materials in terms of their usefulness to objects, including materials that make an object work well or badly.	**2. What does a pan balance tell us about the weight order of the cubes?** Use the pan balance to compare the weights of the materials cubes and check the order that was established by felt weight.	**2. How much do the cubes weigh in grams?** Weigh the cubes in grams and use the weight line to compare the weights of these same-sized samples of different materials. Bring forward the ideas of the additive and continuous nature of weight.	**2. How can centimeter cubes help us measure volume?** Arrange a set of four small wood blocks in order by estimated volume. Using plastic centimeter cubes, build replicas of each of the blocks to measure their volumes and check the estimated order. Establish cubic centimeter as standard unit of volume.
3. How are materials the same and different? Observe the materials in 2 cubes to determine how they are the same and how they are different. Introduce the idea of properties. Include the personal objects in this work.	**3. How can we measure the weights of our cubes?** Space the materials cubes by felt weight and then use uniform weights (paper clips, steel washers, and plastic bears) to compare the weights of the cubes.	**3. Do very tiny things have weight?** Continually halve an 8-gram piece of plasticene, at each step determining the weight, or, when very tiny, reasoning about whether the tiny pieces still have weight.	**3. Does changing the shape of an object change its volume?** Arrange 8 plastic centimeter cubes into a "domino" shape (2 cm x 5 cm x 1 cm) and build a plasticine replica. Using the entire 8 cc's of plasticine, form a variety of shapes or sculptures. Are the new shapes still 8 cc's in volume?
4. How can we sort cubes that are all the same size? Sort the set of materials cubes by their properties. Use the groupings to highlight the concept of organizing properties into categories	**4. How much heavier is one cube than another?** Use one of the three uniform weights (paper clips, steel washers, or bears) to determine relative weights of cubes.	**4. The 10–10–10–10 Challenge** Use grams as standard to measure weight. Experience measuring equal weights of different solid materials. Create something using 10 g each of 4 materials. Discussion: How do the sizes of each material vary for a 10 g weight? Some materials are heavier than others.	**4. How can we describe our personal objects?** Collect and record information about the personal objects. What materials are they made of? What are their weights and estimated volumes? Once this data is collected, students display it graphically and use the data to develop claims about the class-wide set of personal objects.
5. How do materials help us in our classroom? Take a close look at the materials in one object, focusing on how the properties of each material work together to support the function of the object.			

Student Science Notebook

Individual notebook pages can be viewed within the curriculum. To print the entire student notebook, use the file on the right. It is recommended that the notebook is printed or copied in two-sided format.

The notebook file is in pdf format and can be read using Adobe reader. To get the latest copy of Adobe reader click here: Download Adobe Reader.

See Teacher Resources for more information about using science notebooks.

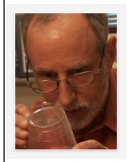
Science Notebook [pdf]

Science Concepts

	Weight	Volume	Material	Matter
Grade 3	The weight of objects can be compared using a pan balance and standard (gram) units.	Two solid objects cannot occupy the same space. The amount of 3D space that objects occupy can be compared.	Objects can be described in terms of their weight and volume and the materials they are made of (clay, cloth, paper, etc.). Materials have observable physical properties such as color, size, texture, flexibility, etc. Same size objects can have different weights when they are made of different materials.	Materials can be subdivided into small pieces and the pieces still have weight.
Grade 4	The weight of solids and/or liquids can be compared using a digital scale and can be represented on a weight line or a table. Weight is conserved during crushing and reshaping	Liquid and solid volumes can be measured in cubic centimeters. When immersed, a solid displaces a liquid volume equal to the solid volume.	The relationship between weight and volume (i.e. density) is a property of solid and liquid materials.	Matter can be divided into tiny pieces, and even the tiniest pieces have weight and take up space.
Grade 5	Weight is conserved during dissolving, freezing, melting, evaporation and condensation.	Volume may not be conserved in phase change.	Air is a mixture of gaseous materials composed of particles too small and spread apart to see. Melting, freezing, evaporation and condensation change the form of matter but do not change the material.	Matter is composed of particles that have weight, occupy space, and are too small to see. Gases, liquids and solids are all forms of matter and have weight and take up space.

The Child and the Scientist

A child and a scientist often have very different ideas about the world around us. Our challenge is to identify the difference between how the child and the scientist think about matter, and then to bridge that gap.



Two essays appear at the beginning of each section of the Inquiry Project curriculum. The first essay, by Professor Roger Tobin, presents the scientist's perspective about the science content that is introduced in the section. The second essay, by Professor Carol Smith, presents the child's perspective, and explains why the science concepts may be hard for students to understand. As a group, these thirteen pairs of essays cover a network of concepts relevant to understanding matter. This network of concepts is developed throughout the learning progression (across grades 3–5), using language and concepts that children can understand. The essays are collected here to be easily accessed at any point in the curriculum. We encourage you to refer to them prior to teaching, as they bring forward the nuances of the concepts and how children perceive them.

The Scientist

Materials
- Why are Material Properties Important?

Weight
- Why is Weight Important?

Standard Measures
- Why are Standard Measures Important?

The Child

Materials
- The Challenges in Learning about Materials

Weight
- The Challenges in Learning about Weight

Standard Measures
- The Challenges in Learning about Weight Measurement

In Grade 3 Curriculum:

- **Overview**
- Curriculum at a Glance
- 1. Materials
- 2. Weight
- 3. Standard Measures
- 4. Volume
- Student Notebook
- Resource Quick Links
- Concept Cartoons
- Science Concepts Grades 3–5
- The Child and the Scientist
- Curriculum Kit
- Easy Print

Curriculum Kit

Materials are listed for a classoom of 24 students split into 6 groups of 4. Your classroom may require modifications of this list.

Sets in the Kit:

- 6 sets of 54 piece hexagram metric weights
- 6 sets of 4 blocks:
  - 2cm x 9cm x 1cm maple block (A)
  - 2cm x 2cm x 5cm maple block (B)
  - 3cm x 5cm x 1cm maple block (C)
  - 3cm x 3cm x 2cm maple block (D)
- 6 sets of 8 materials cubes (1" x 1" x 1")
  - oak
  - pine
  - acrylic
  - pvc
  - nylon
  - aluminum
  - copper
  - steel
- 6 sets of 15 items:
  - piece of cardboard, approx 2"x2"
  - plastic-covered copper wire,approx 6" long
  - bare copper wire; approx 6" long
  - piece cotton cloth fabric, approx 2"x2"
  - wooden spoon (ice cream type)
  - metal spoon
  - plastic spoon
  - metal key
  - steel bolt
  - 3-oz paper cup
  - rubber eraser
  - plastic counting bear
  - steel washer
  - wooden coffee stirrer
  - pencil

Other Materials:

- 1 aluminum cube, cut in half
- 180 plastic counting bears

Grade 3 Easy Print

Easy print versions of the curriculum, teacher resources and science notebook in pdf format are available to simplify printing the Inquiry Project materials.

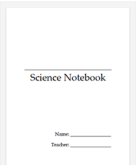
Curriculum/Teacher's Guide

The Curriculum Easy Print (pdf) is formatted for double-sided printing. It includes the overview of the Grade 3 Curriculum, the Sessions at a Glance chart, the Curriculum Kit, the Core Science Concepts chart, Science Background information and all the strand overviews and investigations

Teacher Resources

The Teacher Resources Easy Print (pdf) is not formatted for double-sided printing (most of the resources are single pages). It includes the Concept Cartoons, Key Science Concepts, Children's Ideas, and information about Inquiry, Science Notebooks, Formative Assessment and Representations.

Student Science Notebook



The Student Science Notebook (pdf) is formatted for double-sided printing.

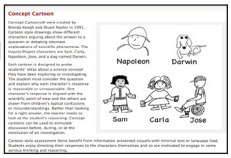
Investigations

1. Materials
- Investigation 1
- Investigation 2
- Investigation 3
- Investigation 4
- Investigation 5

2. Weight
- Investigation 1
- Investigation 2
- Investigation 3
- Investigation 4

3. Standard Measures
- Investigation 1
- Investigation 2
- Investigation 3
- Investigation 4

4. Volume
- Investigation 1
- Investigation 2
- Investigation 3
- Investigation 4



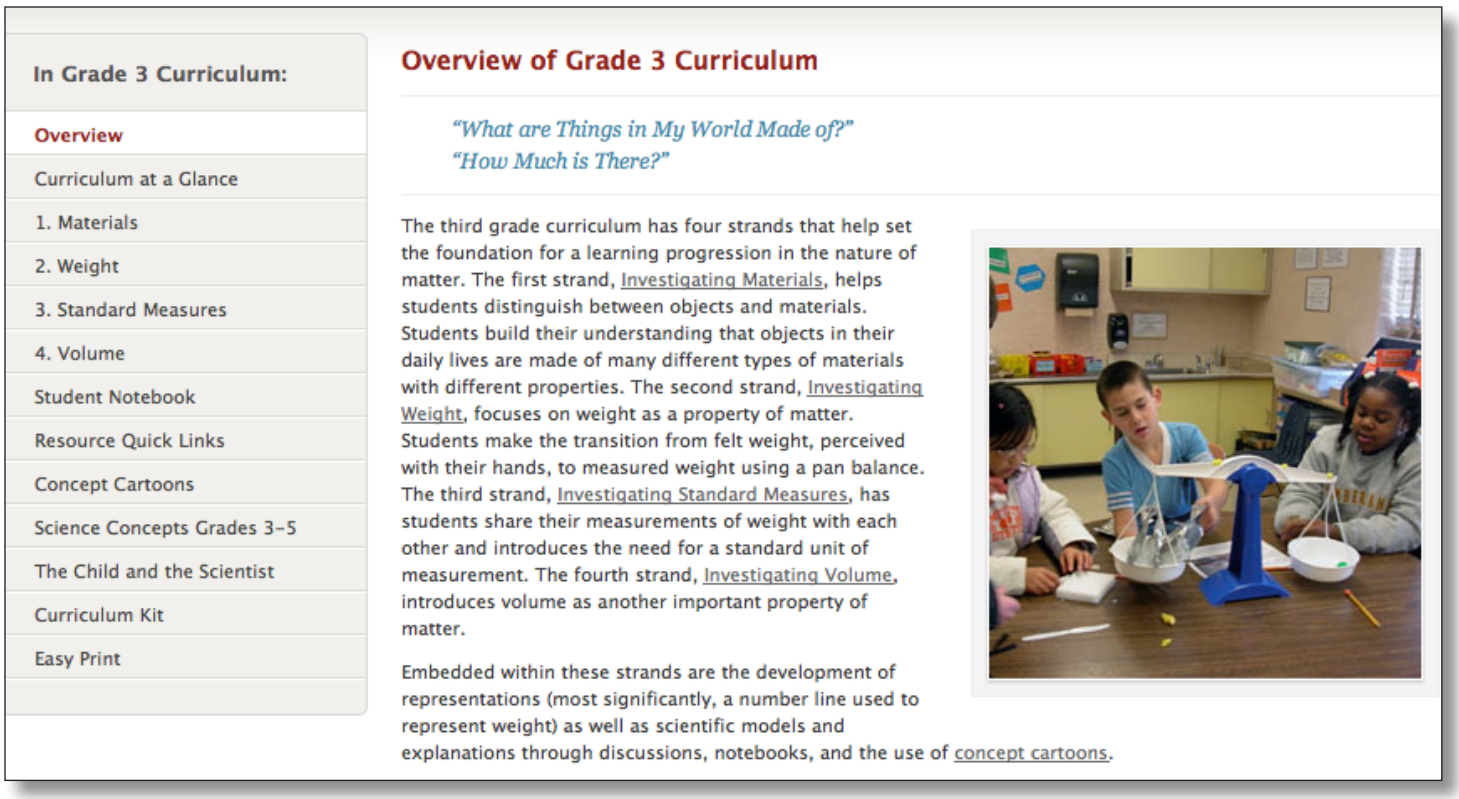
I: To the Workshop Leader

Introducing Investigating Materials

This workshop looks at the Inquiry curriculum through two lenses: the overarching organization and goals or big picture on one hand, and step-by-step details on the other. Teachers need both perspectives, (1) how learning experiences connect and contribute to understanding core science ideas, concepts, and scientific practices and (2) the specifics of how to carry out investigations.

Teachers may be surprised to find that it's a challenge for students to differentiate objects from the materials they are made of. By the end of the first two investigations, students are able to make the distinction and are ready to turn to properties of materials. Here's where a set of eight cubes - all the same size but each made of a different material - comes in handy. Through sorting and ordering the cubes, students become familiar with the concept of "property," including the observation that although they are identical in size, each cube weighs more or less than others. The idea that same-sized samples of different materials have different weights will come up again as students continue to learn about matter.

As you plan the ideas you'll emphasize in each Section, look for a chart, **How Investigations Reflect the Science Framework**, that follows a description of **Materials and Preparation** for this part of the workshop. Here you'll find a concise summary of ideas, scientific practices, and crosscutting concepts to emphasize as you lead participants through the first five investigations.



In Grade 3 Curriculum:

- Overview
- Curriculum at a Glance
- 1. Materials
- 2. Weight
- 3. Standard Measures
- 4. Volume
- Student Notebook
- Resource Quick Links
- Concept Cartoons
- Science Concepts Grades 3–5
- The Child and the Scientist
- Curriculum Kit
- Easy Print

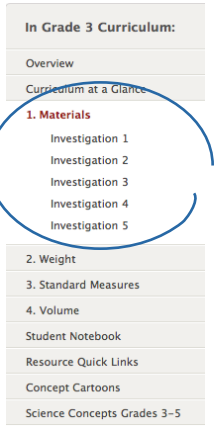
Overview of Grade 3 Curriculum

"What are Things in My World Made of?"
"How Much is There?"

The third grade curriculum has four strands that help set the foundation for a learning progression in the nature of matter. The first strand, Investigating Materials, helps students distinguish between objects and materials. Students build their understanding that objects in their daily lives are made of many different types of materials with different properties. The second strand, Investigating Weight, focuses on weight as a property of matter. Students make the transition from felt weight, perceived with their hands, to measured weight using a pan balance. The third strand, Investigating Standard Measures, has students share their measurements of weight with each other and introduces the need for a standard unit of measurement. The fourth strand, Investigating Volume, introduces volume as another important property of matter.

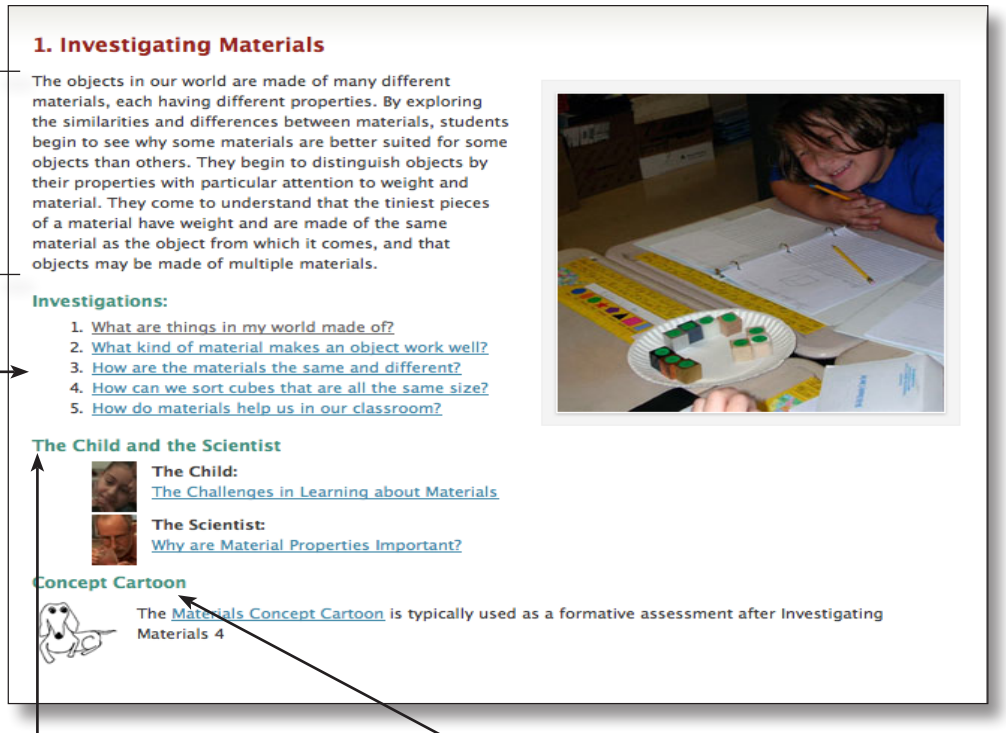
Embedded within these strands are the development of representations (most significantly, a number line used to represent weight) as well as scientific models and explanations through discussions, notebooks, and the use of concept cartoons.

II. Section I: Investigating Materials, Investigations 1-5



The Grade 3 curriculum has four groups of investigations or sections; each section opens with an overview page containing important information for teachers. You are looking at the opening page for **1. Investigating Materials**.

Before participants dive into the investigations in each section (Part III), you'll want to describe the elements of the opening page. An annotated image similar to the one below is included in Part II of each section.



A summary of the major ideas and activities in this set of investigations of earth materials.

5 investigations that focus on the distinction between objects and materials, properties of materials, and finally, how the properties of materials that objects are made of support the function of these objects

The Child and the Scientist
This link takes you to a pair of essays. Here you can find out how students' ideas about materials differ from scientists' so you can help your students use evidence they collect to move closer to a scientific understanding

Concept Cartoon
This link takes you to a cartoon style assessment item designed to probe students' beginning understanding that same-sized samples of different materials will have different weights, not because one is hollow or another filled with rocks, but because the material itself is lighter or heavier for the size of the sample. This idea is a precursor to understanding the property called density.

Materials and Preparation for this part of the Workshop

A critical part of the workshop is the opportunity for participants to experience student investigations firsthand and raise questions about materials management and logistics. In addition to a materials list for each section of the curriculum, you'll find a Master Materials List at the end of this document.

Investigating Materials 1

For each group of 2-4 participants and one for the Workshop Leader

- piece of cardboard, approx 2"x2"
- plastic-covered copper wire,approx 6" long
- bare copper wire; approx 6" long
- piece cotton cloth fabric, approx 2"x2"
- wooden spoon (ice cream type)
- metal spoon
- plastic spoon
- metal key
- steel bolt
- 3-oz paper cup
- rubber eraser
- plastic counting bear
- steel washer
- wooden coffee stirrer
- pencil

Investigating Materials 2

- 1 plastic spoon for class discussion

For each participant:

- 1 personal object selected by participant

Investigating Materials 3

- Prepare a class table to record students' findings; an example is shown in Step 3.

For each group of 3-4:

- A full set of 8 material cubes, each cube labeled with the name of its material:
  - pine
  - oak
  - steel
  - copper
  - aluminum
  - nylon
  - PVC
  - acrylic

Investigating Materials 4

For the workshop leader

- Gather 10–12 common classroom objects
- 2 cubes that have been cut in half (kit)

For each group of 3-4:

- 1 set of the material cubes

Investigating Materials 5

For each participant:

- A pencil (the object participants will draw)
- A lead pencil and colored pencils to draw with

Handout #1 My Observations of Objects and Materials (Notebook page)

Section 1 Investigating Material: How Investigations 1-5 reflect the Science Framework

Component Ideas about Matter and Its Interactions	Everyday objects are made of different kinds of materials. Each material has characteristic properties. The properties of each material work to support the function of the objects made of these materials.
Scientific Practices	Asking questions and defining problems: students ask what is same the same and different about eight materials. They consider materials in terms of properties that make them useful for making everyday objects that do or do not work well.
Crosscutting Concepts	Structure and function: students learn how to distinguish materials from the objects that they make up and how the properties of a material support its function in an object.

1. Materials
- Investigation 1
- Investigation 2
- Investigation 3
- Investigation 4
- Investigation 5

III. Investigations

In the workshop, participants will experience some – but not all – of the investigations in this section first-hand. As you begin their first experience, emphasize how important it is for teachers to actually try out materials and activities before they teach a lesson.

Click 1. Materials

A. Investigating Materials 1. What are things in my world made of?

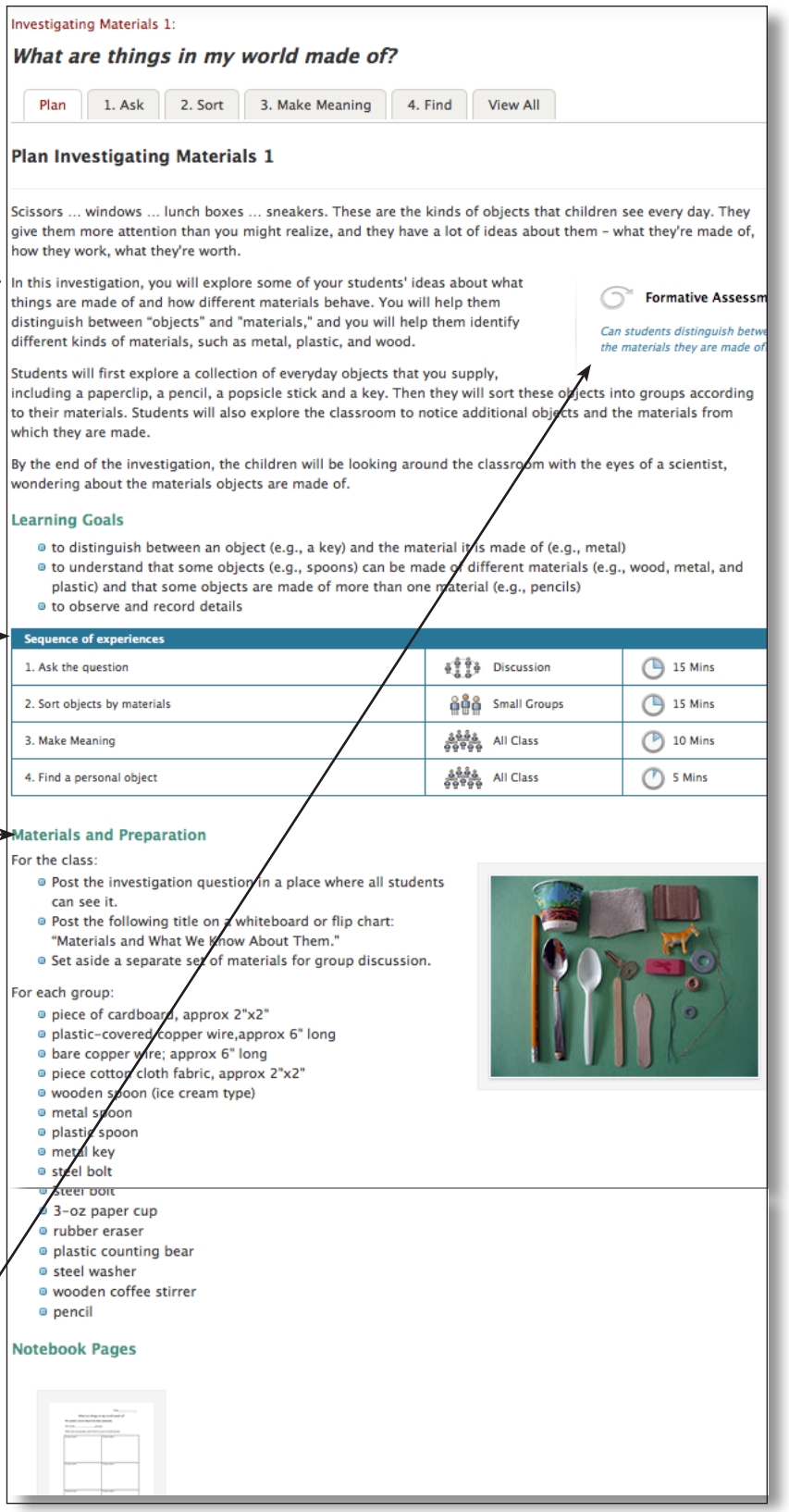
The purpose of this activity is to learn to distinguish between an object and the materials it is made of.
Click 1. Materials, Investigation 1

Point out that each investigation begins with a **Plan** page. Briefly explain the information on each **Plan** page.

TIP The last paragraph of this section always begins

"By the end of this investigation students will…" and describes the learning goals.

- A snapshot of the student experience, including this sentence, "By the end of this investigation students will … " and a pithy description of what students will understand and be able to do at the end of the lesson.
- The Learning goals for this investigation
- Sequence of experiences and time allotted for each
- Materials and Preparation for the class and each group of 4 students
- Notebook pages
- A formative assessment in some, but not all, investigations


Investigating Materials 1:

What are things in my world made of?

Plan | 1. Ask | 2. Sort | 3. Make Meaning | 4. Find | View All

Plan Investigating Materials 1

Scissors … windows … lunch boxes … sneakers. These are the kinds of objects that children see every day. They give them more attention than you might realize, and they have a lot of ideas about them – what they're made of, how they work, what they're worth.

In this investigation, you will explore some of your students' ideas about what things are made of and how different materials behave. You will help them distinguish between "objects" and "materials," and you will help them identify different kinds of materials, such as metal, plastic, and wood.

Formative Assessm

Can students distinguish betwe the materials they are made of

Students will first explore a collection of everyday objects that you supply, including a paperclip, a pencil, a popsicle stick and a key. Then they will sort these objects into groups according to their materials. Students will also explore the classroom to notice additional objects and the materials from which they are made.

By the end of the investigation, the children will be looking around the classroom with the eyes of a scientist, wondering about the materials objects are made of.

Learning Goals

- to distinguish between an object (e.g., a key) and the material it is made of (e.g., metal)
- to understand that some objects (e.g., spoons) can be made of different materials (e.g., wood, metal, and plastic) and that some objects are made of more than one material (e.g., pencils)
- to observe and record details

Sequence of experiences

1. Ask the question	Discussion	15 Mins
2. Sort objects by materials	Small Groups	15 Mins
3. Make Meaning	All Class	10 Mins
4. Find a personal object	All Class	5 Mins

Materials and Preparation

For the class:

- Post the investigation question in a place where all students can see it.
- Post the following title on a whiteboard or flip chart: "Materials and What We Know About Them."
- Set aside a separate set of materials for group discussion.

For each group:

- piece of cardboard, approx 2"x2"
- plastic-covered copper wire,approx 6" long
- bare copper wire; approx 6" long
- piece cotton cloth fabric, approx 2"x2"
- wooden spoon (ice cream type)
- metal spoon
- plastic spoon
- metal key
- steel bolt
- steel bolt
- 3-oz paper cup
- rubber eraser
- plastic counting bear
- steel washer
- wooden coffee stirrer
- pencil

Notebook Pages

1. Experience the sorting activity firsthand

TIP Encourage participants to follow along on their own laptops or tablets as you click, scroll, or move about the web site. Explain that you want them to explore the website throughout the workshop.

a. Distribute the plate of objects (listed in **Materials and Preparation**) and ask participants to work in groups of 2-3.

b. Point out that the title of each lesson (called an investigation) is also the investigation question. Asking questions is a fundamental scientific practice and the investigation question organizes each lesson or learning experience.

Scroll to **1. Ask** and pose the investigation question (**What are things in my world made of?**) and explain that participants – and their students – will collect data to answer this question.

c. Explain that the challenge is to sort the objects on their trays according to their material properties:

- put things together that are made of the same material or "stuff"
- make as many groups as you need
- give each group a name
- make a drawing that shows the name of each group and the items in it.

Display the **Notebook** page for participants to use as a sample.

Notebook Pages

Notebook Page [pdf]

2. Discuss the data

a. Explain that every investigation has three parts (1) ask the investigation question, (2) an exploration or data collection activity such as the sorting challenge they just experienced, and (3) a make meaning discussion.

b. Highlight the importance of discussions. Students make meaning or make sense of their work in science largely through discussion or talk. Discussions are neither optional nor add-ons to a lesson, they are essential for learning.

c. Explain that during Discussions, student sit in a circle, either on the floor or rug or arranged in their chairs so that everyone is facing everyone else and the teacher is part of the circle. They have their **Notebooks** handy. Ask participants to arrange themselves so they can see everyone (no one is looking at anyone's back!)

Time: 10 Mins

Use this investigation to describe how the **Teacher's Guide** helps teachers plan for and lead discussions.

Click **3. Make Meaning**

An essential part of each investigation is time to "make meaning" through discussion (talk) of the activities students experience. Explain that the Teacher's Guide provides support for teachers as they plan these discussions, including

- Purpose for the discussion
- A focus question related to the goals of the investigation and designed to engage students in the discussion. It takes time to craft a productive question focused on the learning goal. The Teacher's Guide provides focus questions and suggested follow-up questions for make meaning discussions.
- Other information relevant to specific content

d. Lead a short discussion.

Ask participants to scroll to **3. Make Meaning** and find the purpose of this discussion. The purpose is for students to use data to

- connect the investigation question and their data.
- reason about why there is variation in the groupings.
- make statements (claims) about the materials that objects from the classroom (things in my world) are made of and to describe the supporting evidence.

Have a collection of objects handy, e.g., a collection of the objects participants sorted, and lead off with the discussion question from the curriculum.

Ask the focus question:

> The investigation question is What are things in my world made of?
>
> Based on our work with an identical set of objects, how would we answer this question?

Ask a team to show how they grouped the objects and how they named each group (metal, plastic, rubber, etc.) Ask if there were different ways to group.

Keep an eye out for how participants place objects made of more than one material (pencil, covered wire) and note that there is more than one solution to this challenge – what's important is that participants (and their students) are able to justify the placement in terms of the materials the object is made of.

Tell participants that the next step is to make a list of properties of metals, plastics, and wood using the question **How do you know something is a metal?** There is an example of a list from a 3rd grade classroom in the **Teacher's Guide, 3. Make Meaning.**

e. Remind participants of the learning goals (scroll back to the Plan section and Learning Goals) and ask them if they think students will achieve the learning goals through the sorting activity and discussion participants have just experienced.

Learning Goals

- to distinguish between an object (e.g., a key) and the material it is made of (e.g., metal)
- to understand that some objects (e.g., spoons) can be made of different materials (e.g., wood, metal, and plastic) and that some objects are made of more than one material (e.g., pencils)
- to observe and record details

Explain that the last step in this investigation is part **4. Find a personal object.** Each child is asked to find a small object at home, something that fits into a pocket, that they can bring to school, and leave there, for use during the study. Alternatively, a teacher can provide a set of objects for students to use. These objects will help students apply their learning in investigations that follow.

B. Investigating Materials 2, What kind of material makes an object work well?

This investigation provides students more time to learn how to distinguish between objects and the materials they are made of, only in a new – and whimsical - context.

1. Describe the investigation

Use this opportunity to review the organization of a typical investigation.

a. Emphasize that **Plan** is essential reading for teachers getting ready to teach a lesson.

b. Scroll to **1. Ask the Question**. This step includes the investigation question and suggestions for how to launch the investigation.

In this lesson the **Investigation Question** is **What kind of material makes an object work well?** and the teacher launches the lesson by modeling how to use a class table to describe an object and the materials that do and don't make is work well.

Walk participants through the first row of the table (window pane).

Object	What it is made of	Other materials that might work well	Materials that would work badly
Window pane	Glass	Plastic	Wood
Spoon	Plastic	Metal, wood	Butter
(Student use)			

c. Scroll to **2. Choose and describe an object**

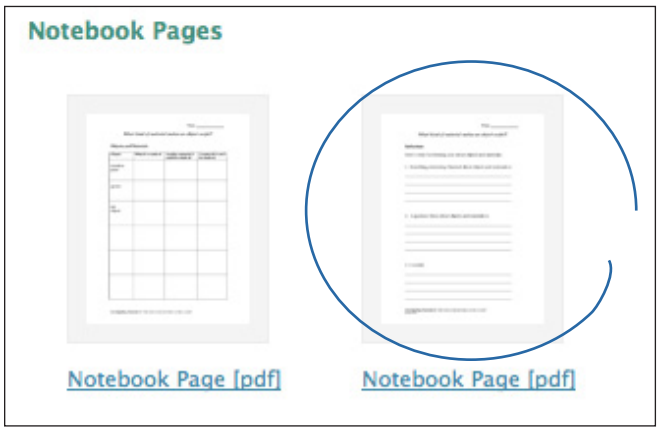
Explain that the student experience in this part of the lesson is exploratory in nature: students use the personal object they selected at the end of Investigation 1 and fill in the information in the row. They do the same for at least one other group member's object.

d. Scroll to **3. Discuss the results**

Reiterate that the discussion is essential so teachers need to keep an eye on the clock and make sure to stop any activity in time to gather in a circle and have 10 minutes to talk.

The purpose of this discussion is to heighten students' awareness of relationships between a material, its properties, and an object's function.

e. Scroll to **4. Write a reflection.**



Explain that teachers should feel free to ask students to write reflections at other times in the curriculum. There are blank pages in the **Notebook** and this set of reflection questions can be used at any time:

- Something interesting I learned about …
- A question I have about …
- I wonder …

C. Investigating Materials 3, How are materials the same and different?

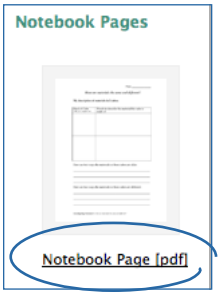
In this investigation, a set of 8 cubes is introduced. The cubes are all the same size but are made of different materials. The cubes are used to help students compare and contrast materials in terms of their physical properties.

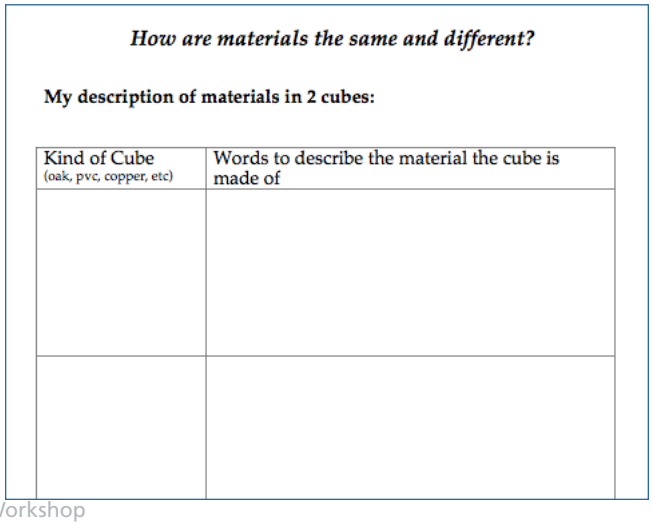
1. Experience the activity firsthand

a. Ask the investigation question How are materials the same and different?

Give each participant 2 cubes made of different materials.

Click **Plan** and scroll to the **Notebook** page. Click the text at the bottom to enlarge the page on the screen and ask participants to make a list of properties for the material each cube is made of.





How are materials the same and different?

My description of materials in 2 cubes:

Kind of Cube (oak, pvc, copper, etc)	Words to describe the material the cube is made of

b. Bring individual observations together

Note that each participant is now quite familiar with characteristics or descriptions of two materials – they have expertise! All the "pine" experts compile a list of words that describe pine, these descriptors are recorded in a class table, and so forth, for each of the 8 materials.

Note that the Discussion focuses on similarities and differences.

2. Introducing scientific language

Point out that the term "property" is introduced at this point, after students have had experience observing and describing properties. In addition to linking a new term to a familiar object or phenomenon or experience, be explicit about what colloquialism the new term is replacing. For example, the term "material" replaces "stuff" and the term "property" replaces "description."

D. Investigating Materials 4, How we sort cubes that are all the same size?

The purpose of the sorting activity to provide students with a greater range of properties they can use to describe materials; students also learn how to organize properties into larger categories such as color or texture.

1. Experience the investigation firsthand

TIP The Teacher's Guide describes how students are likely to sort the cubes and provides suggestions and questions for facilitating the sorting activity.

a. Explain that the materials cubes are used once again and the investigation question is **How can we sort cubes that are all the same size?**

b. Distribute a set of 8 cubes to each group of 2-4 participants.

Pose the challenge:

Can you find at least 3 different ways to sort the cubes?

Give participants 4-5 minutes to sort and record their groupings.

c. Share the data

Take a few minutes for participants to describe the ways they sorted.

Point out that students typically sort (1) by weight either by ordering or grouping by heavy, medium, and light, (2) by material, (3) by property, e.g., shiny vs. dull; rough vs. smooth, etc.

d. Making meaning

Scroll to **4. Make Meaning.**

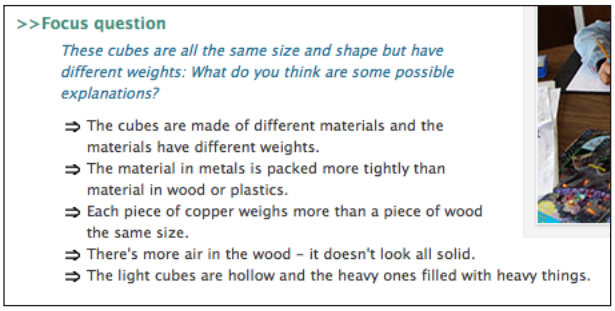
Explain that the focus question asks students to reason, **not** to come up with a "right answer."

These cubes are all the same size and shape but have different weights: What do you think are some possible explanations?

Ask participants take a few minutes to discuss with a partner what they think students are likely to say, and to jot down one or two of their ideas.

Ask people to share ideas with the group.

Point out the ideas students typically hold.



Explain the last (hollow cube) explanation is quite common. Therefore, the kit includes a pine cube and an aluminum cube that have been cut in half.

2. Introduce a new term, "heavy for size"

Explain that at the end of this discussion, the teacher wraps up with the message that materials have properties such as color, luster, and a property the curriculum commonly refers to as "heavy – or light - for size." This means that every cube is the same size (there is the same volume of material) but some materials are heavier for their size than others.

Alert participants to the need to include"for its size" in their descriptions of materials.

A copper cube (object) is heavier than a pine cube (object) of the same size; copper (material) is heavier for its size than pine (material). The samples must be of equal size to compare this property. After all, a large pine board will be heavier than a small piece of copper.

E. Investigating Materials 5.,How do materials help us in our classrooms?

In this investigation participants (and students) consider objects, their materials, the relationship between materials, their properties, and how properties support students in their everyday lives. In this lesson you'll also introduce observational drawing, another kind of data. Engineering concepts are embedded in the lesson.

1. Introduce observational drawing

a. Describe characteristics of an observational drawing and tell participants that they will need to model making an observational drawing for their class, using a simple object, and speaking their observations out loud and explaining what they are trying to do as they go.

Drawings should

- show what the observer saw by looking very carefully
- fill the space provided – in order to be able to include detail
- be done in pencil – easier to make changes, colored pencils can be used later
- represent the shape of the object
- include all the parts of the object
- be labeled (annotated) in pencil

b. Distribute Hand Out #1 My Observations of Objects and Materials, a pencil and colored pencils

2. Highlight structure and function, a crosscutting concept

a. Point out that the object is a pencil but it is made up of other objects: an eraser, wooden shaft covered with paint, a "lead", a metal band

b. Ask participants to complete the Notebook page by listing the materials used in the manufacture of the pencil and the "What I noticed" column.

3. Engineering connections

Point out an example of engineering concepts in this curriculum. A pencil is an engineered object. Each part of the pencil is made of a material that has been selected because its properties make the object work well. For example, graphite is very soft and a little will rub off and leave a trace as it is pulled across a piece of paper. Wood is strong, relatively light for its size, and can be easily shaped with tools – thus making it a good material for the body of the pencil.

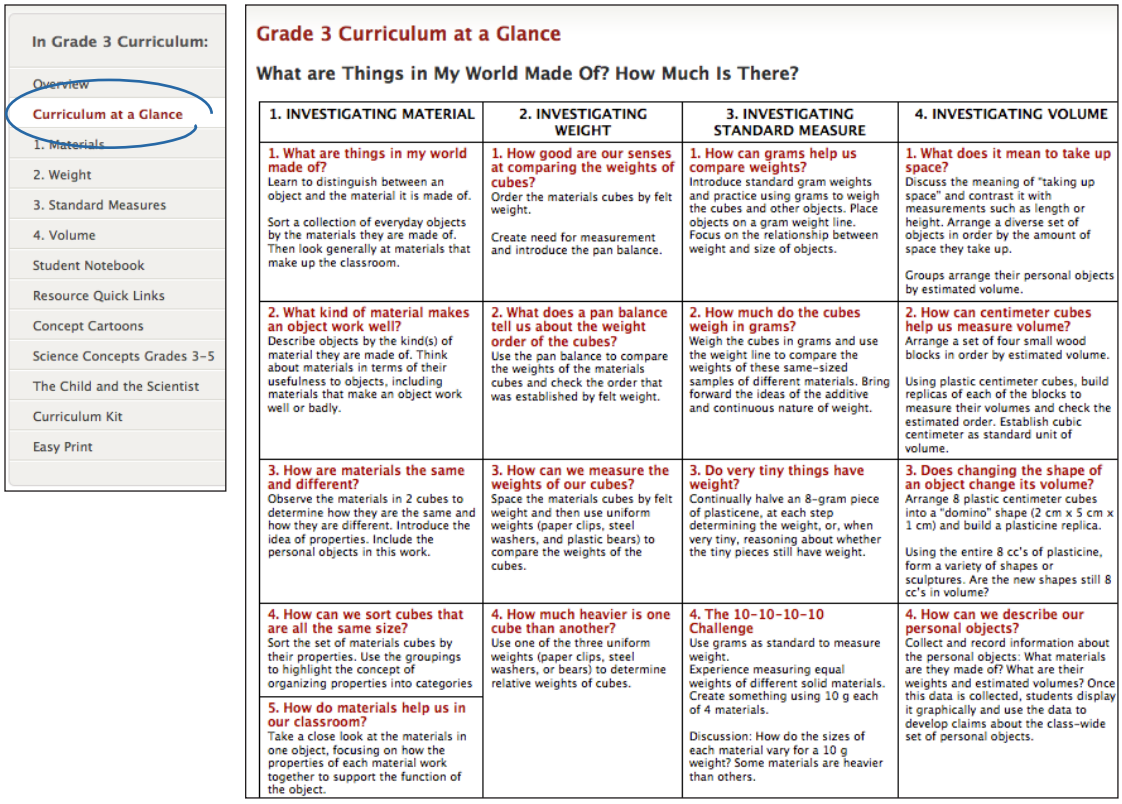
4. Pulling it all together

Point out that as they plan this lesson, teachers need to think about how the final step can help students see how the diverse activities in these five investigations will help them better understand their world. The paragraph below from the Teacher's Guide provides a summary.

"The idea that students depend on the properties of materials in their everyday lives is one that they can carry with them long after this class session. Whether it's pencils, lunchboxes, bicycles, or bath tubs, students can start to make more sense of the objects in their world as they develop a greater awareness of the materials they count on every day."

5. Remind participants of Curriculum at a Glance

Ask participants to click Curriculum at a Glace from the sidebar menu.



In Grade 3 Curriculum:

- Overview
- Curriculum at a Glance
- 1. Materials
- 2. Weight
- 3. Standard Measures
- 4. Volume
- Student Notebook
- Resource Quick Links
- Concept Cartoons
- Science Concepts Grades 3–5
- The Child and the Scientist
- Curriculum Kit
- Easy Print

Grade 3 Curriculum at a Glance

What are Things in My World Made Of? How Much Is There?

1. INVESTIGATING MATERIAL	2. INVESTIGATING WEIGHT	3. INVESTIGATING STANDARD MEASURE	4. INVESTIGATING VOLUME
1. What are things in my world made of? Learn to distinguish between an object and the material it is made of. Sort a collection of everyday objects by the materials they are made of. Then look generally at materials that make up the classroom.	**1. How good are our senses at comparing the weights of cubes?** Order the materials cubes by felt weight. Create need for measurement and introduce the pan balance.	**1. How can grams help us compare weights?** Introduce standard gram weights and practice using grams to weigh the cubes and other objects. Place objects on a gram weight line. Focus on the relationship between weight and size of objects.	**1. What does it mean to take up space?** Discuss the meaning of "taking up space" and contrast it with measurements such as length or height. Arrange a diverse set of objects in order by the amount of space they take up. Groups arrange their personal objects by estimated volume.
2. What kind of material makes an object work well? Describe objects by the kind(s) of material they are made of. Think about materials in terms of their usefulness to objects, including materials that make an object work well or badly.	**2. What does a pan balance tell us about the weight order of the cubes?** Use the pan balance to compare the weights of the materials cubes and check the order that was established by felt weight.	**2. How much do the cubes weigh in grams?** Weigh the cubes in grams and use the weight line to compare the weights of these same-sized samples of different materials. Bring forward the ideas of the additive and continuous nature of weight.	**2. How can centimeter cubes help us measure volume?** Arrange a set of four small wood blocks in order by estimated volume. Using plastic centimeter cubes, build replicas of each of the blocks to measure their volumes and check the estimated order. Establish cubic centimeter as standard unit of volume.
3. How are materials the same and different? Observe the materials in 2 cubes to determine how they are the same and how they are different. Introduce the idea of properties. Include the personal objects in this work.	**3. How can we measure the weights of our cubes?** Space the materials cubes by felt weight and then use uniform weights (paper clips, steel washers, and plastic bears) to compare the weights of the cubes.	**3. Do very tiny things have weight?** Continually halve an 8-gram piece of plasticene, at each step determining the weight, or, when very tiny, reasoning about whether the tiny pieces still have weight.	**3. Does changing the shape of an object change its volume?** Arrange 8 plastic centimeter cubes into a "domino" shape (2 cm x 5 cm x 1 cm) and build a plasticine replica. Using the entire 8 cc's of plasticine, form a variety of shapes or sculptures. Are the new shapes still 8 cc's in volume?
4. How can we sort cubes that are all the same size? Sort the set of materials cubes by their properties. Use the groupings to highlight the concept of organizing properties into categories **5. How do materials help us in our classroom?** Take a close look at the materials in one object, focusing on how the properties of each material work together to support the function of the object.	**4. How much heavier is one cube than another?** Use one of the three uniform weights (paper clips, steel washers, or bears) to determine relative weights of cubes.	**4. The 10-10-10-10 Challenge** Use grams as standard to measure weight. Experience measuring equal weights of different solid materials. Create something using 10 g each of 4 materials. Discussion: How do the sizes of each material vary for a 10 g weight? Some materials are heavier than others.	**4. How can we describe our personal objects?** Collect and record information about the personal objects: What materials are they made of? What are their weights and estimated volumes? Once this data is collected, students display it graphically and use the data to develop claims about the class-wide set of personal objects.

Explain that teachers find this a valuable resource as they get to know the Grade 3 curriculum and plan their teaching.

Provide a few minutes for participants to look at the chart.

Note that:

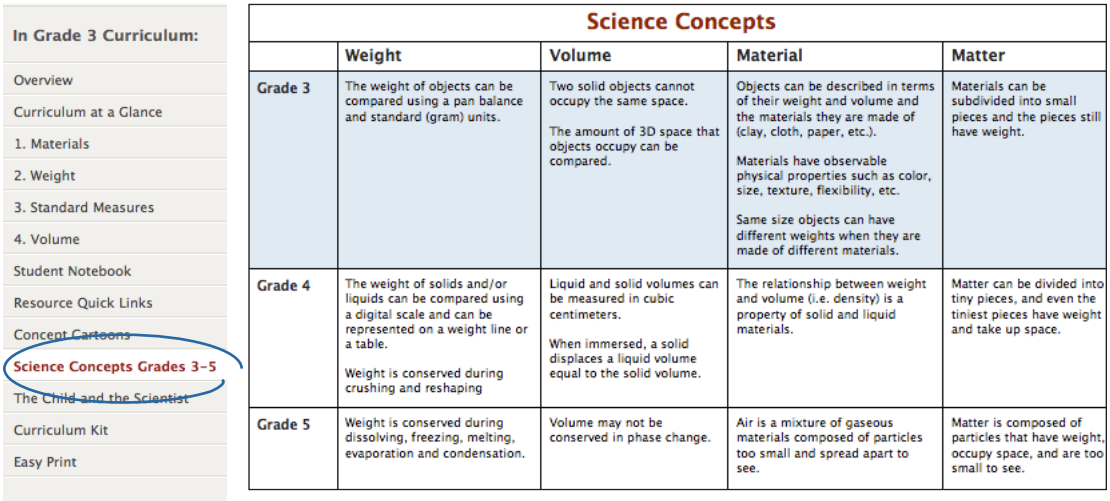
- this can be printed out as a pdf.
- The text provides a snapshot of the student experience.

Ask participants to click Science Concepts 3-5 on the sidebar menu.

This resource summarizes the learning progression.

Ask participants to take a few minutes to see how concepts about Material are developed further in Grades 4 and 5.

Provide a few minutes for the group to comment on what they see here and for them to ask any questions.



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Science Concepts

	Weight	Volume	Material	Matter
Grade 3	The weight of objects can be compared using a pan balance and standard (gram) units.	Two solid objects cannot occupy the same space. The amount of 3D space that objects occupy can be compared.	Objects can be described in terms of their weight and volume and the materials they are made of (clay, cloth, paper, etc.). Materials have observable physical properties such as color, size, texture, flexibility, etc. Same size objects can have different weights when they are made of different materials.	Materials can be subdivided into small pieces and the pieces still have weight.
Grade 4	The weight of solids and/or liquids can be compared using a digital scale and can be represented on a weight line or a table. Weight is conserved during crushing and reshaping	Liquid and solid volumes can be measured in cubic centimeters. When immersed, a solid displaces a liquid volume equal to the solid volume.	The relationship between weight and volume (i.e. density) is a property of solid and liquid materials.	Matter can be divided into tiny pieces, and even the tiniest pieces have weight and take up space.
Grade 5	Weight is conserved during dissolving, freezing, melting, evaporation and condensation.	Volume may not be conserved in phase change.	Air is a mixture of gaseous materials composed of particles too small and spread apart to see.	Matter is composed of particles that have weight, occupy space, and are too small to see.

I. To the Workshop Leader

Introducing Investigating Weight

As you think about what ideas and practices to emphasize in this part of the workshop, one way to begin is to imagine a group of third grade students hearing that "Weight is a property of matter." The three words, weight, property, and matter will be familiar to students from everyday conversation but the scientific meaning will not. The term "property" was introduced in the last investigation and over time, "property" will be better understood as students use it to describe objects or materials. You'll want participants to know that weight and matter are the subjects of study not only in this unit but in the grades 4 and 5 curricula as well.

In Grade 3, we focus on weight. The four investigations in this section are built around testable questions: how good are our senses at measuring weight? If we had a pan balance would our measurements be more accurate? What units of weight do we use: if we had a bucket of paper clips, washers, counting bears could we compare weights? If we could choose just one kind of counterweight – either paper clips, washers, or counting bears – which would be best and why? As you lead participants through these investigations, emphasize the idea that their students will able to construct answers to these questions using evidence they have collected.

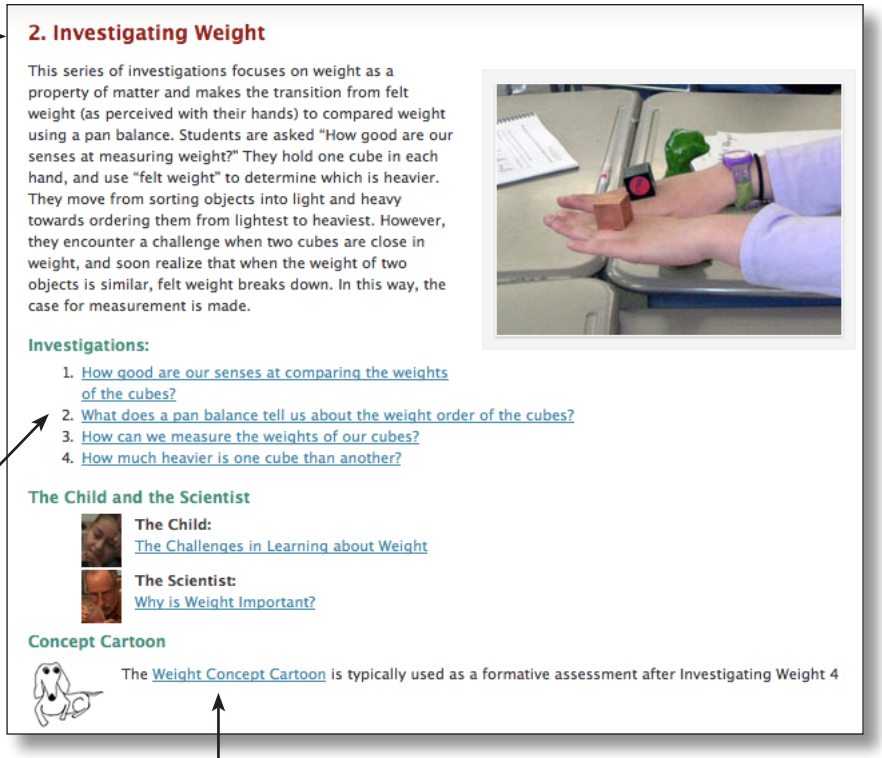
This learning sequence sets the stage for introducing the gram as a standard unit for measuring weight and that is the topic of the next set of investigations!

II. Section 2, Investigating Weight, Investigations 1-4

This learning sequence begins with children's initial concept of weight as "felt weight," moves from measuring weight with their two hands to using two pans on a balance scale. Students use the balance scale to measure weight in term of units and discover the value of using one standard unit of weight to compare the weight of objects. (See **The Child and the Scientist** essays)

There are 4 investigations in this sequence.

"Children's initial understanding of weight is limited, and very different from the understanding of scientists, as it is grounded in their perceptual experiences of weight." Read these essays to learn more about what you can expect third grade children to think about weight and how these ideas can be restructured to become more similar to the ideas about weight held by scientists.



2. Investigating Weight

This series of investigations focuses on weight as a property of matter and makes the transition from felt weight (as perceived with their hands) to compared weight using a pan balance. Students are asked "How good are our senses at measuring weight?" They hold one cube in each hand, and use "felt weight" to determine which is heavier. They move from sorting objects into light and heavy towards ordering them from lightest to heaviest. However, they encounter a challenge when two cubes are close in weight, and soon realize that when the weight of two objects is similar, felt weight breaks down. In this way, the case for measurement is made.

Concept Cartoon

This **Concept Cartoon** is typically used after students have completed all 4 Investigating Weight lessons and serves as a formative assessment item. In some classrooms, the teacher asks students to "act out" the cartoon by reading the parts of each cartoon character. Students respond in writing to each cartoon character describing where and why they agree or disagree with the character's ideas. Then, the class critiques each other's responses. In some classrooms students edit their own work after discussion using a different color pen or pencil.

Materials and Preparation for this part of the workshop

Investigating Weight 1

For the Workshop Leader

- 3 objects that appear identical but that have clearly different weights: 3 chalk boxes containing different numbers of pieces of chalk; 3 salt shakers containing different amounts of salt
- Prepare a data table for recording the order of cubes by felt weight (step 4)

For each group of 2-3 participants:

- 1 set of cubes with the names of the materials on the cubes

Investigating Weight 2

For each group of 2-3 participants:

- 1 set of cubes with the names of the materials on the cubes
- 1 pan balances adjusted for accuracy

Investigating Weight 3

For the workshop leader:

- Prepare a data table on the SMARTBoard or chart paper where participants can record their data

For each group of 2-3 participants:

- 1 aluminum, 1 PVC, and 1 acrylic cube
- A container with a mixture of at least 25 plastic counting bears, 40 steel washers, and 85 large paper clips
- 1 pan balance

Investigating Weight 4

For the workshop leader:

- A plastic measure line to use as a weight line

For each group of 2-3 participants:

Time:
60 Mins

- 1 pan balance
- 2-3 personal objects

How Investigating Weight reflects the Science Framework

Component Ideas about Matter and Its Interactions	The weight of objects can be compared using a pan balance and standard units; objects can be described in terms of their weight and the materials they are made of; same size objects can have different weights when they are made of different materials.
Scientific Practices	Analyzing and interpreting data: students use "felt weight" to order 8 material cubes and analyze data to evaluate felt weight as a measurement tool; Engaging in argument from evidence: students use felt weight data as evidence to answer the question how good are our senses at measuring weight?
Crosscutting Concepts	Energy and Matter: flows, cycles, and conservation: weight can be used to track flows and cycles of matter.

III. Investigations

Click Investigating Weight

A. Investigating Weight 1, How good are our senses at comparing the weight of cubes?

TIP Check to be sure participants understand how "order" is used in these lessons – as a verb meaning to place things in order according to some rule.

This investigation challenges the idea that we can use "felt weight" to find out how the weights of two objects compare. Children's initial understanding of weight is grounded in their perceptual experiences. However, the data students collect themselves lead them to understand that we can't always rely on our senses to compare weights.

1. Experience the activity firsthand

a. Explore sensed weight

Ask the investigation question: **how good are our senses at comparing the weights of objects**?

Show participants three objects that appear identical but have different weights.

If we want to order these objects by weight, can we use our sense of sight? hearing? touch?

Have a volunteer order the boxes by weight.

b. Order cubes by felt weight

Distribute a set of cubes to each group of 2-4 participants.

Ask them to compare the weights of the cubes using their hands (felt weight) and record the order on the data table you have prepared (either posted on chart paper or projected using an electronic board or document camera).

Order of cubes by weight, using felt weight

Group	Least Weight → Most Weight							
1								
2								
3								
4								
5								

2. Make meaning

Ask participants to look closely at the results.

Model strategies that help make sense of class data, for example,

- Use a color to highlight areas of the table where everyone is in agreement or where there are patterns.
- Use another color to highlight areas of disagreement.

Ask participants to use these results to make statements (or claims) that answer the investigation question and point to evidence in the data that supports the claim.

How good are our senses at comparing the weights of cubes?

Students typically find that felt weight isn't very accurate when objects are very light (the woods) or very heavy (copper and steel) or when their weights are similar (woods, plastics). Felt weight is fine as long as the size of the objects is similar and the weights are quite different.

B. Investigating Weight 2, What does a pan balance tell us about the weight of the cubes?

The purpose of this investigation is to introduce the double pan balance, provide time for students to learn to use the balance, and appreciate the value of the instrument when felt weight fails them.

TIP Provide instruction on how to adjust the balance so that the pans are level and the pointer points to the vertical mark in the middle of the scale. The balance may need to be adjusted from time to time.

1. Ask participants to use the double pan balance to check the weight order of their cubes.

Have participants make necessary changes to the data (order of cubes by weight) they reported in Investigating weight 1.

2. Make Meaning discussion

Explain that the purpose for each discussion is included in the Teacher's Guide. In this lesson, the discussion will reveal what students are thinking about the question How good are our senses at comparing weight? and students' ideas about what additional information a pan balance does and doesn't provide.

Tell participants that the focus question for this discussion is

- How did the pan balance help you answer the question
  How good are our senses at comparing weight?

Ask participants to imagine what students will say in response to this question and take a few minutes for them discuss these ideas.

C. Investigating Weight 3, How can we measure the weight of our cubes?

Students know the weight order of the cubes but not what the cubes weigh or how much more one cube weighs than another. The purpose of this investigation is to have students appreciate the necessity of using a single unit of measure to compare weight by seeing what happens when you don't use a single measure!

TIP If asked, do not offer an opinion on how participants should weigh the cubes. Talking among themselves about quandaries such as this is a necessary part of the learning.

1. Experience the activity firsthand

a. Put an unmarked strip of adding machine tape where everyone can see it.

- Ask a participant to order an oak, pine, and copper cube by weight.
- Ask him or her person to order these cubes this time by relative weight – how much heavier one cube is than another.
- Point out that they can't know for sure how to space the cubes unless they know how much each one weighs.

Top: Pine, oak and copper cubes in order by weight.
Bottom: Pine, oak and copper cubes on the weight line ordered by "relative weight".

b. Provide time for the group to generate some weight data

- Give each group an identical set of 3 cubes and a bucket of paper clips, washers, and counting bears.
- Give them 10 minutes to weigh the cubes using the items in the bucket and record their results on a data table you have prepared.

2. Make meaning

Record results. If groups used a single measure for all items or if no one used a mixture of measures, explain that students typically use a mixture of paper clips, washers and counting bears which they can quickly see makes it impossible for groups to agree on the weight of a cube or how much heavier one cube is than another.

	Aluminum cube	Pine cube
Group A	9 bears, 4 paper clips	1 bear, 3 paper clips
Group B	10 washers, 21 paper clips	2 washers, 2 paper clips

Ask participants to discuss the question below.

When students are given a bucket of paper clips, washers, and bears and are left to decide how to weigh the cubes can be messy. Teachers are advised to let students deal with these quandaries themselves.

What do you think about this approach?

D. Investigating Weight 4 How much heavier is one cube than another?

Click 2, Weight, Investigation 4

The purpose of this investigation is to set the state for understanding why grams are used to measure weight. Students agree on a unit of weight (paper clips, washers, or bears), weigh the cubes, and record an agreed-upon class weight for each cube. They place the cubes on the measure line and are poised to understand why scientists all over the world use the gram as a standard measure of weight.

1. Describe the activity

Scroll to 2. Weigh the cubes

Explain that the Teacher's Guide describes the logistics of this investigation. The class agrees upon a unit of measure for weight (bears, paper clips, or washers).

- Each kind of cube is weighed twice – there are 16 "weighings."
- Students agree upon a final weight for each cube to put in the class data table.
- The teacher rolls out the measure line (which is now a weight line) from the kit
- Students put cubes in the appropriate place on the weight line.

2. Experience placing cubes on a weight line firsthand

Place an index card labeled "Paper Clips" next to the weight line.

Ask participants to imagine they had weighed the cubes in paper clips and to place the cubes in the appropriate places on the weight line.

If time permits and you think participants would benefit, repeat with a "bears," or "washers" weight line.

Approximate Weights of Objects

Object	Weight in Paper Clips	Weight in Washers	Weight in Bears	Weight in Grams (g)
Pine	6	3	2	8
Oak	9	4–5	3–4	12
Nylon	14	7	4–5	18
Acrylic	14–15	7–8	5	19
PVC	17	8–9	5–6	22
Aluminum	34	17	11	44
Steel	98	49	32	128
Copper	112	56	37	146
Paper Clip	1			1.3
Metal Washer		1		2.6
Bear			1	4

3. Make meaning

Point out that

Sometimes the purpose of a discussion is to consolidate learning. This type of discussion is framed by three questions

What did we do?

Why did we do it?

What did we find out?

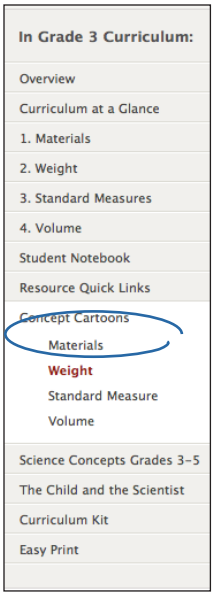
This discussion is an opportunity for students to put some of their math learning to work, for instance by asking, How many grams do we have to add to the PVC cube to make the weight equal to a copper cubes? How much heavier than a pine cube is the PVC cube? What cube is about 2X the weight of a PVC cube? etc.

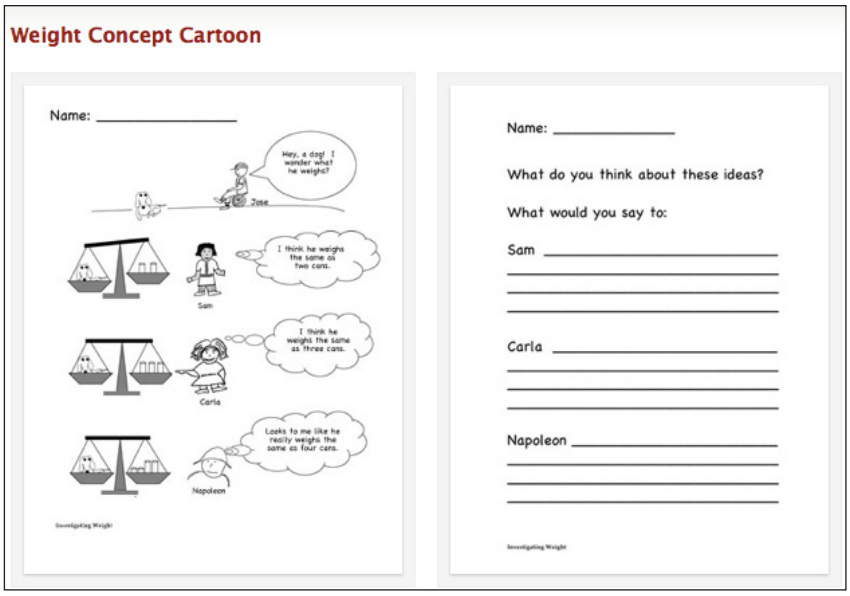
It's the same data on the measure line and in the data table, only represented two different ways.

4. The Concept Cartoon

Ask participants to find the link to the **Weight Concept Cartoon** (sidebar menu).

Look at this assessment together. Note that some teachers have students discuss – agree or disagree - their responses to these cartoon characters' ideas in small groups and then write individual responses. These responses will help teachers decide next steps, for example, is the class ready to move on to the next investigation or will the class or a few individuals benefit from more experience measuring weight?





I. To the Workshop Leader

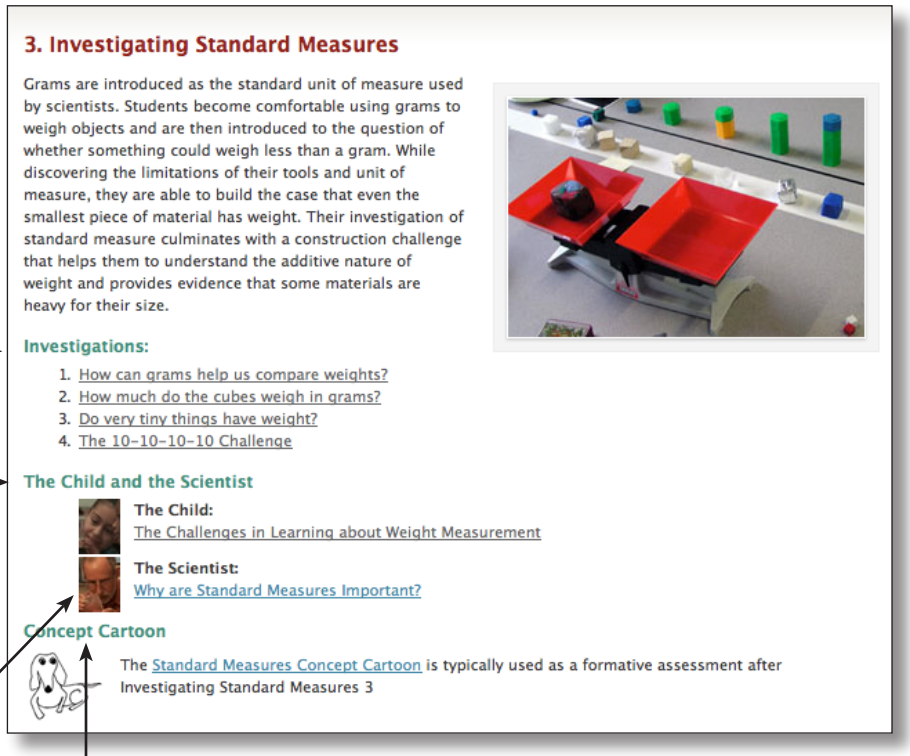
Introducing Investigating Standard Weight

Once they understand the need for standard units to measure weight, students readily accept the gram as the standard unit for scientific work the world over. Teachers will appreciate knowing that it takes a while – and lots of experience – before grams are really familiar. Is there something in the classroom that weighs just 1g? Can I find a 10g object? Would any of the materials cubes weigh about 10g? What about 100g? Can I think of something familiar that weights about 100g?

The first order of business in these investigations is becoming familiar with grams. Then comes an intriguing question: could very tiny objects (so small they don't register weight on our hands or even on our scales) weigh something? Can something weigh less than a gram - can grams be divided into fractional units? Until students are convinced – by evidence and reasoning – that tiny things have weight, they will be unprepared for some important ideas about matter they'll meet in Grade 5: that air is matter or that matter is composed of unbelievably tiny particles.

II. Investigating Standard Measure

This set of investigations introduces the gram as the standard unit of measure, asks what the 8 material cubes weigh in grams, provides a context to reason about whether tiny things have weight, and wraps up with a weighing/building challenge.



The Child and Scientist essays Learning to measure weight is more than a set of procedures and teachers need to know what that is!

The Scientist Essay explains why standard units are important and provides insight into the practices of the scientific community.

Concept Cartoon
The Concept Cartoon is typically used as a formative assessment after Investigation 3. Learn what this assessment can reveal about students' understanding of standard measure.

Materials and Preparation for this part of the workshop

Investigation 1

For the workshop leader:

- The plastic weight line
- 1 gram weight set
- 1 index card labeled "Grams"
- 1 object weighing approximately 1 pound (450 grams)

For each group of 2-4 participants:

- a pan balance
- 1 gram weight set

For each participant:

- 1 gram weight
- 1 large paper clip

Investigation 2

For the workshop leader

- Prepare a class table on a whiteboard or flip chart for recording the gram weights of the cubes; an example is shown in Step 2.
- the plastic weight line
- 1 index card labeled "Grams"
- 1 or more sets of materials cubes (each participant needs one cube to weigh)
- 2 cubes that have been cut in half (kit)

For each group of 2-4 participants:

- 1 gram weight set
- a pan balance

Investigation 3

For the workshop leader:

- Draw an oversized 4-gram weight line on a flip chart or whiteboard.
- 1 8-gram piece of plasticene, rolled to the thickness of a pencil

For each group of 2-4 participants:

- 1 pan balance
- 1 5–gram weight
- 4 1–gram weights
- a plastic knife
- a small plate
- 1 desktop weight line labeled from 0 to 4 grams (Handout #2)
- approximately 10 grams of plasticene

Investigation 4

For the workshop leader:

If possible, gather the following materials to demonstrate the 10-10-10-10 activity.

- Styrofoam 10g
- aluminum foil 10g
- plasticene 10g
- wood stirrers 10g
- scissors

Handout packet

How Investigating Standard Measures reflects the Science Framework

Component Ideas about Matter and Its Interactions	The weight of objects can be compared using a pan balance and standard gram units;
Scientific Practices	Using mathematics and computational thinking: measurements of weight of same-sized samples of eight solid materials; 8 grams of plasticene can halved and halved again into smaller and smaller pieces until the pieces are too small to see or register on our scales
Crosscutting Concepts	Scale, proportion, and quantity: students use standard units to express and measure weight; they reason that matter can be subdivided into tinier and tinier pieces and each piece has weight; each tiny piece contributes to the total weight.

Time: 60 Mins

III. Investigations

A. Investigating Standard Measures 1, How can grams help us compare weights?

The overarching purpose of this investigation is to introduce the gram as a standard unit of measure. By placing a variety of objects on a weight line, students see size and weight don't always correspond.

1. Experience the activity firsthand

Explain the 1. Ask step introduces the set of gram weights students will use from now on.

Distribute objects or ask participants to select objects and weigh them in grams.

Roll out the weight line, including an index card that says "grams," and ask participants to place objects on the weight line.

TIP When referring to a measurement, always include units.

For example,

"How much does the lightest object weigh?"

"14."

"14 what?"

"14 grams."

2. Review the weight line

Reiterate the following points about the weight line

- Weight is represented by distance from zero.
- Objects that are close to zero on the weight line weigh less than objects that are a greater distance from zero.
- The weight line is continuous: there is a place for every object on the weight line.
- The weight of an object can be between marks and numbers on the weight line.

3. Make meaning

Ask participants what they think about the advantages of grams as a unit of measure (rather than bears, paper clips, or washers, for example).

Call their attention to the objects arrayed along the weight line and ask what they notice about the relationship between weight and size.

- Are there objects that weigh about the same but have different sizes? How can this be?
- Are any objects just one gram different in weight? Could there be objects closer than 1 gram in weight?
- How do the sizes of the lightest (heaviest) objects compare? How much do they weigh? Any surprises?

B. Investigating Standard Measures 2, How much do the cubes weigh in grams?

Weighing the cubes in grams and placing them on the weight line is a straightforward activity that provides a context for introducing two ideas about weight: the additive and continuous nature of weight.

1. Experience the activity firsthand

Ask participants to weigh the 8 cubes in grams and place them on the weight line.

(Distribute the cubes and gather weight data as quickly as possible. If you are short on time, you can have participants click **Resource Quick Links** and look up the weights. Note that the weight of the woods will depend on factors such as humidity.)

Explain that in the classroom, each student weighs one cube and enters the data in a class table. There may be discrepancies between the weight measurements of the same kind of cube. The Teacher's Guide suggests that the students involved swap cubes and weigh them one more time.

2. Making meaning

Once the cubes are displayed on the weight line, explain that the purpose of this discussion is to bring forward the idea that weight is a property that can be increased in small or large increments. Ask questions such as

How much would I have to add to

- the acrylic cube to make it weigh the same as the PVC cube?
- the pine cube to make it weigh the same as the oak cube?
- the PCV cube to make it weigh the same as the copper cube?

Ask participants to imagine a cube made of another material and say where they think it might fit on the weight line. Have some fun: a cube made of banana, of brick, of butter, of whipped cream, etc.

Explain that the idea behind this thought experiment is that every point on the weight line represents a different weight, that there are no gaps; that there's a place for every object, and that new objects can be added between any two points on the line. This is referred to as the "continuous" nature of weight.

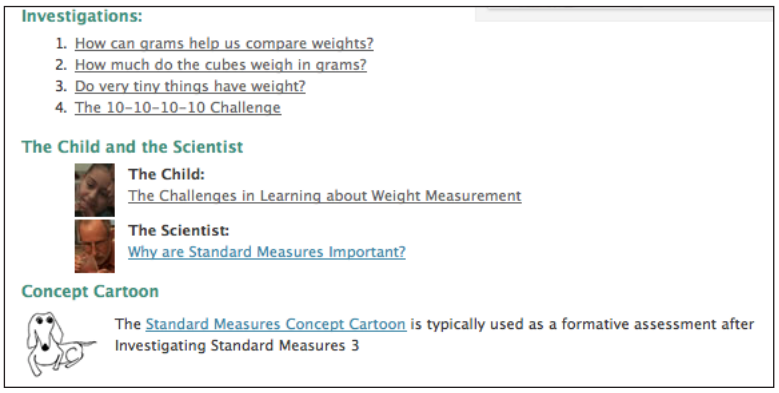
C. Investigating Standard Measures 3, Do very tiny things have weight?

The purpose of this investigation is to produce evidence that it's reasonable to believe that teeny, tiny things have weight.

1. Experience the activity firsthand

a. Rub an eraser so that participants can see the tiny "rubbings." Pick up a piece of the rubber, place it in the hand of a participant and ask if this tiny thing has weight.

Explain that children commonly think that objects like a piece of dust or flakes of chalk don't weigh anything. Encourage people to read Carol Smith's **Child and the Scientist** essay.



b. Distribute Handout #, the desktop weight line and an 8 gram piece of Plasticine (you'll save time if you weigh these out ahead of time).

(The **Desktop Weight Line** can be found in **Resource Quick Links**.)

Display a copy of the mini-weight line, (either tape a copy on the board, use a document camera, or the SMARTBoard).

Model an introduction to this activity: hold up the 8g piece of Plasticine and ask

"If I cut this is half, how much will each piece weigh?" [4g]

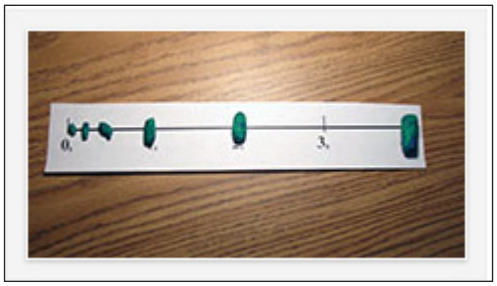
"Where does a 4g piece go on the weight line?" [Make the mark.]

"If I cut the remaining 4g piece in half, how much will each piece weigh? [2g]

"Where does a 2g piece go on the weight line?" [Make the mark.]

c. Ask participants to work in pairs and follow your narration below.

- Begin with an 8 gram piece of Plasticine
- Divide the piece of Plasticine into two equal pieces and place one of the pieces on the 4 gram mark on the weight line.
- Divide the other 4 gram piece into two equal pieces and place one of these on the 2 gram mark on the weight line.
- Divide the other 2 gram piece in half and put one piece on the 1 gram mark.
- Divide the remaining 1 gram piece in half and decide where this piece goes on the weight line
- Decide where the half of the half-gram piece goes, and a half of the one-quarter-gram piece



d. Lead a discussion

Ask participants to do the same thought experiment they will use in their classrooms.

As fine motor skills limit the size of the pieces you can continue to subdivide, try this thought experiment (an experiment you do in your imagination):

Imagine you had microscopic hands and tiny little scissors and could keep cutting the pieces of Plasticine in half as many times as you want.

• Would you ever run out of Plasticine?

• As the pieces of Plasticine get smaller and smaller, will you ever get to zero on the weight line?

• Can you ever have a piece of Plasticine—no matter how tiny—on the other side of zero on the weight line?

• Do you think objects have weight even if we can't feel the weight?

e. Return to the Investigation Question:

Ask participants to take a few minutes to discuss their ideas about why **Do tiny things have weight?** is an important question for students who are learning about matter.

D. Investigating Standard Measures 4, The 10-10-10-10 Challenge

This investigation taps into students' creativity and imagination at the same time they practice weighing objects in grams. When they see what 10 grams of aluminum, foam, wood, and Plasticine look like, it becomes clear that some materials take up more space for the same amount of weight than others.

1. Explain that you will not do this investigation in the workshop.

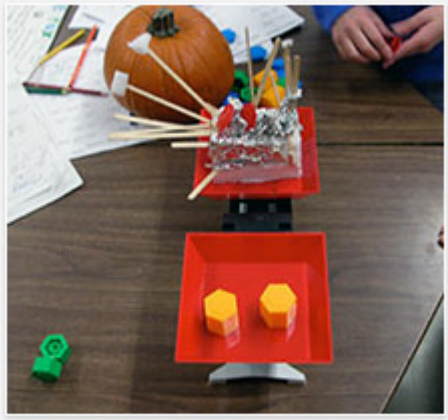
Ask participants to show with their hands how much space they think 10g of each material will take up. (They have just seen 8g of Plasticine so should be able to make a reasonable prediction about this material!)

Encourage participants to tell their students to weigh carefully, be creative, and have fun!

2. The additive nature of weight

Explain that after students complete their constructions, the teacher asks each team to predict the weight of the final product. Note that a seated pan balance accommodates these objects more readily than and hanging pan balance.

The final weigh-in can be quite exciting! If the final weight is more or less than 40g, the teacher asks students to figure out where to find missing materials or what they might do to hit the 40g target.



A seated pan balance accommodates larger objects more readily than a balance with suspended pans.

3. Make meaning

Explain that the discussion focuses on three big ideas about matter and weight

- Each material weighed the same (10g). What did you notice about the amount of space they took up? property of materials is its "heaviness for size," which is a precursor idea to the concept of density]
- You began with 10g of each material. Some materials were reshaped (the plasticene was divided into pieces, squished, stretched; the aluminum was bent; some of the wood was broken into pieces). Did the weight change? Explain. [Weight is conserved during transformations of matter]
- Did the total weight equal the sum of the weights of the parts? [weight is additive in nature; weight stays the same as long as no matter is added and no matter is taken away]

Explain that this is an opportunity for teachers to touch on engineering ideas.

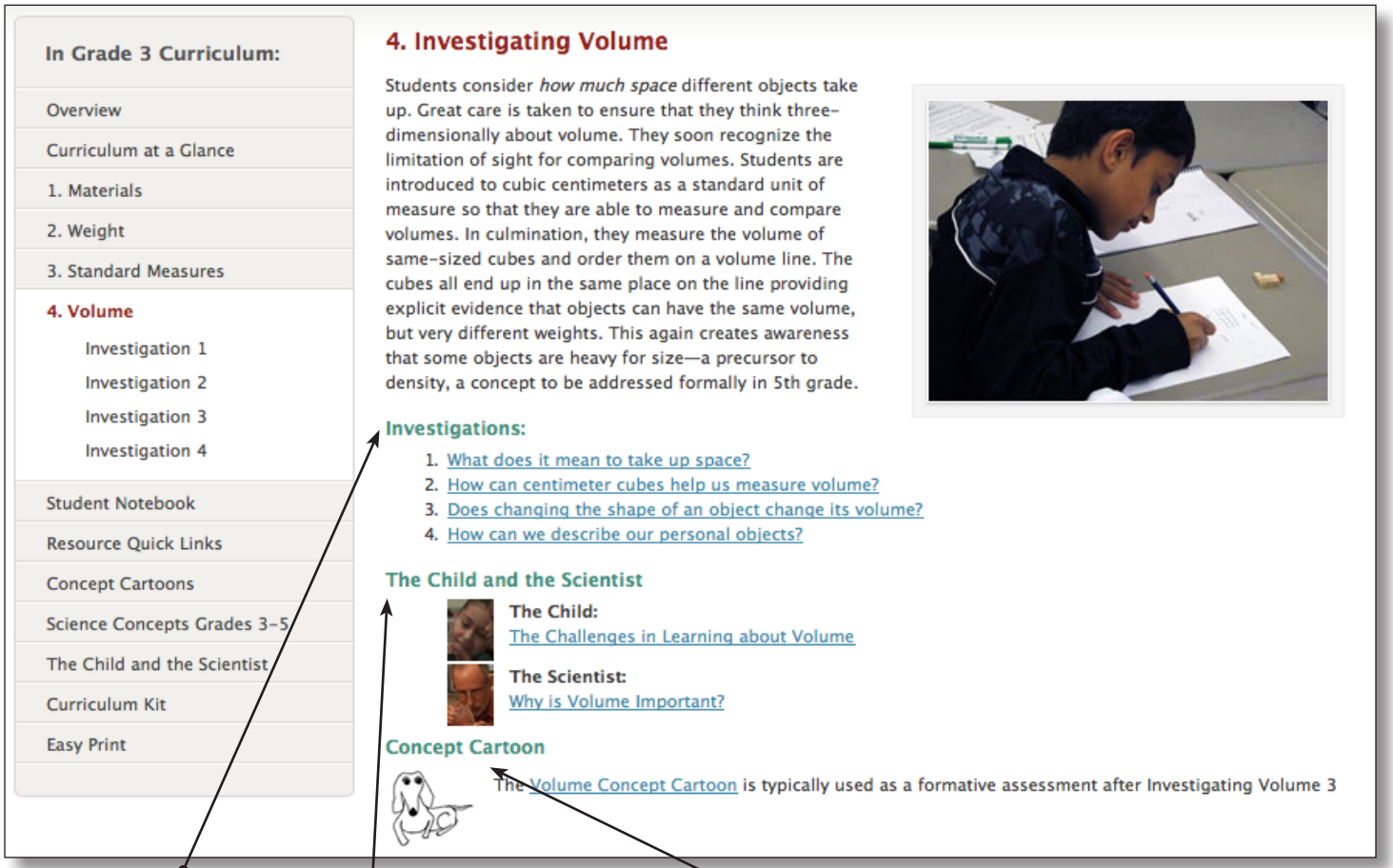
- The properties of each material determine its function in 10-10-10-10 construction, e.g., if a team wanted "legs" to hold the foam block off the table, wooden sticks would be a better choice than Plasticine or aluminum foil.

Grade 3: Section 4: Investigating Volume

I. To the Workshop Leader

Volume is challenging for students; you won't get any disagreement from their teachers on this point! Your challenge in this part of the workshop is to make the case that children's understanding of volume develops over time through multiple experiences in a variety of contexts. And, that these four experiences with volume are a beginning - they set the stage for more in-depth investigations of volume in Grade 4. Teachers will appreciate knowing the rationales for the activities in this set of investigations and how they serve as a springboard for further learning.

II. Section 4, Investigation Volume, Investigations 1-4



The investigations in this section introduce volume, distinguishing the amount of space an object takes up from weight, height, area, and other measures. A cube 1cmx1cmx1cm is introduced as the standard measure of volume. Students discover that objects of equal volumes can have very different weights, an idea that is a precursor to the concept of density that students encounter in middle school.

The Child and the Scientist
Volume is a difficult concept for students and teachers will want to learn what we know about why this is so. Volume plays an important role in science and this resource elaborates on this point.

The Concept Cartoon
The Concept Cartoon is here for teachers to assess students' understanding of volume as a three-dimensional measure of the amount of space an object takes up and students' ability to differentiate volume from area or length.

Materials and Preparation for this part of the workshop

Investigating Volume 1

For the Workshop Leader:

- 1 block of Styrofoam (approx. 10 cm x 10 cm x 20 cm)
- 1 pillar candle #1 (approx. 8 cm diameter x 16 cm tall)
- 1 small maple block (from 4 piece wood block set)
- Several creations from the 10–10–10–10 Challenge, if available

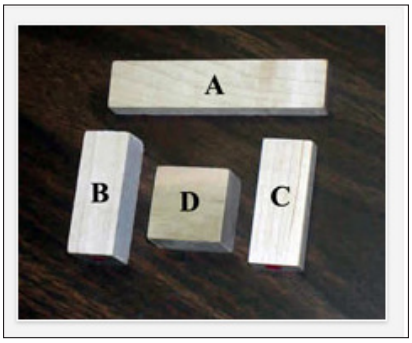
For each group of 2-4 participants:

- 1 small cube (cubic centimeter block)
- 1 copper cube (from the set of materials cubes)
- 1 pine cube (from the set of materials cubes)
- 1 100–gram piece of plasticene

Investigating Volume 2

For Workshop Leader

- Prepare and post a class table labeled "Order of Blocks by Volume"; an example is given in Step 2.
- The class volume line from the previous session (with the Styrofoam, maple block, cubes, et al.)
- Label sets of 4 wooden blocks A, B, C, D; see image in Step 1.



For each group of 2-4 participants:

- 1 set of 4 wood blocks labeled A, B, C, and D, or enough blocks for each student to have 1 block
- At least 75 cubic centimeter blocks

Investigating Volume 3

For each participant:

- 1 plastic knife
- 1 small plate
- 8 centimeter cubes
- Approximately 10 cubic centimeters of plasticene

Investigating Volume 4

For the group:

- Histogram 1: Number of Materials in Our Objects
- Histogram 2: Materials Our Objects are Made of
- Histogram 3: Estimated Volume of Our Objects
- The class weight line
- 3 volume reference blocks: 1, 10, 100 cubic centimeters (see the photo in Step 2).
  - 10 cubic centimeter reference is created by taping 10 centimeter cubes together
  - 100 cubic centimeter reference is created by taping 5 maple blocks labeled B (20 cubic centimeters) together

For each group of 2-4 participants:

- 1 gram weight set
- a pan balance

For each participant:

- 1 personal or classroom object

Time: 90 Mins

How Investigating Volume reflects the Science Framework

Component Ideas about Matter and Its Interactions	Volume describes the amount of 3-D space an object takes up. The volumes of objects can be compared. Two solid objects cannot occupy the same space. Matter has weight and volume.
Scientific Practices	Analyzing and interpreting data: students collect data about the weight, volume, and materials of a collection of objects and make evidence-based claims. Using mathematics and computational thinking: students investigate volume when an object is transformed
Crosscutting Concepts	Scale, proportion, and quantity: the volumes of objects can be quantified and compared.

III. Investigations

Click 4. Volume, Investigation 1

A. Investigating Volume 1, What does it mean to take up space?

This investigation introduces the concept of volume (and the term) which may be new to 3rd grade students and difficult for them to separate from other measures that also describe an object's size (e.g., weight, height, length, area, perimeter).

1. Click 1. Ask the question

Take time to describe and model this step in the investigation: learning about volume can't be rushed.

a. Explain that the lesson begins with the 10-10-10-10 student-created objects from the last investigation. (If possible, show a sample 10-10-10-10 creation.)

The following question is designed to call students' attention to the different amounts of space 10g of each material takes up.

All four materials weighted exactly the same – 10 grams. What differences did you notice about how much of each material there was?

Ask participants to think about what students might say in response. [more of, less of, bigger, smaller]

Suggest that teachers might ask students to "say more" about these ideas. The goal is to have the group reach consensus that what's different is the amount of space 10g of each material takes up.

b. Choosing language and using hands

Scroll to the Talking Points box and point out that the term "volume" is not introduced until the very end of the lesson. Until then the phrase "takes up space" is used to emphasize the three-dimensional nature of volume.

Scroll to the modeling 3-dimensional objects box

As the discussion winds down, tell students that, just as objects have height and weight, every object also takes up space. Put the tall pillar candle on the floor and use your hands to define the amount of space the candle takes up, moving two hands around and above the candle, to illustrate how much space this candle takes up.

Modeling 3-dimensional objects: To demonstrate the meaning of *how much space* an object takes up, use both hands, in motion, to show all of the physical boundaries of an object — its top and bottom, its left and right boundaries, its front and back boundaries. By keeping your hands in motion, you focus attention on the size of the *whole* object — not only its height or length — and embody the three-dimensionality of the concept.

Next place the maple block beside the candle and move your fingers around the block in a similar way, to illustrate how much space the wood block takes up.

Finally, invite some comparisons:

Which object takes up more space, the candle or the block of wood?

What about this block of Styrofoam? How does it compare?

Leave the Styrofoam block, pillar candle, and maple block in order for later reference.

Encourage participants to use their hands as they describe the three-dimensional nature of volume (and model this yourself during the workshop).

c. Order three objects by volume

Place a large block of Styrofoam, a pillar candle, and a small maple block where everyone can see them and ask a volunteer to order them **by the amount of space they take up.**

2. Experience the activity firsthand

- Distribute 3 cubes (cm cube, pine cube, copper cube) and a 100g piece of Plasticine to each group of 2-4 participants and have participants order them from the least to the greatest amount of space they take up.
- Ask participants to consider the reason why there are two cubes with the same volume in this set of materials. [can students can separate volume from weight?]
- Project the **Notebook** page and ask participants how they think students will respond to the question **Do you think a tiny ant takes up space?** [this is a chance to distinguish weight and volume: having just addressed the question Do tiny things have weight?, students may confuse weight and volume]
- Remind participants that the term "volume" has not yet been introduced.

3. Make meaning

Ask participants to combine the two sets of materials they have ordered by the amount of space they take up into a single ordered volume line.

Take a few minutes for participants to raise any questions they have about leading this activity or challenges they think their students might face.

Tell participants that at the end of the discussion, the teacher introduces the term "volume," and distinguishes its use in science from other uses, e.g., the amount of sound.

B. Investigating Volume 2, How can centimeter cubes help us measure volume?

The purpose of this investigation is to raise students' awareness of the need for a standard measure for volume and to introduce them to the cubic centimeter that they can use to quantify and compare volumes.

Click **Investigating volume 2** and scroll to **1. Think** about measuring volume

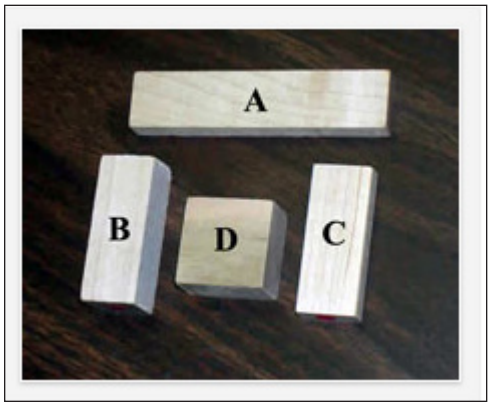
1. Experience the activity firsthand

a. Explain that the 1. Ask step is replaced by a discussion of units are used to measure things. This short activity makes the case for needing units to measure and compare volumes.

How We Measure Things	
Height	Centimeters Inches
Weight	Grams Pounds
How much space (VOLUME)	???

b. Distribute sets of 4 blocks labeled A, B, C, D.

- Ask participants to order the blocks by volume. These materials (the blocks) are designed so the volumes are difficult to compare).
- Record each group's order on a group data table (that you prepared ahead of time and post or project on the SMARTBoard) from least to most volume



Model of table for recording the order of blocks by volume

	Least volume	Next	Next	Most volume
Group 1 Order				
Group 2 Order				
Group 3 Order				
Group 4 Order				
Group 5 Order				
Measured Order*				

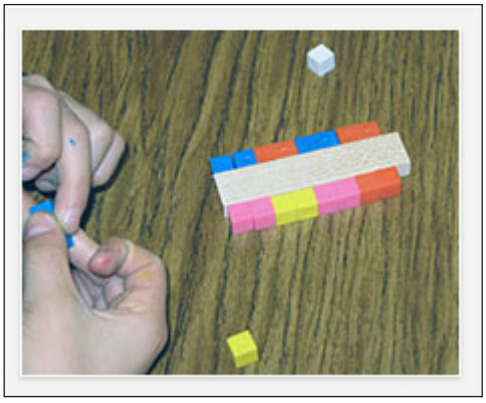
- Ask participants to use the data to answer the question

  How good are our senses at measuring volume?

- Explain that typically not everyone's estimated order is the same and students are pleased to learn they can use centimeter cubes to measure and compare.

c. Use the cm cubes to measure

- Distribute cm cubes.
- Scroll to 3. **Explore the cubic centimeters** and focus on the photograph.
- Explain that many 3rd graders find it challenging to use the cubes to measure the volumes of the blocks. A good strategy is to replicate the object (make a twin) with cubes, however, making a replica is not always easy for 3rd graders to accomplish. **Step 4. Measure the volume of the blocks** describes what teachers may expect in the classroom.



By building a replica of Block Busing centimeter cubes, students can see that the volume of the block is 20 cubic centimeters.

- Ask participants to use the cm cubes to measure and record the measured order on the data table.
- There is no discussion in this investigation.

TIP The plastic centimeter cubes have a volume of 1cc (cubic centimeter) and each cubic centimeter of this material weighs 1g. However, in this curriculum the cubes are used ONLY to measure volume. The hexagram metric weights are used to measure weight. Students often confuse weight and volume so it's very important to use the cubes to measure volume only.

d. Explain that in the Grade 4 curriculum, students will build on this introduction to centimeter cubes. They use these same cubes to estimate and measure the volume of irregularly shaped objects, calibrate a container to measure the volume of liquids in cubic centimeters, and investigate measuring volume by displacement of water.

C. Investigating Volume 3, Does changing the shape of an object change its volume?

It's easy to understand why someone might think that changing the shape of an object changes the volume! In this investigation students collect evidence that as long as no matter is added or taken away, changing the shape of an object doesn't change the volume.

1. Experience the investigation firsthand

Click **Investigation 3.**

a. Ask the question

- Explain that before students begin to use materials to investigate, they must be able to distinguish shape from volume.
- Click **1. Ask the question** and review the sequence suggested in the **Teacher's Guide** (i) define "shape" and "volume," (ii) check for understanding, (iii) ask the investigation question, (iv) use the three scenarios to help students understand the meaning of the investigation question

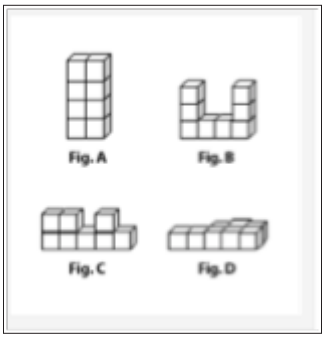
b. Explore shape and volume with cubes

This activity provides evidence that changing the shape of an object (in this case a structure built of cubes) does not change its volume.

Distribute 8 centimeter cubes to each participant.

Guide participants through the activity sequence outlined in the **Teacher's Guide**

- Build rectangle 4 stories tall and describe the volume (8 cubic centimeters)
- Predict the volume if you change the shape.
- Construct a new building either one-, two-, or three-, or four stories and describe the volume



c. Explore shape and volume with Plasticine cubes

Distribute approximately 10 cubic centimeters of Plasticene to each participant.

Guide participants through the activity sequence.

- Make 8 centimeter cubes (use one of the cm cubes from the kit as a guide)
- Create a building using all 8 cubes
- Keep 4 cubes in a cube shape but use the other 4 in any way or shape

d. Make meaning

Explain that the purpose of this discussion is to bring forward students' ideas about volume and see if they can use evidence from their investigation to support their position (no, the volume doesn't change, or yes, the volume does change) with evidence and reasoning.

Click the formative assessment icon and listen to a little bit of this discussion from a 3rd grade classroom.

Formative Assessment

Do students understand that the volume of 8cc of plasticene stays the same even if you change the shape?

Provide time for participants to discuss what they noticed in these few minutes of a class discussion.

Is there evidence that students understand that the volume of 8cc of Plasticine stays the same even if you change the shape?

e. Formative Assessment Volume Concept Cartoon

Point out the Concept Cartoon that is designed for teachers to assess their students' (a) understanding of volume as a measure of the amount of 3-D space an object occupies and (b) ability to distinguish volume from area or height.

If time permits, look at this item together, including the What to look for in student responses section – a rubric for teachers.

D. Investigating Volume 4, How can we describe our personal objects?

The purpose of the final investigation is to consolidate the learning from the previous 16 investigations by gathering weight, volume, and materials data about all the personal objects.

1. Experience the activity firsthand.

Post the three histograms you prepared ahead of time.

Locate a weight line where participants can place their objects

a. Explain the purpose of the investigation and ask each participant to

- select an object to stand in for a personal object (something that will fit in a pocket, e.g., a cell phone, lipstick, marker)
- estimate the (i)weight, (ii)the volume, and (iii) describe the materials it is made of.
- weigh the object and put the object on the weight line
- use the 1cc, 10cc, 100cc volume blocks you have prepared to estimate the volume and record their initials on the appropriate histogram
- Record the number of materials in the object and the kinds of materials on appropriate histograms

TIP Students will need practice and modeling in order to understand the relationship and connections between a claim and the data.

b. Make claims about the personal objects

- Explain that the focus question is How can we describe our personal objects? and the challenge for the teacher is helping students learn how to find evidence in the data that will back up a claim statement.
- You will need to model the process for participants: find the data that can support a claim, make the claim, point to (refer to) the evidence in the graph or weight line.
- Ask participants to make claims about with the # of materials in the collection of objects and point to the data in the histogram.

  How can we describe the number of materials our objects are made of?

- Facilitate participants' discussion, making claims and pointing to the evidence in on the histogram.
- Repeat for kind of materials and volume of objects.
- Finally, turn to the weight line and ask

  How can we describe the weight of our collection of objects?

There will be a number of possible claims that the weight data will support.

2. Wrap up discussion

The goal of this investigation is to use skills and concepts related to materials, weight, and volume and to gain experience using data representations (graphs and the weight line).

Ask participants to reflect on this data gathering activity as a way for them to achieve the goal.