

SESSION EIGHT

STUDENT LEARNING GOALS

- ❖ Become aware of key misunderstandings in early mathematics education.
- ❖ Understand the importance of number sense as a foundational math skill for young children.
- ❖ Apply science process skills to exploring baking soda and vinegar reactions.



Materials List

General

- Computer with internet access, speakers
- PowerPoint slides for Session 8 (downloaded from website)
- Data projector
- Sign-In Sheet (customizable printable)
- Course Reader
- *Big Ideas of Early Mathematics* textbook

For the Arrival Activity

- Unifix® cubes (1 tub per table group containing 2 colors of cubes, at least 20 of each color. Groups do not need to have the same two colors of cubes.)

For the Math Focus

- Optional: *10 Black Dots* book by Donald Crews
- Colored markers or crayons
- ½" or ¾" black sticker dots (10 per student)
- 8.5" x 11" white paper (1 per student)

For the Science Focus

- Baking Soda and Vinegar exemplar activity guide
- Liquid watercolors (red, yellow, and blue)
- Wax-coated or plastic disposable plates (1 per student - can be washed and saved for re-use)
- Magnifying lenses
- Optional: bottle of liquid hand or dish soap (soap can be added to the cups of colored vinegar after students have first explored just the baking soda and vinegar), extra baking soda and vinegar

For each group of 4-6 students

- 1 tray
- 4 clear plastic cups that do not easily spill
- 4 eyedroppers (provide extra droppers if more than 4 students will be sharing cups)
- 1 facial tissue
- 1 quart-size zipper-seal bag
- ¼-measuring cup (use paper cups if measuring cups are not available)
- 1 Tablespoon (use plastic teaspoons if Tablespoons are not available.
- **Students provide:** baking soda and vinegar

Session at a Glance

Topic	Description	Estimated Time (In Minutes)
Arrival Activity	Students use two colors of Unifix® cubes to make a set of 6 in as many different combinations as they can.	10
Welcome, Announcements, and Agenda	Make any relevant announcements and invite students to share if they've tried science or math activities from the course with children. Give a general overview of the session.	5
Discussion: Myths About Early Mathematics	Students watch an Erikson video that presents research on the relationship between early math and later achievement.	15
Math Focus: Number Sense	Students participate in a number sense activity based on the book, <i>10 Black Dots</i> , and explore the big ideas about Number Sense.	55
Science Focus: Baking Soda and Vinegar	Students participate in the exemplar activity Baking Soda and Vinegar. They investigate the chemical reaction that happens when these ingredients are combined, and do an experiment to inflate a plastic bag with the gas created from the reaction.	60
Looking Ahead to Next Week	Remind students that Midterm reports are due next week. Go over the materials that students are responsible for bringing next week.	5

Total Estimated Time: 2 hr 30 min

Before Session

- Review the materials relevant to this session:
 - Chapter 2: Number Sense in *Big Ideas of Early Mathematics*
 - Exemplar activity guide: Baking Soda and Vinegar
 - PowerPoint for Session 8 (downloaded from website)
 - Video: Myths of Early Mathematics Part 1: <http://earlymath.erikson.edu/myths-of-early-mathematics-part-1/>
- Set Up Materials
 - Cut sticker dots into sheets of 10 dots per student.
 - Place the following materials where you will be doing the *Engage* part of the exemplar activity:
 - bottle of white vinegar and a box of baking soda (you can bring your own or use what students bring to class)
 - plastic plate, magnifying lens, 4 empty clear cups, 4 eye droppers
 - liquid watercolors (red, blue and yellow)
 - Organize the materials for *Explore* to be ready to distribute when needed. It is helpful to place each group's cups, droppers, and plates on trays and set them aside until needed.
 - Prepare each group's materials for the *Inflate a Bag* experiment so they will be easy to distribute – 1 tissue, 1 quart-size zipper seal bag, ¼ measuring cup (or paper cup), 1 Tablespoon (or plastic teaspoon).

As Students Arrive

- Have students sign in on attendance sheet and check off if they brought their baking soda or vinegar to class.
- Have students turn in their homework.

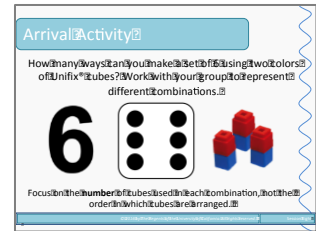
Getting Started

Arrival Activity: How many ways can you make a set of 6 using two colors of Unifix® cubes? Work with your group to represent different combinations. Note: Tell students to leave their sets of 6 on the tables to talk about later in class.

1. Announcements and sharing.

- If you have students who are working with children, ask if anyone tried any of the activities from the previous class and to share their observations and insights.
- Share any observations, clarifications, or notable comments that you feel should be mentioned related to the previous week's homework.
- Check in on students' plans for their Midterm project. By now, they should have made arrangements for when and where they will teach one of the exemplar activities.

2. Review agenda.

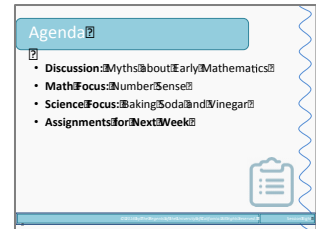


Arrival Activity

How many ways can you make a set of 6 using two colors of Unifix® cubes? Work with your group to represent different combinations.

6

Focus on the number of cubes used in each combination, not the order in which the cubes are arranged.



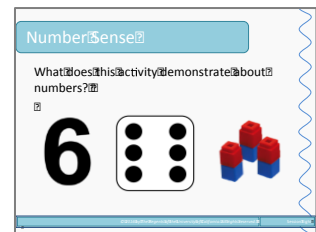
Agenda

- Discussion: Myths about Early Mathematics
- Math Focus: Number Sense
- Science Focus: Baking Soda and Vinegar
- Assignments for Next Week

Early Childhood Topic

3. Debrief and reflect on the Arrival Activity.

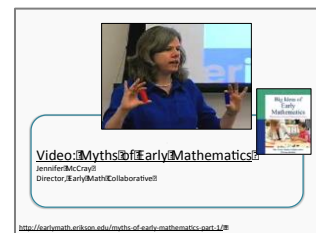
- Have the students share how many ways they found to make a set of 6 using two colors of cubes.
- Ask them to think about what this activity demonstrates about numbers. Use this as an opportunity to access students' prior knowledge and existing understandings. Encourage students to share their ideas but refrain from giving detailed explanations at this point. Let them know that today's class will delve into the concept of "number sense."



Number Sense

What does this activity demonstrate about numbers?

6



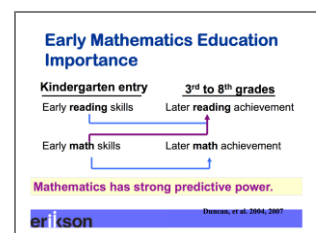
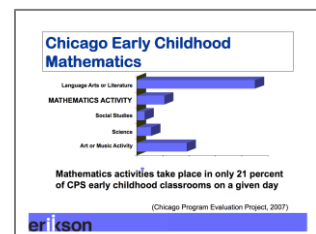
Video: Myths of Early Mathematics

Jennifer McCray
Director, Early Math Collaborative

<http://earlymath.erikson.edu/myths-of-early-mathematics-part-1/>

4. Watch and discuss the Erikson video: Myths of Early Mathematics Part 1

- This video is a talk given by one of the author's of the *Big Ideas of Early Mathematics* book, Jennifer McCray. First she gives a general introduction about early math, and then she talks specifically about number sense.
<http://earlymath.erikson.edu/myths-of-early-mathematics-part-1/>
- After watching the video, ask students to share their reactions to the research findings discussed in the talk (listed below):
 1. Mathematics activities take place in only 21 percent of Chicago Public School early childhood classrooms on a given day. (Note how much science is even less than that!)
 - Ask students what they think might explain this statistic.
 2. Early mathematics has a strong predictive power for later reading achievement.
 - Reiterate that this finding can be explained because the flexible thinking, analytical thinking, abstract thinking, and problem solving involved in mathematics applies broadly and has implications for literacy development.



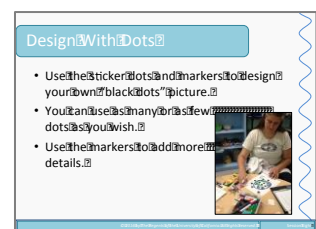
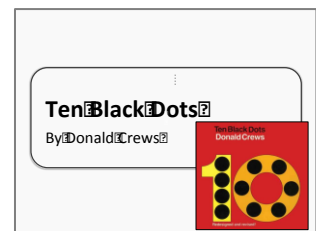
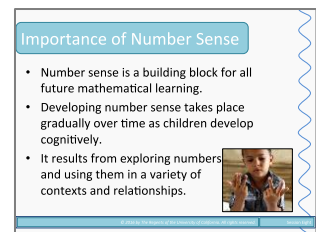
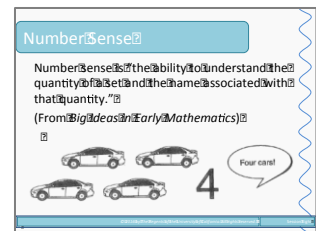
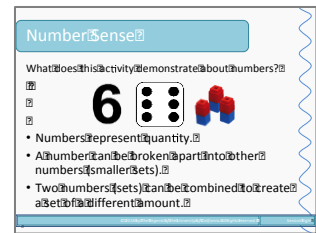
Math Focus

5. Engage students in thinking about number sense.

- Re-focus students back on the Arrival Activity they did with the unifix cubes, which was also demonstrated in the video. Explain that this activity demonstrates how complex a seemingly simple thing, understanding 6, is. Children may recognize the numeral 6 and be able to count to 6, but number sense is much more than that. The unifix cube activity helps children understand that: (each bullet is animated on slide)
 - Numbers represent quantity.
 - A set can be broken apart into smaller sets.
 - Two sets can be combined.
- Use the definition from the Erikson *Big Ideas of Early Mathematics* book to define “number sense.”
 - Number Sense is the ability to understand the quantity of a set and the name associated with that quantity. For example, with the graphic of cars on the slide, children must mentally connect the numeral 4 and the word *four* before they can be said to have an adult version of four-ness.
- Emphasize the importance of number sense as a building block for all future mathematical learning. Developing number sense takes place gradually over time as children develop cognitively. It results from exploring numbers and using them in a variety of contexts and relationships.

6. Use the book **10 Black Dots** to engage the students in an activity about number sense.

- Show the book, “10 Black Dots” by Donald Crews. There are many ways to use this book to inspire math conversations and activities with young children.
- Read the book aloud and/or show the sample pages on the PowerPoint slides. Model how you might read it with children, discussing how the dots are used on each page. (For example, “How many dots do you need to make the sun?”) With each picture, count the black dots.
- After reading the book (or sample pages), introduce the activity using black sticker dots as an example of a way to use the “10 Black Dots” book as a springboard for deeper learning. Model as you would with children:
 - Give each student 10 black sticker dots, crayons or markers, and paper. Tell them to use their imaginations to create a dot picture. They can decide how many dots to use in their picture and arrange the dots any way they want on a piece of paper. They do not have to use all 10 dots. They can use markers to add more details to their pictures.
 - As students are making their dot pictures, circulate around the room asking students about their pictures. Use prompts such as:
 - Can you tell me about your picture?



- How are you using your dots?
 - Can you count your dots for me?
 - How did you get your idea?
- Give students a few minutes warning before they need to stop (stress that with children, they would be given as much time as they wanted for this activity.)
- Ask for some volunteers to share about their pictures.
- Ask the students what a teacher could learn about a child's sense of number from watching them work on this activity.
- Point out that when children are given the opportunity to create something and decide on their own how many dots they need for their creation, the teacher can gain insight into their comprehension of number concepts. This activity gives teachers an opportunity to hear children count, use number words, and match number words to quantity.
- Show the examples of child-made pictures using dots. Teachers can write down the children's words on their pictures.

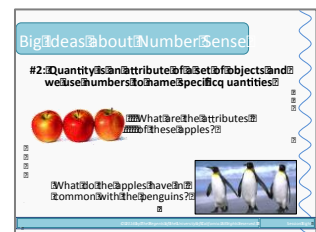
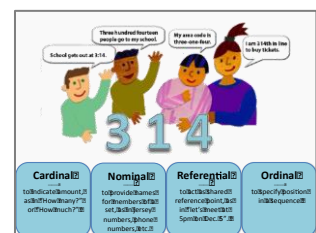
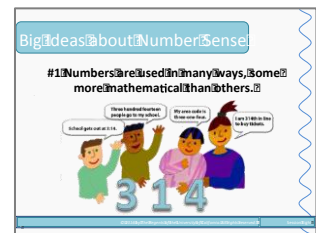
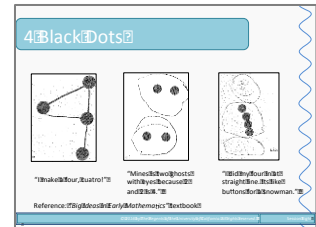
7. Introduce the Big Ideas about Number Sense from the “Big Ideas of Early Mathematics” textbook. These are the ideas that teachers need to be aware of in order to best support young children's development of number sense.

#1. Numbers are used in many ways, some more mathematical than others. When you think about it, we use numbers in many different ways - not just for counting, and that's a lot for young children to sort out.

- Show the slide with examples of cardinal, ordinal, nominal, and referential use of number. Read each of the examples aloud and ask students to discuss the different ways the number 314 is being used.
- Show the slide with the definitions and have the students match the definitions to the examples:
 - Cardinal: “Three hundred fourteen people go to my school.”
 - Ordinal: “I am 314th in line to buy tickets.”
 - Nominal: “My area code is three-one-four.”
 - Referential: “School gets out at 3:14.”
- Ask students to think of more examples of cardinal, ordinal, nominal, and referential uses of numbers.

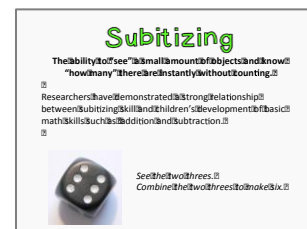
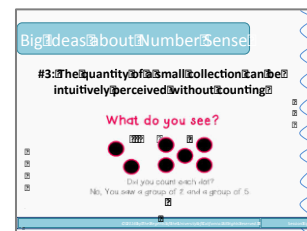
#2. Quantity is an attribute of a set of objects and we use numbers to name specific quantities.

- For example, three is the quality that a set of three apples and a set of three penguins have in common. To see the three-ness of the apples, we must set aside redness, shininess, fruitiness, roundness, and other attributes. One must see past the qualities of the things themselves and see only quantity. Quantity is only one attribute of a set of objects. “3” is an adjective, as are “red”, “crunchy”, or “shiny”.



#3. The quantity of a small collection can be intuitively perceived without counting.

- Introduce the word subitizing. Subitizing is the ability to see a small amount of objects and know “how many” there are instantly without counting. This is the skill of seeing a small group or set of objects or dots and “just know” how many there are without having to stop and count them one by one. For example, when a child sees three dots come up on a die, and knows instantly that it’s three, without having to count. Children begin to learn that sometimes we don’t need to count because we can subitize. It is a skill that will help them understand addition and subtraction when they are older as they see numbers as composed of parts as well as whole units.



Science

7. Introduce the Baking Soda and Vinegar Exemplar.

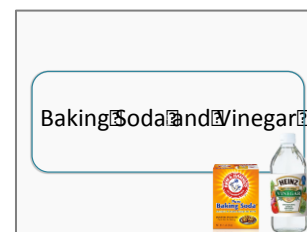
Let students know that you are going to model the *Engage* part of the activity in much the same way as if you were doing it with children in order to help them experience the activity through a child’s eyes and to demonstrate the activity as written in the exemplar.

Engage

- Tell the students that today they are going to experiment with two special ingredients that you bought at the grocery store.
- Show a box of baking soda and ask them if they have seen this ingredient before. Let them share how they’ve used baking soda. (Baking soda is used in cooking, cleaning, and other uses.)
- Pour some baking soda onto a plate. Ask for observations about the baking soda (white, dry, looks like sugar, etc.).
- Show the bottle of vinegar and tell them what it is called. Pour some vinegar into a clear cup. Ask for observations (looks like water, clear, wet, etc.).

Note: you may suggest that when actually working with children, you might give each child a turn to smell the vinegar.

- Invite them to share how they’ve used vinegar.
- Pour vinegar into 3 more clear cups so you have a total of 4 cups of vinegar. Add a small amount of liquid watercolor or food coloring to color one cup of vinegar red, one blue, and one yellow (leave one cup clear). Place a dropper in each cup of vinegar.
- Ask for predictions about what might happen when the vinegar is dripped onto the baking soda on the plate. Do not actually drip any vinegar onto your plate of baking soda so that they will be able to have the experience of discovery.



- Demonstrate how to use a dropper (For children, eye droppers are often a new tool so they need to be taught how to use them.)
- Emphasize that it is important to put droppers back into the cups they belong to so that all the mixing happens in the plates not the cups.

Explore

- Provide each group of 4-6 students with 4 clear cups to fill with vinegar. Use the liquid watercolors to color each group's cups of vinegar, leaving one cup with clear vinegar.
- Pass out plastic plates and instruct students to cover their plates with about a ½ inch of baking soda.
- Allow students to freely explore with the ingredients. They will soon discover the exciting reaction that happens when the vinegar mixes with the baking soda.
- Encourage them to SEE the bubbles! SMELL the vinegar! LISTEN to the fizzing! All of the senses are engaged (except taste).
- You may want to offer magnifying lenses for the students to use to observe their experiments more closely.
- Encourage them to use small amounts of vinegar and take their time with this activity so they can more carefully observe all of the changes taking place. Also, if they use too much vinegar too fast, their trays will quickly become a wet mess.
- As students are experimenting, circulate around the room and model asking questions, focus observations, and encourage use of science process skills (predicting, noticing cause and effect relationships, and communicating about their process and discoveries.)
- Optional: After the students have explored with the colored vinegar and baking soda for a while, you can ask them to predict what will happen if you add liquid soap to the vinegar. Add a squirt of liquid soap to the clear vinegar for those groups who want to try it.

Reflect

- Ask the students to share what happened when they mixed the baking soda and vinegar together. Ask questions such as: *“What kinds of experiments did you do?”*; *“What science process skills did you use?”*; *“What ideas or questions do you have about doing this activity with children?”*

8. Lead the Baking Soda and Vinegar chant below, and have the students stand up and follow along.

- Tell the students that every time the word “vinegar” is said, everyone is going to jump up in the air. Have the students start off by crouching down on bent knees. If students are not comfortable crouching down, encourage them to still participate by throwing their hands in the air when the word “vinegar” is said.

Explore

- Spread baking soda on the plate approximately half-inch deep.
- Pour vinegar into cups and use water colors to make a set of red, blue, and yellow colored vinegar. Leave one cup clear.
- Test out the colors to make sure they are nice and bright when dripped onto the baking soda.
- Experiment and observe all the changes taking place. Take your time.

Thinking about the learning...

- What kinds of experiments did you do?
- What science process skills did you use?
- What ideas or questions do you have about doing this activity with children?

Baking Soda and Vinegar Chant

(Same rhythm as “Peanut Butter and Jelly” chant)

Baking, baking soda and vinegar! (*Crouch down, jump up when you say vinegar*)

Baking, baking soda and vinegar! (*Crouch down, jump up when you say vinegar*)

Mix them together, it makes lots of bubbles. (*Make mixing motion with hands*)

Mix them together, it makes lots of bubbles. (*Make mixing motion with hands*)

Baking, baking soda and vinegar! (*Crouch down, jump up when you say vinegar*)

Baking, baking soda and vinegar! (*Crouch down, jump up when you say vinegar*)

- Emphasize that for children, songs are a great way to reinforce concepts and vocabulary and help them to remember their experience.

9. Inflate a Bag with Baking Soda and Vinegar

- This additional experiment is a dramatic way to observe that combining baking soda and vinegar creates gas. Show students a zipper-seal bag. Ask them to make predictions about what they think will happen when baking soda and vinegar are sealed together in the bag. Invite them to find out!
- Pass out the following materials to each group of 4-6 students: quart-sized zipper-seal bag, a tissue, $\frac{1}{4}$ measuring cup, and 1 tablespoon. Have them follow the directions on the slide (directions are also on the exemplar activity guide).
- Expect the students to get very excited doing this activity. The anticipation of seeing the bubbling liquid and the pressure building in the bag is as much fun for adults as for children.
- Debrief the *Inflate a Bag* activity by having students share what they did and discuss how they would do this activity with children.

Clean up: Direct students to clean up the materials.



10. Show photos of children engaged in the Baking Soda and Vinegar exemplar activity.

11. Share background information on physical changes vs. chemical changes to build students’ content knowledge.

- Remind students that this is information for their own knowledge, not meant to be taught to young children.
- Ask if students have heard of physical changes and chemical changes in Chemistry. Before showing the definitions, ask students to talk at their tables about what they think those terms mean.
- Go over the basic definitions of a physical change and chemical change and have the students guess which change is represented in each of the photos.
 - Physical change:** does not change the chemical composition
 - Chemical change:** when a substance combines with another to form a new substance

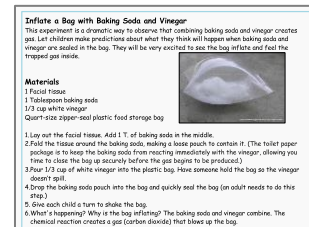
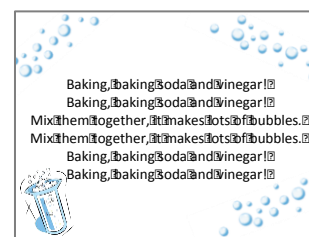
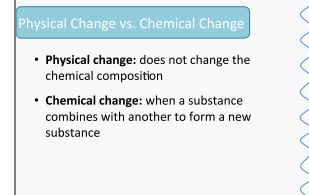


Photo Slides



Science Background Slides

Wrapping Up

12. Looking Ahead to Next Week

- Remind students that their Midterm reports are due next week. You may want to review the grading rubric.
- **Review homework assignment due in two weeks.** Some students may want to get a jump start on the homework due in two weeks.
- **Review materials to bring for next week:** Emphasize that student-supplied materials are essential for the hands-on activities in each class.
 - 5 objects that move when blown (for example: cotton ball, pom-pom, packing peanut, ponytail holder, feather, button, etc.).
 - 1 air blower (turkey baster or empty bottle with a squeeze top, such as dish soap or shampoo).

