

### **Components and Subcomponents of Numeracy**

**CONTEXT** – the use and purpose for which an adult takes on a task with mathematical demands

**Family or Personal**—as a parent, household manager, consumer, financial and health-care decision maker, and hobbyist

**Workplace**—as a worker able to perform tasks on the job and to be prepared to adapt to new employment demands

**Further Learning**—as one interested in the more formal aspects of mathematics necessary for further education or training

**Community**—as a citizen making interpretations of social situations with mathematical aspects such as the environment, crime and politics

**CONTENT** – the mathematical knowledge that is necessary for the tasks confronted

**Number and Operation Sense**—a sense of how numbers and operations work and how they relate to the world situations that they represent

**Patterns, Functions and Algebra**—an ability to analyze relationships and change among quantities, generalize and represent them in different ways, and develop solution methods based on the properties of numbers, operations and equations

**Measurement and Shape**—knowledge of the attributes of shapes, how to estimate and/or determine the measure of these attributes directly or indirectly, and how to reason spatially

**Data, Statistics and Probability**—the ability to describe populations, deal with uncertainty, assess claims, and make decisions thoughtfully

**COGNITIVE AND AFFECTIVE**—the processes that enable an individual to solve problems and, thereby, link the content and the context

**Conceptual Understanding**—an integrated and functional grasp of mathematical ideas

**Adaptive Reasoning**—the capacity to think logically about the relationships among concepts and situations

**Strategic Competence**—the ability to formulate mathematical problems, represent them, and solve them

**Procedural Fluency**—the ability to perform calculations efficiently and accurately by using paper and pencil procedures, mental mathematics, estimation techniques, and technological aids

**Productive Disposition**—the beliefs, attitudes, and emotions that contribute to a person's ability and willingness to engage, use, and persevere in mathematical thinking and learning or in activities with numeracy aspects

From Ginsburg, L., Manly, M., and Schmitt, M. J. (2006). *The components of numeracy* [NCSALL Occasional Paper]. Cambridge, MA: National Center for Study of Adult Literacy and Learning. Available: [http://www.ncsall.net/fileadmin/resources/research/op\\_numeracy.pdf](http://www.ncsall.net/fileadmin/resources/research/op_numeracy.pdf)

## Flavors

<ul style="list-style-type: none"> <li>• <u>Apricot</u></li> <li>• <u>Apricot Chardonnay</u></li> <li>• <u>Banana</u></li> <li>• <u>Banana Mango</u></li> <li>• <u>Banana Walnut Praline</u></li> <li>• <u>Blackberry Cabernet</u></li> <li>• <u>Blood Orange (Sicilian)</u></li> <li>• <u>Blueberry</u></li> <li>• <u>Bourbon Butter Pecan</u></li> <li>• <u>Butter Pecan</u></li> <li>• <u>Caramel</u></li> <li>• <u>Caramel Heath Bar Crunch</u></li> <li>• <u>Cassis</u></li> <li>• <u>Champagne</u></li> <li>• <u>Chocolate (No Sugar Added)</u></li> <li>• <u>Chocolate (Soy)</u></li> <li>• <u>Chocolate (Valrhona)</u></li> <li>• <u>Chocolate (West African)</u></li> <li>• <u>Chocolate Alba Hazelnut</u></li> <li>• <u>Chocolate Chip</u></li> <li>• <u>Chocolate Chocolate Chip</u></li> <li>• <u>Chocolate Jalapeño</u></li> <li>• <u>Cinnamon (Indonesian)</u></li> <li>• <u>Cinnamon Carmel Swirl</u></li> <li>• <u>Cinnamon Oatmeal Cookie</u></li> <li>• <u>Coconut (Dominican)</u></li> <li>• <u>Cookie Dough</u></li> <li>• <u>Cookie Dough (Soy)</u></li> <li>• <u>Cookies &amp; Cream</u></li> <li>• <u>Cool Mint Chocolate Chip</u></li> <li>• <u>Cranberry Orange</u></li> <li>• <u>Dulce de Leche</u></li> <li>• <u>Espresso</u></li> <li>• <u>Espresso (Triple)</u></li> <li>• <u>Ginger (Asian)</u></li> <li>• <u>Grapefruit Campari</u></li> <li>• <u>Green Apple</u></li> <li>• <u>Green Tea &amp; White Chocolate Chunks</u></li> <li>• <u>Green Tea (Matcha)</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Hazelnut (Italian Alba)</u></li> <li>• <u>Hazelnut-Biscotti</u></li> <li>• <u>Kalamansi (Philippine Lime)</u></li> <li>• <u>Key Lime Graham Cracker</u></li> <li>• <u>Lebanese Yogurt</u></li> <li>• <u>Lemon (Lemon Curd)</u></li> <li>• <u>Lemon (Sicilian)</u></li> <li>• <u>Lime</u></li> <li>• <u>Malted Milk Ball</u></li> <li>• <u>Mango (Alphonso)</u></li> <li>• <u>Maple Ginger Snap</u></li> <li>• <u>Maple Walnut</u></li> <li>• <u>Mint Chocolate Chip</u></li> <li>• <u>Mint Leaf</u></li> <li>• <u>Mocha Chip</u></li> <li>• <u>Orange (Floridian)</u></li> <li>• <u>Papaya Crème de Cassis Gelato</u></li> <li>• <u>Passion Fruit (Ecuadorian)</u></li> <li>• <u>Peach (Northwest)</u></li> <li>• <u>Peach Martini Sorbetto</u></li> <li>• <u>Peaches &amp; Cream</u></li> <li>• <u>Peanut Butter Crunch Gelato</u></li> <li>• <u>Pear (Bartlett)</u></li> <li>• <u>Pineapple (Philippine)</u></li> <li>• <u>Pistachio (Turkish)</u></li> <li>• <u>Pomegranate (Californian)</u></li> <li>• <u>Raspberry (Northwest)</u></li> <li>• <u>Red Bean</u></li> <li>• <u>Rum Raisin</u></li> <li>• <u>Strawberry (Northwest)</u></li> <li>• <u>Strawberry Chardonnay</u></li> <li>• <u>Tahitian Vanilla</u></li> <li>• <u>Tangerine</u></li> <li>• <u>Vanilla (French)</u></li> <li>• <u>Vanilla (Madagascar)</u></li> <li>• <u>Vanilla (No Sugar Added)</u></li> <li>• <u>White Chocolate</u></li> <li>• <u>White Chocolate Raspberry Swirl</u></li> </ul>
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## The Gelato Shop

You own a Gelato Shop and need to make decisions about ordering gelato. You sell about 80 containers of gelato a week. You have room for 12 containers of gelato in your display case, but you have additional storage space in the freezer.

—Which flavors (and how many containers of each) are you going to order for the week?

—Which flavors are you going to put in the display case?

**Context: Gelato**

	<b>Number and Operation Sense</b>	<b>Patterns, Functions, and Algebra</b>	<b>Measurement and Shape</b>	<b>Data, Statistics, and Probability</b>
<b>Conceptual Understanding</b>				
<b>Adaptive Reasoning</b>				
<b>Strategic Competence</b>				
<b>Procedural Fluency</b>				
<b>Productive Disposition</b>				

The video shown, "Ice Cream the Italian Way" is available at: [www.thefutureschannel.com](http://www.thefutureschannel.com)

## Custard Gelato

Yield: Makes 1 1/2 quarts; serves 6

### **Ingredients**

2 1/4 cups whole milk  
Pinch of salt  
2/3 cup sugar  
6 egg yolks  
2/3 cup heavy cream

### **Preparation**

In a medium saucepan, combine the milk and salt. Heat the milk over medium heat until bubbles form around the edges of the pan. Set aside and cover to keep hot.

In a blender or food processor, blend the sugar and egg yolks together until very thick and smooth. With the machine running, gradually add the hot milk. Return the mixture to the saucepan and cook over medium heat, stirring constantly with a wooden spoon, for 6 to 8 minutes or until the mixture thickens slightly and coats the back of the spoon. Remove the pan from heat and set it in a bowl of ice water. Stir for 2 minutes to cool the mixture. Cover and refrigerate for 2 hours, or until thoroughly chilled.

In a deep bowl, beat the cream until soft peaks form. Fold the whipped cream into the custard mixture. Transfer to an ice cream maker and freeze according to the manufacturer's instructions.

### **Source Information**

*Gelato!* by Pamela Sheldon Johns

### **Ingredient Prices: (WalMart, 7/05/09)**

Milk (1 qt)	\$ .93
Sugar (1 lb)	\$ .92
(≈2 1/3 c.)	
Eggs (1 doz)	\$1.00
Cream (1 pt)	\$2.66

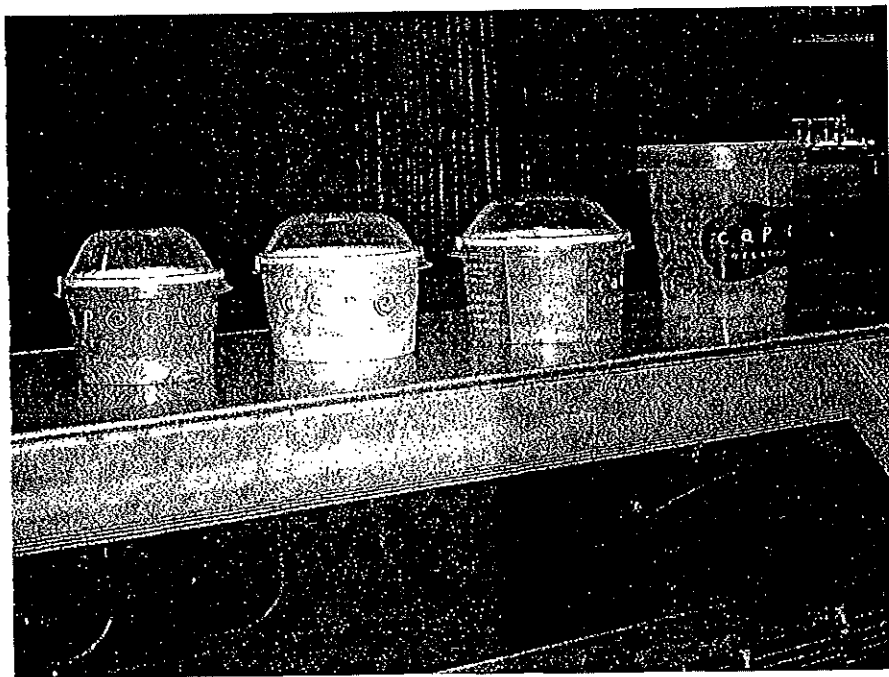
Price List

Gelato Sizes	Cup/Cono
Piccolo (2 flavors)	\$4.50 \$4.75
Medio (3 flavors)	\$5.75 \$6.00
Grande (4 flavors)	\$7.00
Affogato	\$4.75
Frappé	\$5.50
Granita	\$4.00
" con gelato "	\$6.00
Gelato con brioche	\$4.25
One pint	\$10.00
Two or more " "	\$9.00 each
<b>Panini</b>	
Classico	\$7.00
Hot	\$6.00
Capicola	\$7.00
Salami	\$6.00

Piccolo (small) — 4 oz.

Medio (medium) — 6 oz.

Grande (large) — 8 oz.



## Developing Mathematical Thinking with Effective Questions

### To promote problem solving, ask...

- What information do you have? What do you need to find out?
- What strategies are you going to use?
- Will you do it mentally? With pencil and paper? Using a number line?
- What tools will you need? Will a calculator help?
- What do you think the answer or result will be?

### To promote problem solving, ask...

- How would you describe the problem in your own words?
- What facts do you have?
- What do you know that is not stated in the problem?
- How did you tackle similar problems?
- Could you try it with simpler numbers? Fewer numbers? Using a number line? What about putting things in order?
- Would it help to create a diagram? Make a table? Draw a picture?
- Can you guess and check?
- If you compared your work with anyone else's, what did they try?

### To make connections among ideas and applications, ask...

- How does this relate to...?
- What ideas that we have learned were useful in solving this problem?
- What uses of mathematics did you find in the newspaper last night?
- Can you give me an example of...?

### To encourage reflection, ask...

- How did you get your answer?
- Does your answer seem reasonable? Why or why not?
- Can you describe your method to us? Can you explain why it works?
- What if you had started with... rather than...?
- What if you could only use...?
- What have you learned or found out today?
- Did you use or learn any new words today? What did they mean?
- What are the key points or big ideas in this lesson?

Do you want to develop additional mathematical thinking strategies for your teaching practice? Visit [www.pbs.org/teacherline](http://www.pbs.org/teacherline) to view our Mathematics professional development options.



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## Developing Mathematical Thinking with Effective Questions

**To help students build confidence and rely on their own understanding, ask...**

- Why is that true? How did you reach that conclusion?
- Does that make sense?
- Can you make a model to show that?

**To help students learn to reason mathematically, ask...**

- Is that true for all cases? Explain.
- Can you think of a counterexample?
- How would you prove that?
- What assumptions are you making?

**To check student progress, ask...**

- Can you explain what you have done so far? What else is there to do?
- Why did you decide to use this method?
- Can you think of another method that might have worked?
- Is there a more efficient strategy?
- What do you notice when...?
- Why did you decide to organize your results like that?
- Do you think this would work with other numbers?
- Have you thought of all the possibilities? How can you be sure?

**To help students collectively make sense of mathematics, ask...**

- What do you think about what \_\_\_\_ said?
- Do you agree? Why or why not?
- Does anyone have the same answer but a different way to explain it?
- Do you understand what \_\_\_\_ is saying?
- Can you convince the rest of us that your answer makes sense?

**To encourage conjecturing, ask...**

- What would happen if...? What if not?
- Do you see a pattern? Can you explain the pattern?
- Can you predict the next one? What about the last one?
- What decision do you think he/she should make?

The contents of this card were developed under a grant from the U.S. Department of Education. However, the contents do not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the federal government.



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Context: \_\_\_\_\_

	Number and Operation Sense	Patterns, Functions, and Algebra	Measurement and Shape	Data, Statistics, and Probability
<p><b>Conceptual Understanding</b></p> <ul style="list-style-type: none"> <li>- Why does that work?</li> <li>- What is another way of showing this relationship?</li> <li>- In what way is this problem connected to others?</li> </ul>				
<p><b>Adaptive Reasoning</b></p> <ul style="list-style-type: none"> <li>- Share your reasoning for proceeding that way.</li> <li>- Show us how that makes sense.</li> <li>- How does the answer connect to the problem?</li> <li>- Which fraction is close to that percent; why do you think so?</li> </ul>				
<p><b>Strategic Competence</b></p> <ul style="list-style-type: none"> <li>- What elements are relevant?</li> <li>- What are the relationships between the elements of the problem?</li> <li>- How would you formulate the problem in a mathematical way?</li> <li>- Is there another way?</li> </ul>				
<p><b>Procedural Fluency</b></p> <ul style="list-style-type: none"> <li>- What did you do to get the answer?</li> <li>- Show another way to find the answer.</li> <li>- How can you estimate what the answer will be?</li> <li>- Find the answer without pencil, paper, or calculator.</li> </ul>				
<p><b>Productive Disposition</b></p> <ul style="list-style-type: none"> <li>- Share your strategies for getting "un-stuck".</li> <li>- Where else could you use the same strategies?</li> </ul>				