Content-Area Graphic Organizers

MATH

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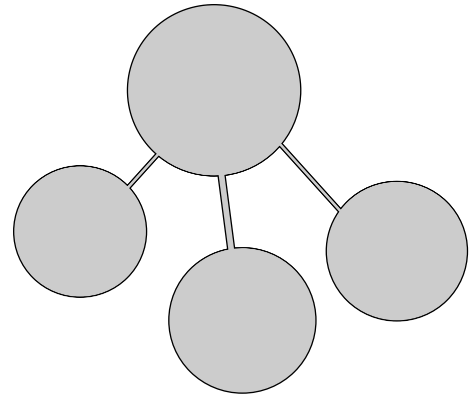
WALCH PUBLISHING



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To the Teacher

Graphic organizers can be a versatile tool in your classroom. Organizers offer an easy, straightforward way to visually present a wide range of material. Research suggests that graphic organizers support learning in the classroom for all levels of learners. Gifted students, students on grade level, and students with learning difficulties all benefit from their use. Graphic organizers reduce the cognitive demand on students by helping them access information quickly and clearly. Using graphic organizers, learners can understand content more clearly and can take clear, concise notes. Ultimately, learners find it easier to retain and apply what they've learned.

Graphic organizers help foster higher-level thinking skills. They help students identify main ideas and details in their reading. They make it easier for students to see patterns such as cause and effect, comparing and contrasting, and chronological order. Organizers also help learners master critical-thinking skills by asking them to recall, evaluate, synthesize, analyze, and apply what they've learned. Research suggests that graphic organizers contribute to better test scores because they help students understand relationships between key ideas and enable them to be more focused as they study.

This book shows students how they can use some common graphic organizers as they read and write in math classes. As they become familiar with graphic organizers, they will be able to adapt them to suit their needs.

In the math classroom, graphic organizers help students:

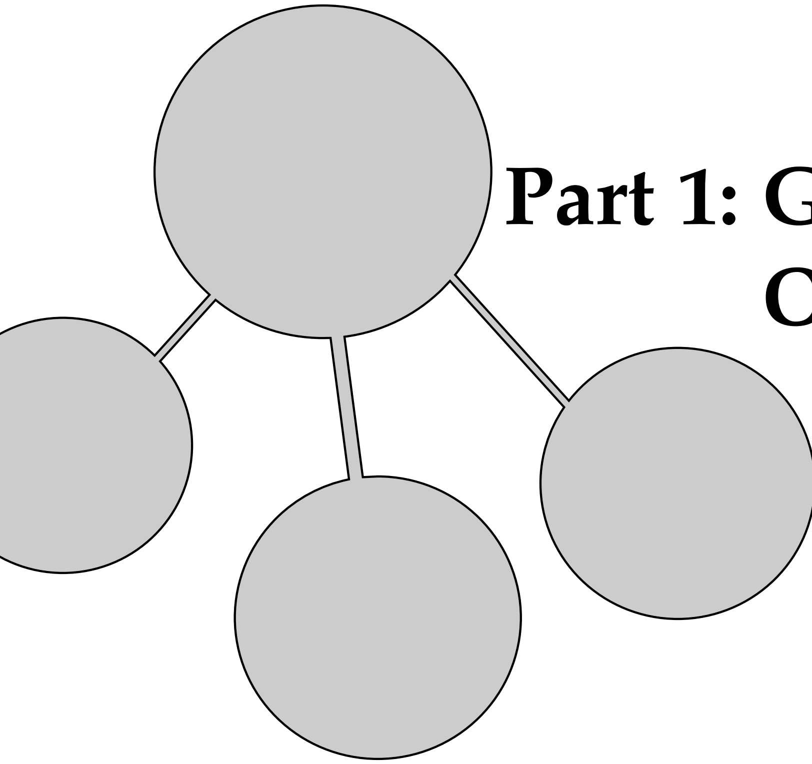
- preview new material
- make connections between new material and prior learning
- recognize patterns and main ideas in reading
- understand the relationships between key ideas
- organize information and take notes
- review material

This book offers graphic organizers suitable for math tasks, grouped according to big-picture skills, such as storing and retrieving information; problem-solving; and communicating with others. Each organizer is introduced with an explanation of its primary uses and structure. Next comes a step-by-step description of how to create the organizer, with a worked-out example that uses text relevant to the content area. Finally, an application section asks students to use the techniques they have just learned to complete a blank organizer with information from a sample text. Throughout, learners are encouraged to customize the organizers to suit their needs. To emphasize the variety of graphic organizers available, an additional organizer suitable for each big-picture skill is introduced briefly at the end of each lesson.

Content-Area Graphic Organizers for Math is easy to use. Simply photocopy and distribute the section on each graphic organizer. Blank copies of the graphic organizers are included at the back of this book so that you can copy them as often as needed. The blank organizers are also available for download at our website, www.walch.com.

As learners become familiar with using graphic organizers, they will develop their own approaches and create their own organizers. Encourage them to adapt them, change them, and create their own for more complex strategies and connections.

Remember, there is no one right way to use graphic organizers; the best way is the way that works for each student.



Part 1: Graphic Organizer Overview

1 Introduction to Graphic Organizers

You've probably heard the old saying, "A picture is worth a thousand words." Like most old sayings, it isn't always true. But in many things we do, words alone are not the best way to communicate. That's why we use pictures and, in particular, graphic organizers.

A graphic organizer is simply a special drawing that contains words or numbers. If you've ever made a web or filled in a chart, then you already know how to use a graphic organizer. In this book, you'll find that you can use graphic organizers in ways you may not have expected. And you'll find that they can make your learning a lot easier!

The power of a graphic organizer is that instead of just telling you about relationships among things, it can show them to you. A graphic organizer can help you understand information much more easily than the same information written out as a paragraph of text. For example, look at this listing of names, addresses, and telephone numbers. Use it to find the telephone number for Amanda Jones.

Alden E. Jones, 18 Milford St., Boston, MA 02118, (617) 555-8040. Alun Huw Jones, 91 Westland Ave., Boston, MA 02115, (617) 555-9654. Alvin Jones, 715 Tremont St., Boston, MA 02118, (617) 555-2856. Alvin D. Jones, 77 Salem St., Boston, MA 02113, (617) 555-2890. Amanda Jones, 111 W. 8th St., Boston, MA 02127, (617) 555-0738. Amos K. Jones, 11 Helen St., Boston, MA 02124, (617) 555-3560. Andre N. Jones, 523 Mass. Ave., Boston, MA 02118, (617) 555-0829. Andrew Jones, 168 Northampton St., Boston, MA 02118, (617) 555-0069.

In order to find Amanda's number you had to read, or at least scan, the whole text. Here is the same information presented in a graphic organizer—a table.

Name	**Address**	**City, State, Zip**	**Phone**
Alden E. Jones	18 Milford St.	Boston, MA 02118	(617) 555-8040
Alun Huw Jones	91 Westland Ave.	Boston, MA 02115	(617) 555-9654
Alvin Jones	715 Tremont St.	Boston, MA 02118	(617) 555-2856
Alvin D. Jones	77 Salem St.	Boston, MA 02113	(617) 555-2890
Amanda Jones	111 W 8th St.	Boston, MA 02127	(617) 555-0738
Amos K. Jones	11 Helen St.	Boston, MA 02124	(617) 555-3560
Andre N. Jones	523 Mass Ave.	Boston, MA 02118	(617) 555-0829
Andrew Jones	168 Northampton St.	Boston, MA 02118	(617) 555-0069

Which arrangement was easier to use? Most people find it easier to see the information in the table. This is because the table gives all the names in one column, all the telephone numbers in another column, and all the information about each person in one row. As soon as you know how the table is set up—the labels at the top of each column tell you—you can quickly find what you're looking for.

Graphic organizers use lines, circles, grids, charts, tree diagrams, symbols, and other visual elements to show relationships—classifications, comparisons, contrasts, time sequence, parts of a whole, and so on—much more directly than text alone.

You can use graphic organizers in many ways. You can use them before you begin a lesson to lay the foundation for new ideas. They can help you recall what you already know about a subject and see how new material is connected to what you already know.

You can use them when you are reading to take notes or to keep track of what you read. It doesn't matter what you are reading—a textbook, a biography, or an informational article. Organizers can help you understand and analyze what you read. You can use them to recognize patterns in the reading. They can help you identify the main idea and its supporting details. They can help you compare and contrast all kinds of things, from people to ideas, animals, and events.

Graphic Organizers can help you after you read. You can use them to organize your notes and figure out the most important points in what you read. They are a great tool as you review to make sure you understood everything or to prepare for a test.

You can use graphic organizers when you write, too. They are particularly useful for prewriting and planning. Organizers can help you brainstorm new ideas. They can help you sort out the key points you want to make. Graphic organizers can help you write clearly and precisely.

Think of graphic organizers as a new language. Using this new language may be a bit awkward at first, but once you gain some fluency, you will enjoy communicating in a new way.

Part 2: Graphic Organizers in Math

2 Organizing, Categorizing, and Classifying

Have you ever read an explanation and found it hard to remember the important points? Perhaps something distracted you from what the author was saying. Perhaps the material was poorly organized, or contained a lot of new information.

One of the best ways to keep track of important information is to use a graphic organizer to take notes. Graphic organizers can help you sort information into categories. This makes it easier to remember what you have read. And once you have organized the information, you can use the organizer as a reference while you are solving problems in class or for homework, or when you are reviewing for a test.

The way you organize your notes depends on the material you are reading. This lesson will present two organizers that are useful for organizing mathematical material: tables and flowcharts.

Tables are a way to show comparisons and contrasts. Flowcharts are a visual approach to laying out the steps in a process. You can use these graphic organizers to record mathematical information that you need to recall later. And once you learn how to make them, you'll find other uses for them, too.

Tables

Of all the graphic organizers in this book, the one you have probably seen most often and will use the most, both in math and elsewhere, is the table. A table is simply a grid with rows and columns. Tables are useful because information stored in a table is easy to find—much easier than the same information embedded in text.

Tables are so useful that software packages, such as Word and Excel, offer table-making capabilities. But you don't need a computer to make a table. All you need is a pencil and paper. If you make tables by hand, you can include them in your handwritten notes.

Tables in Action

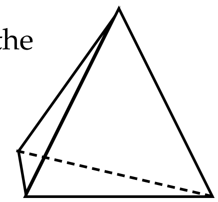
Tables come in all sizes and shapes. The size and shape of a table depends, of course, on what's in it. When you're reading material that you will need to recall later, the first step is to think about how to take notes on it. Should you make a table or should you take notes in some other form? If what you're reading is a description, a narrative, or a logical argument, it may not lend itself to storage in a table. A table is essentially a list of things that have something in common with one another, and the attributes that they have in common. If, as you read, you find yourself thinking "Oh, this is a list of . . .," a table is probably a good organizer to use.

Usually, a table has a row (the horizontal part) for each item being listed. The columns (the vertical part) provide places for aspects of the listed items—the things they have in common. The places where the rows and columns meet are called cells. In each cell, we write information that fits both the topic of the row—the thing being listed—and the topic of the column—the aspect being examined. To create a table, we make rows and columns to fit the number of items and attributes.

For example, look at this reading about Platonic solids. The first sentence tells us that there are five of them and names some attributes of the first one. Is this going to be essentially a list of items that all have certain attributes? A quick scan of the text tells us that it is. So we'll take notes on it in the form of a table.

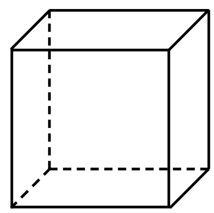
Platonic Solids

There are five Platonic solids. The first is called the tetrahedron, which is Greek for "four faces." Each face is an equilateral triangle. It has 4 vertices and 6 edges, with 3 triangular faces meeting at each vertex.



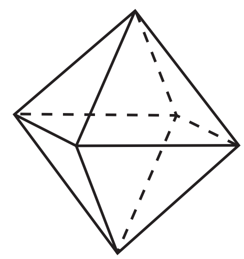
regular tetrahedron

The second Platonic solid is the cube. It has 6 faces, each of which is a square. It has 8 vertices and 12 edges, with 3 faces meeting at each vertex.



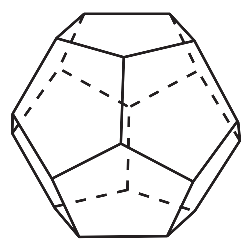
cube

The third Platonic solid is the octahedron, which in Greek means "eight faces." Like the tetrahedron, the octahedron's faces are equilateral triangles. It has 6 vertices, with 4 triangles meeting at each vertex, and, like the cube, it has 12 edges.



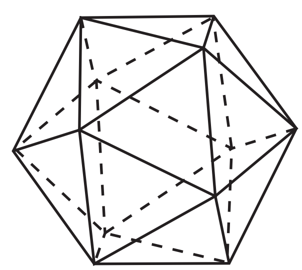
regular octahedron

Next comes the dodecahedron, a 12-faced solid. The faces of the dodecahedron are regular pentagons, 3 of which meet at every vertex. There are 20 vertices and 30 edges.



regular dodecahedron

The last Platonic solid is the icosahedron, a 20-faced solid. Each of the 20 faces of the icosahedron is an equilateral triangle. It has 5 triangles that meet at each of 12 vertices, and there are 30 edges.



regular icosahedron

Before we can make a table, we have to know what the rows and columns are going to be. Since the text is essentially a list of the five Platonic solids with information about each one, the table will have a row for each solid, or five rows.

What are the columns going to be? To answer this we go back to the text. What kinds of information does it give us about each Platonic solid? It gives us the number of faces, what regular polygon each face is, the number of vertices, the number of faces that meet at each vertex, and the number of edges. That tells us both how many columns we need and what the column heads will be. We need a total of seven columns, one for the name of the solid and one for each piece of information.

Now we can draw the table, adding the appropriate number of rows and columns. Write the column heads at the top of each column. Then write the name of each Platonic solid at the start of each row.

Finally, we can go through the text again to find the information for each cell.

Here's the finished table.

Platonic Solid	**Faces**	**Polygon**	**Vertices**	**Faces Meeting at Each Vertex**	**Edges**
tetrahedron	4	equilateral triangle	4	3	6
cube	6	square	8	3	12
octahedron	8	equilateral triangle	6	4	12
dodecahedron	12	pentagon	20	3	30
icosahedron	20	equilateral triangle	12	5	30

The information is much more compact in table form than in text. It's also more accessible. If you need to look up a characteristic of a particular solid, you can find it easily. Also, a table makes it easier to compare the properties of the different Platonic solids. For example, to see how the number of edges increases as the number of faces increases, you can look from the faces column to the edges column.

You can make tables on a computer using software programs, such as Word or Excel. However, if you are taking notes on your own reading, it is often quicker and easier to make a table by hand. That way you can include tables on pages of your handwritten notes.

No matter how you prepare the table, follow the same basic steps.

1. Decide what the rows and columns are going to be—the items being listed and the attributes of each one.

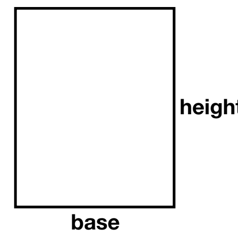
2. Draw a table with the appropriate number of rows and columns.

3. Write the items being listed at the start of each row. Write the aspects being examined at the top of each column.

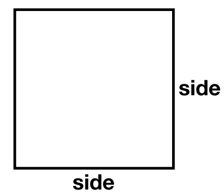
4. Fill in the cells with information that fits both the row and the column.

Application Read the text below about area formulas. Then use the table on page 13 to take notes on the text.

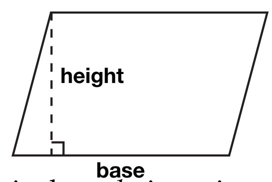
Area Formulas



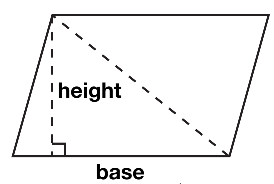
The area of a polygon is the number of square units of measure needed to cover it completely. A rectangle is the simplest polygon with which to measure the area. The number of square units a rectangle contains is the product of the length of one side by the length of a side perpendicular to it. We call one of these sides the base and the other the height. So the formula for the area A of a rectangle is its base b times its height h. $A = bh$.



A square is a special kind of rectangle. The formula for the area of a square is still $A = bh$. But in a square, the base and height are equal. So we often call the base and height sides s and write the formula as $A = s^2$.

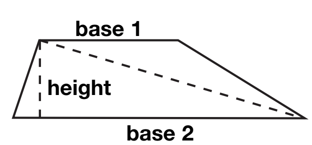


The formula for the area of a parallelogram is also the same as for a rectangle. The only difference is that the height of a parallelogram is not the length of a side. It is the length of a line segment perpendicular to the base from the base to the opposite side (like the side of a rectangle). As long as you define height in that way, the formula for the area A of a parallelogram is its base b times its height h. $A = bh$.



Once you know the formula for the area of a parallelogram, the formula for the area of a triangle follows logically. By drawing a diagonal line, you can divide any parallelogram into two congruent triangles—triangles that have the same size and shape.

Since the two triangles are congruent, the area of each triangle is half of the area of the parallelogram. Therefore, the area of a triangle is half its base b times its height h. $A = \frac{1}{2}bh$.



We can derive the formula for the area of a trapezoid in a similar way. When we draw a diagonal, we divide the trapezoid into two triangles that are not congruent. Notice that they have different bases—we'll call them base 1 (b_1) and base 2 (b_2)—but the same height. The area of the trapezoid is the sum of the areas of the two triangles formed by the diagonal. $A = \frac{1}{2}b_1h + \frac{1}{2}b_2h = \frac{1}{2}(b_1 + b_2)h$.

Table Use the blank table below to summarize the information from the text on page 12. Add or delete columns and rows as needed. Remember the steps for preparing a table: First, decide on the information to go in the rows. Next, see what information needs to go in the columns. Then write in the column heads and the names of the things being listed. Finally, fill in the information from the text.

Flowcharts

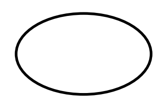
Flowcharts are graphic organizers that show the steps in a process. Flowcharts can be very simple—just a series of boxes with one step in each box. However, there is also a more formal type of flowchart. These flowcharts use special symbols to show different things, like starting and stopping points or points where decisions must be made. These symbols make flowcharts especially useful for showing complicated processes. Whenever a process needs to show several different options—"if this happens, then you follow this step, but if that happens, then you follow another step"—a flowchart is probably the best way to chart the steps.

Flowcharts are often used in science and business. They can show all kinds of different processes: how factories make products, how computers process data, and so on. In math, you can also use flowcharts to show many different processes, from adding a column of numbers to using formulas. You can use them to take notes as you read or as your teacher explains a new concept. You can use them as a guide to a process when you are solving problems, either in class or at home. And you can use them as a reminder when you study for a quiz or a test.

Each step in a flowchart is written in a box. The boxes are connected by arrows to show the sequence of steps. The boxes aren't all rectangular; different shapes are used to indicate different actions. The shapes and symbols are a kind of visual shorthand. Whenever a certain symbol is used, it always has the same meaning.

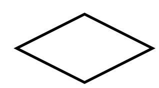
Flowchart Symbols

Circles and ovals show starting and stopping points. They often contain the words "start" or "stop." The "start" box has no arrows in and one arrow out. The "stop" box has one arrow in and no arrows out.

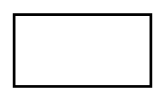


Arrows show the direction in which the process is moving.

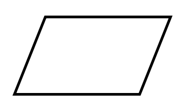
Diamonds show points where a decision must be made or a question must be answered. The question can usually be answered either "yes" or "no."



Rectangles and squares show steps where a process or an operation takes place.



Parallelograms show input or output, such as writing or printing a result or solution.

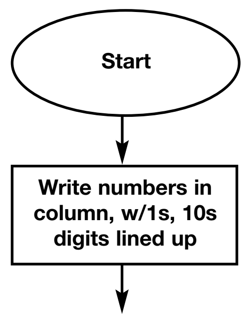


Flowcharts in Action

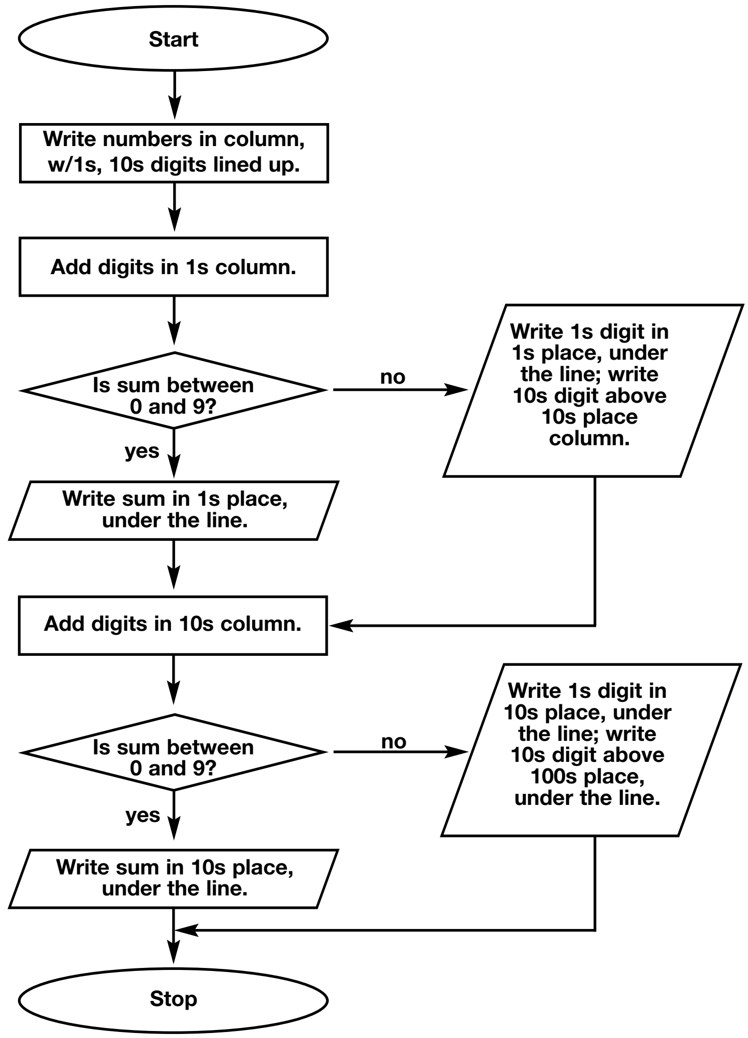
To make a flowchart, you have to think through the process carefully. How does the process start? How does it end? What happens in between? In what order? Do any steps call for making decisions or choices? Do any steps have more than one possible result? Try to break down the process into the smallest possible parts. Once you have done this, you can use the symbols given on page 14 to create the flowchart.

Let's look at a common mathematical process: addition. We'll make a flowchart for the process of adding two-digit numbers.

The first step in making a flowchart is identifying the "start" point of the process. When adding two-digit numbers, where do we start? We write the numbers in a column so that the digits in the tens place and in the ones place are lined up. How can we categorize this step? Is it a decision, an output, or an operation? It's something we do to the numbers, so it's an operation. We can draw in the "start" oval, then a rectangle for the first step. The text in the rectangle should be as short as possible. We don't need to write full sentences—just enough to get the information across.



Now, identify the next steps in the process. Look for places where more than one thing can happen. These steps will go in diamonds, to show they call for questions or decisions. Try to phrase questions so the answer can be "yes" or "no." Remember to add a box for both results. Keep going until you finish the process.



Let's review the steps for creating a flowchart.

1. Think through the process, and break it down into steps.
2. Decide whether each step is an input, an output, an operation, or a point where a decision must be made.
3. Write decision points as questions that can be answered "yes" or "no." Include options for both answers.
4. Use flowchart symbols to chart the process, beginning with a shape labeled "start" and ending with a shape labeled "stop."

Application Here are the rules for the order in which operations should be done when evaluating arithmetic expressions. Use the lines below to rewrite the rules as a process. Remember to look for points where more than one thing can happen. Include both possible results in your process. When your written version of the process is complete, use it to fill in the flowchart on page 18.

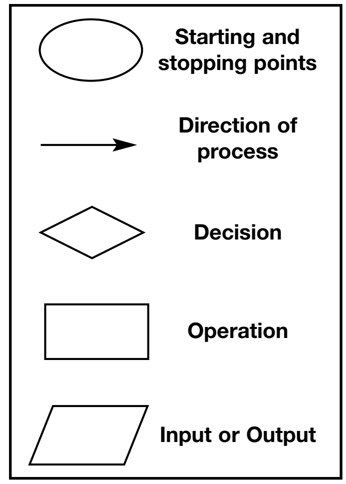
Rule 1: First, perform any calculations inside parentheses.

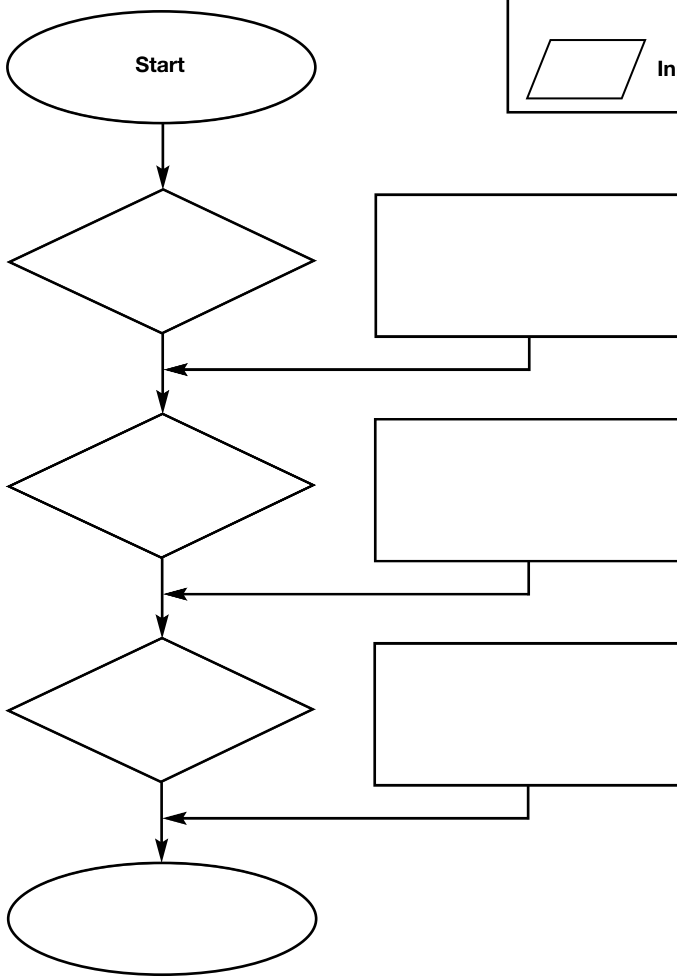
Rule 2: Next, perform all multiplication and division, working from left to right.

Rule 3: Last, perform all addition and subtraction, working from left to right.

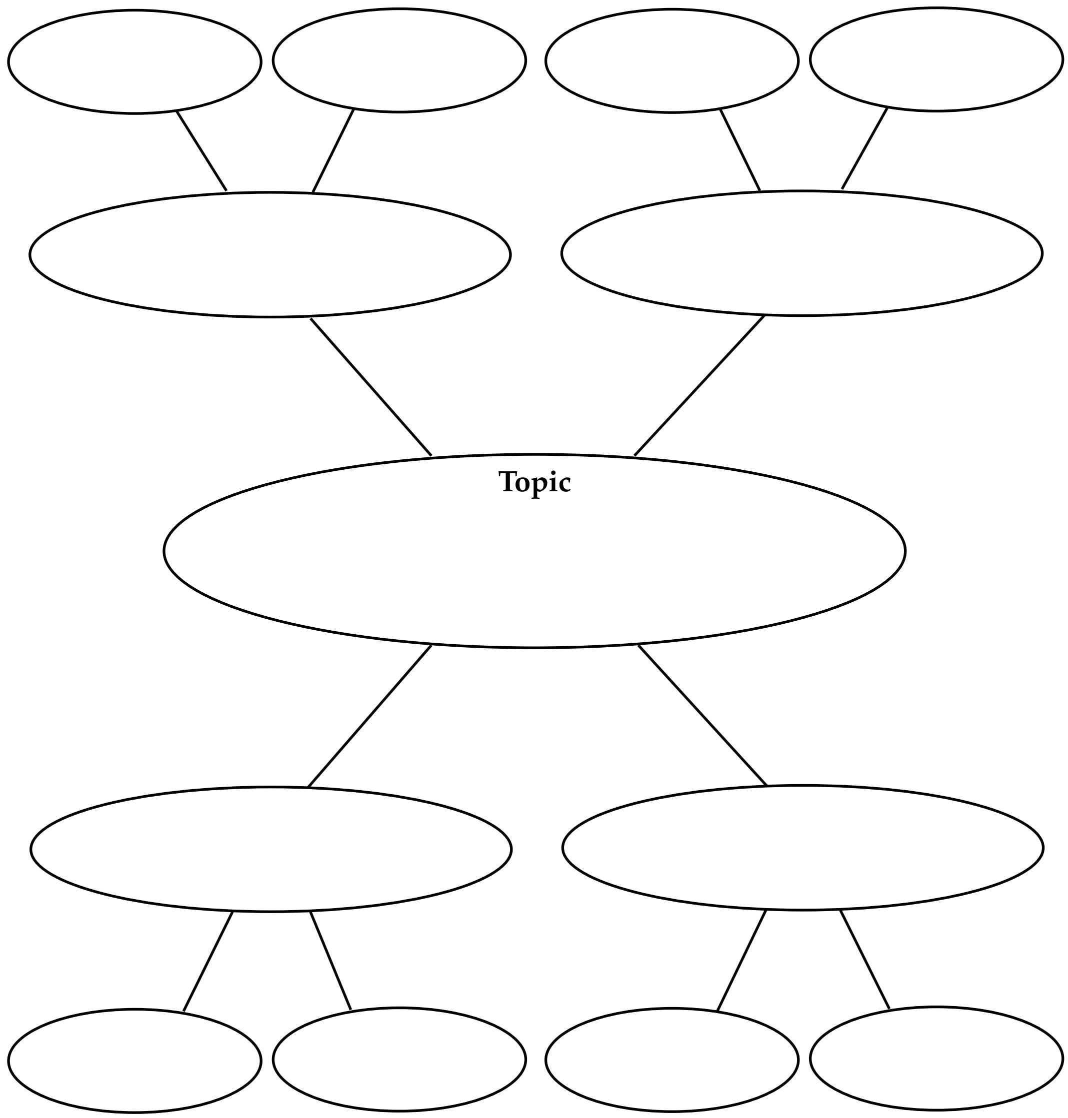
Process for Evaluating Arithmetic Expressions

Flowchart Use the blank flowchart below to chart the process on page 17. Add, delete, or change boxes and lines as needed.





Web We have looked at two types of organizers in this lesson, but there are many other ways to organize information. Here is another organizer you could use for taking notes. Write the main idea in the center circle. Write details in the other circles. Draw lines to connect related topics. Add or delete lines and circles as needed.



Answer Key: Lesson 2

Table, page 13

Polygon	Area Formula
Rectangle	$A = bh$
Square	$A = s^2$
Parallelogram	$A = bh$
Triangle	$A = \frac{1}{2}bh$
Trapezoid	$A = \frac{1}{2}(b_1 + b_2)h$

Answer Key: Lesson 2

Flowchart, page 18

Answers may vary. Sample answer:

Process for Evaluating Arithmetic Expressions

Start
Are there any parentheses in the expression?
If yes, do any calculations inside parentheses.
If no, are there any multiplication or division operations?
If yes, do multiplication and division, working from left to right.
If no, are there any addition and subtraction operations?
If yes, do addition and subtraction, working from left to right. Then stop.
If no, Stop.