**Mathematics Comprehension Strategies**

**Literacy in Secondary Schools**
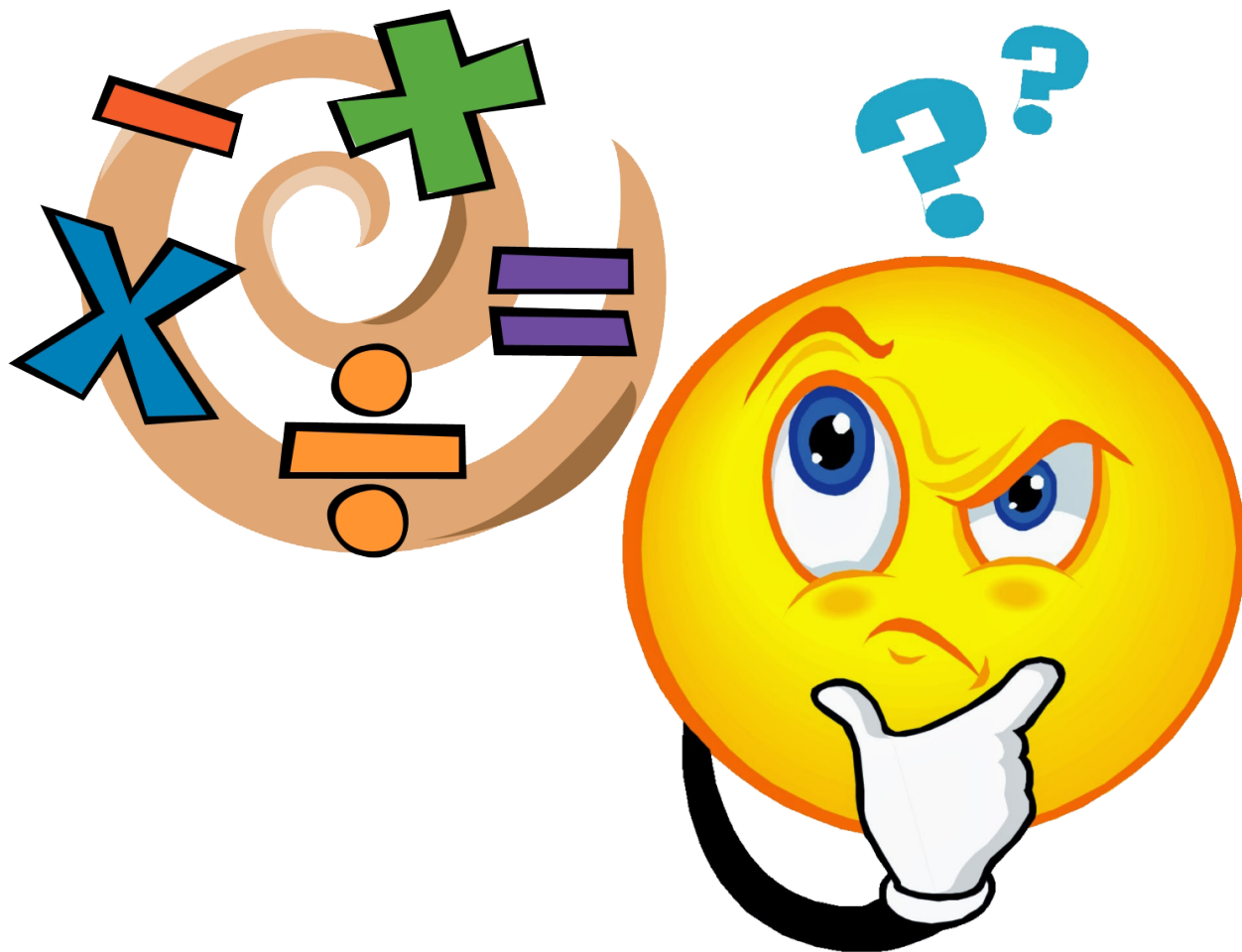
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**April 18, 2015**

**Table of Contents**

## Table of Contents (Cont.)

**Reference:**

McLaughlin, M. (2010). Content Area Reading. Boston, MA: Pearson Education.

**An Educational Philosophy**

My teaching philosophy is a student-centered approach that involves partnering with the learners in my classroom. The achievement gap has been stubbornly persistent, and it is our job as educators to tackle this social justice issue. To do this, we must build internal motivation in our students to foster engagement with the learning process.

## What is Literacy? A Personal Perspective

 To be considered literate in our society implies several competencies. Literacy includes the ability to consume and integrate new textual content into one's pre-existing knowledge. Literacy includes the ability to express oneself through text in various media (letters, emails, essays, blog posts, short stories, tweets, etc.). Literacy also includes the ability to integrate information from a variety of content areas (mathematics, science, history, technology, etc.).

**The Value of Cultural Responsive Teaching to Teach Urban Learners**

Culturally responsive teaching achieves many educational goals. It increases comprehension by connecting educational content to students' lives. It ensures students see role models they can relate to in every content area. It responds to the challenges and specific needs of the students in the class. Ultimately, culturally responsive teaching is the tool that will eliminate the achievement gap.
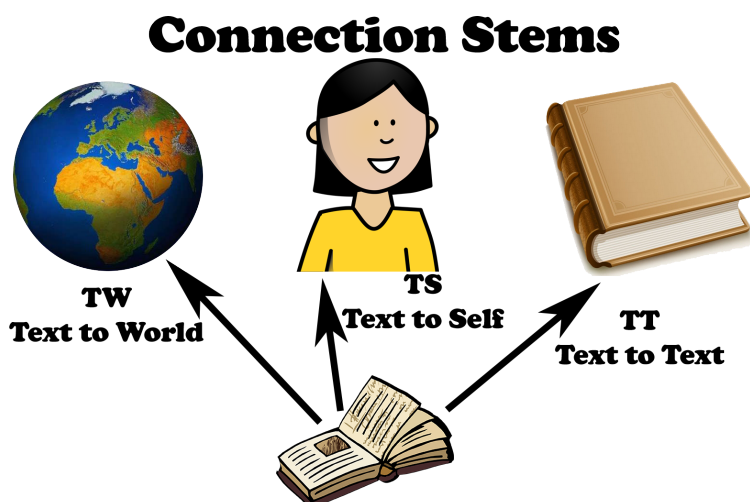
# Connection Stems

**Summary:**

*Connection Stems* is a reading comprehension strategy in which students activate prior knowledge and make a variety of connections or associations to the text they are reading. Note that there are three kinds of connections: text-self (TS), text-text (TT), and text-world/others (TW). Examples of *Connection Stems* are 'That reminds me of…' or 'I remember one…' Students are asked to create connection stems prior to, during, and after reading various texts to connect the new knowledge to students' prior knowledge (constructivism).

**Diagram:**



**Instructional Connection:**

*Connection Stems* is useful when teaching mathematics. When introducing students to Sir Isaac Newton, first elicit connection stems from students and share them with the class. One such response is, "I remember eating Fig Newtons as a child (TS)." Or, "I once read that Newton discovered the rainbow in white light (TT)." Then, students break into pairs and take turns reading to each other about Newton. While one student is reading, the other generates new connection stems. One example connection is "Newton and I have the same birthday (TS)!" When students are done reading, students share their connections with the class. This maintains their motivation by personalizing the experience, and helps students with comprehension.

# Pre-reading Plan (PreP)

**Summary:**

Previewing is a comprehension strategy that includes activating background knowledge, setting purposes for reading, and predicting what comes next based on what students have already read. *Pre-reading Plan (PreP)* provides students with an opportunity to brainstorm words or ideas related to a topic and explain why they suggested particular words. After clarifying the words or ideas, they read a related text, revisit the terms, and revise as necessary.

**Diagram:**
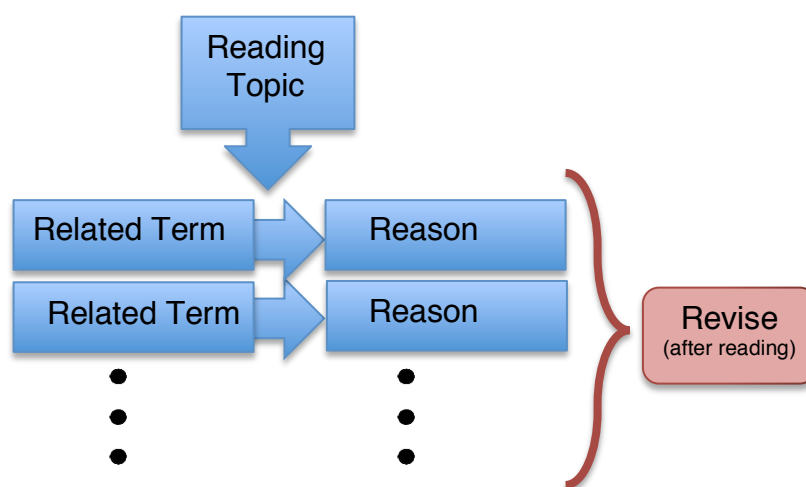


**Instructional Connection:**

*PreP* is useful when teaching mathematics, especially when looking at introducing new mathematical concepts. For example, when introducing circles, prompt students to consider terms related to the concept of a circle (wheel, sphere, pi, radius), and the reasons they believe the terms relate ("wheels are round," "spheres our three-dimensional circles"). Write them on the board, and ask a student to read the text introducing circles. After the reading, the class reviews the terms on the board, and suggests revisions to the list (circumference: distance across a circle, center: middle of a circle). This procedure allows students to predict the type of information they are about to learn, and connect it to their pre-existing knowledge (constructivism).

# Juxtapositioning Texts

**Summary:**

*Juxtapositioning Texts* is a technique that helps demonstrate multiple perspectives. The technique allows for a critical analysis of the issues presented in texts written from different perspectives. Students are presented the texts in various contexts (whole class, individual reading, small group) and are encouraged to consider how the narratives differ based upon the perspective of the writers. Students are asked to consider what information is included, and excluded from the texts, and why this might be. *Juxtapositioning Texts* provides students with a less subjective perspective on an issue, allowing them to see it from multiple angles. Students also learn the value of finding texts from different perspectives when investigating an issue.

**Diagram:**
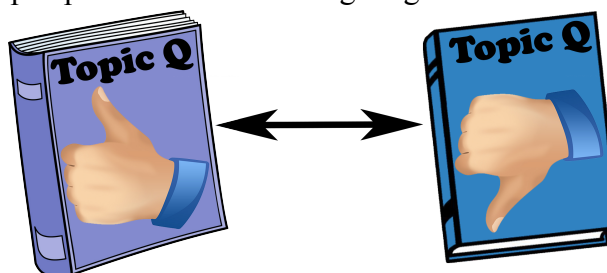
**Instructional Connection:**

*Juxtapositioning Texts* is useful when teaching mathematics. When looking at the Pythagorean theorem, there are a vast number of proofs.  Introduce students to the traditional Pythagorean proof provided in the textbook. Next, prompt students to get into small groups, each group learns a different proof, and discusses the merits of learning the Pythagorean theorem with their assigned proof (area of triangle side squares, Pythagoras' Proof, Bhaskara's First Proof). Next, the class gets into new groups such that each of the new groups has a member representing each of the different proofs. Students debate which of the proofs is the best method for learning the Pythagorean theorem. Finally, each group reports back to the whole class by way of a nominated spokesperson, giving the group's findings. This strategy allows students to consider how different representations of the theorem might benefit students with different learning styles.
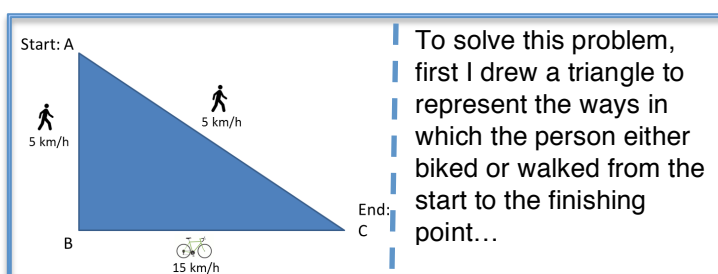
# Write and Sketch in Math and Science

**Summary:**

*Write and Sketch in Math and Science* allows students to use both language and symbols to make their thinking about problem solving visible to themselves and others. For example, when a math problem is posed, students read or listen to the problem and paraphrase it. Then, they record their thinking about how to solve the problem on a paper that has been divided in half vertically. On the left side of the paper, students sketch a picture to solve a problem. On the right side of the paper, students use words to solve it.

**Diagram:**



**Instructional Connection:**

*Write and Sketch in Math and Science* is useful when teaching mathematics. When looking at Angle of Elevation word problems, students must visualize the situation in order to solve the problem. *Write and Sketch in Math and Science* provides a framework for students drawing the parts of the word problem and generating the necessary triangle upon which the students apply the trigonometric equations. Students then describe their thinking process on the right side of the paper, giving themselves an opportunity to catch any flaws in their thinking. For example, "The angle of elevation from a sailboat to the top of a 121-foot lighthouse on the shore measures 16°. To the nearest foot, how far is the sailboat from shore?" The student would draw a picture of this scenario on the left side, and then explain their process on the right. Their explanation could be, "since I know an angle, the height of the side of the triangle opposite the angle, and want to know the length of the triangle adjacent to the angle, I will use the tangent property. Since the tangent of an angle is equal to the opposite side divided by the adjacent side, I will substitute the known values and solve for the adjacent side."

# Be a Math or Science Author

## Summary:

When students create their own math problems or science experiments, they are more interested and engaged. Designing written problems or experiments is an effective way to tap into students' personal experiences and bridge the gap between existing and new knowledge. In addition, practice in interpreting problems or experiments invented by peers, helps students better interpret more formal information presented in textbooks or by teachers. With the *Be a Math or Science Author* technique, students create problems to be solved by classmates. Problem topics are left open to the imagination of students, or directed by a topic currently being studied in math class.

## Diagram:

## Instructional Connection:

*Be a Math or Science Author* is useful when teaching mathematics. When looking at Angle of Elevation, give students several examples of word problems to solve, and then they generate word problems that include content from their own lives. Examples might include finding the height of a local bridge, finding the distance to a far off location based upon the known height of a far off structure or mountain/tree. An example is "I know that tall building is 500 feet tall, and I can see with my clinometer that the angle of elevation is 20°. How far away is that building?" Students then share their word problems with a partner, and give each other feedback. Then, the whole class shares examples, and discusses difficulties.
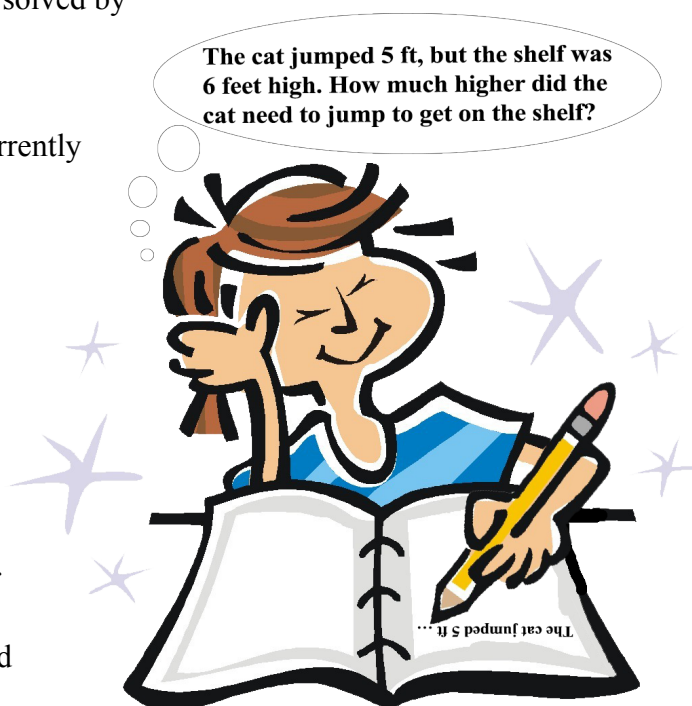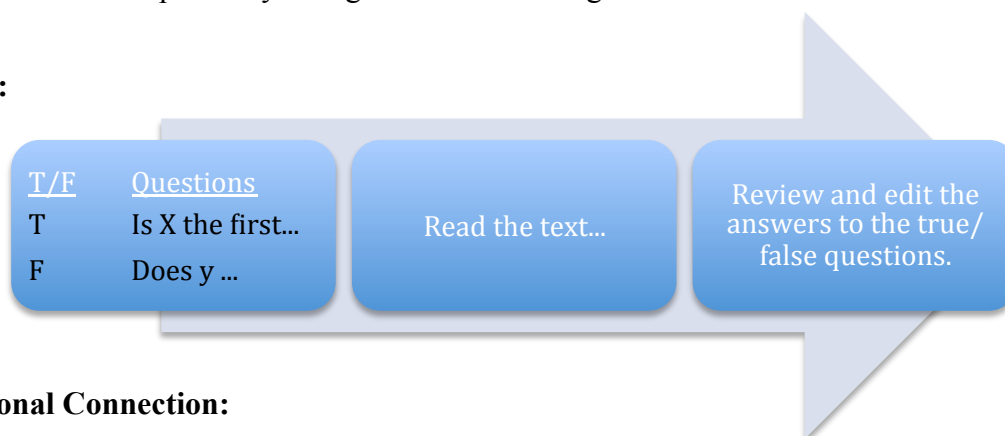
**Anticipation/Reaction Guide**

**Summary:**

Students use an *Anticipation/Reaction Guide* to preview what they are about to read and to monitor their thinking while reading. Specifically, these guides activate prior knowledge, make connections to the text, set purposes for reading, and develop more accurate understandings of informational text. An *Anticipation/Reaction Guide* consists of several statements related to the text; the statements may or may not be true. Before reading, students indicate whether they agree or disagree with each statement and share their responses through partner, small-group, or whole-group discussion. After reading, students revisit the statements, decide whether their thinking has changed, and mark the statements accordingly. Then, the class discusses the guide again, and students explain any changes in their thinking that occurred.

**Diagram:**

| T/F | Questions | | |
|-----|-----------|---|---|
| T | Is X the first… | Read the text… | Review and edit the answers to the true/false questions. |
| F | Does y … | | |

**Instructional Connection:**

An *Anticipation/Reaction Guide* is useful when teaching mathematics. When looking at the hierarchy of quadrilaterals, students are asked questions about the properties of squares, parallelograms, rhombi, rectangles, and trapezoids in the *Anticipation/Reaction Guide*. This includes statements like: "Squares are a type of rectangle." and "The angle measure of two consecutive interior angles in a parallelogram is 180°," and "A quadrilateral's diagonals bisect each other," and "Trapezoids are types of parallelograms." This serves as a first assessment. Then after reading the text, the class reviews and edits the list appropriately.

# Semantic Map

**Summary:**

Teachers use *Semantic Maps* to activate prior knowledge, introduce content specific vocabulary, and organize information about a topic. When teaching students how to use this map, the teacher chooses a focus word, engages students in brainstorming, and creates a graphic organizer that features categories and details. Teachers use completed *Semantic Maps* to create summaries. Because the design of the *Semantic Map* depends on students' responses, the structure of each map is different. Students usually use *Semantic Maps* before and after reading either narrative or informational text.

**Diagram:**

Related Term F — Example 1 / Example 2 / …

Related Term E — Example 1 / Example 2 / …

Focus Word

Related Term A — Example 1 / Example 2 / …

Related Term D — Example 1 / Example 2 / …

Related Term B — Example 1 / Example 2 / …

Related Term C — Example 1 / Example 2 / …
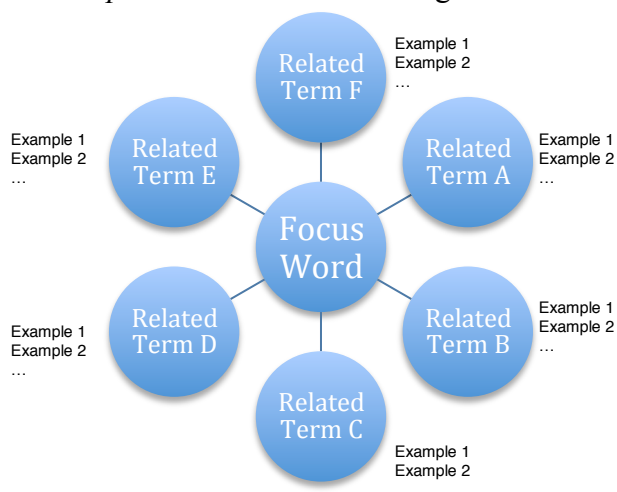
**Instructional Connection:**

A *Semantic Map* is useful when teaching mathematics. When looking at number sets, the teacher chooses the focus word "Number Sets." Students brainstorm to consider Related Terms (rational, irrational, natural) and examples (1/2, pi, 432) and details (a rational number has one integer divided by another, irrationals have nonrepeating infinite decimals, natural numbers are integers starting with 1). Students read the informational text, rejoin the whole class, and edit the *Symantec Map* based upon what is in the text. Students add details like the Related Term "integer," that this number set includes negative numbers and zero, and that an example is -432.

## Question-Answer Relationship

**Summary:**

*Question-Answer Relationship* (*QAR*) is a teaching idea that helps students understand how to self-question. Students learn that there are two information sources: text (In the book) and prior knowledge (In my head). Within each information source, there are two *Question-Answer Relationships*. This teaching idea helps students focus on the information source needed to answer a question. *QAR* is used when reading narrative and expository text. Give students a list of questions that are each categorized as one of the four *QAR* methods below. Students then read the text, and attempt to answer the questions using the method indicated.

# In the book:          # In my head:

**Diagram:**

**Right There**     **Think and Search**     **On My Own**     **Author and Me**



**Instructional Connection:**
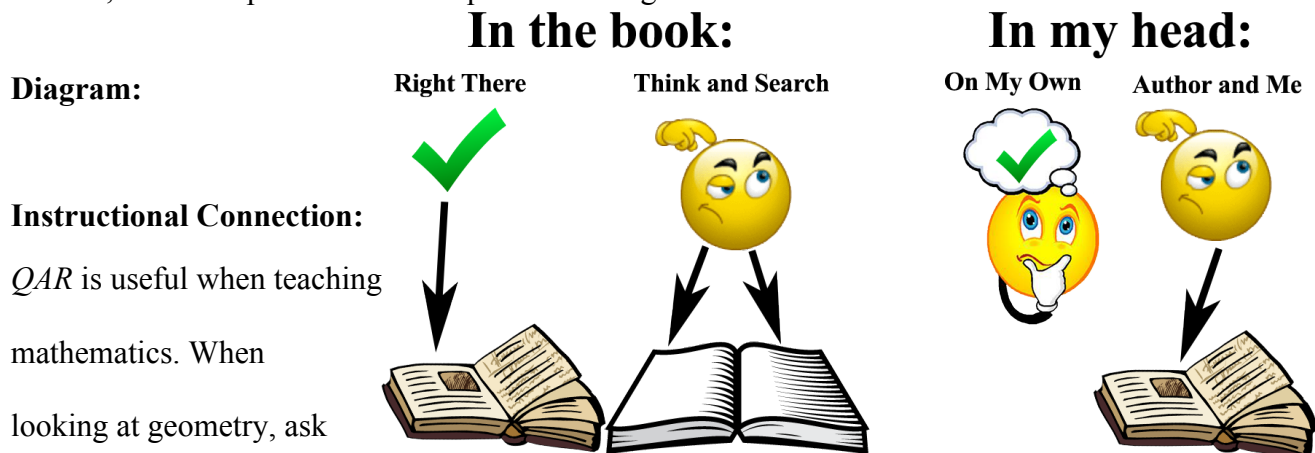
*QAR* is useful when teaching mathematics. When looking at geometry, ask students questions from each of the four methods. For example, for 'Right There,' ask students, "What is a property of two consecutive interior angles of a parallelogram?" For 'Think and Search,' ask students, "What is a general formula which can be used to calculate the area of any regular polygon?" For 'On My Own' ask students, "What kind of career might you imagine doing where this knowledge would be useful?" For 'Author and Me' ask students, "When finding the area of a regular polygon, do you think it is better to use the equations which break the polygons into triangles, or the equations which are specific to each type of polygon? Justify your answer."

# I Wonder

**Summary:**

"I wonder…" statements are designed to encourage students to generate questions and to provide a model for active thinking during the reading process. These statements can be used with either narrative or informational text, before, during, and after reading. "I wonder…" statements are shared orally, through sketching, or in writing. One engaging way to use the strategy is by students writing their "I wonder…" statements on a bookmark that they place in the book they are wondering about.

**Diagram:**

**Instructional Connection:**

*I Wonder* is useful when teaching mathematics. When looking at right triangles, prior to reading the text, students suggest "I wonder …" statements. The teacher places a list on the board. Possible statements are "I wonder why are right triangles used more than other triangles in man-made objects?" and "I wonder how long ago society discovered the properties of right triangles?" Then, after learning about right triangles, the class considers whether the text has brought clarity to the "I wonder" statements.
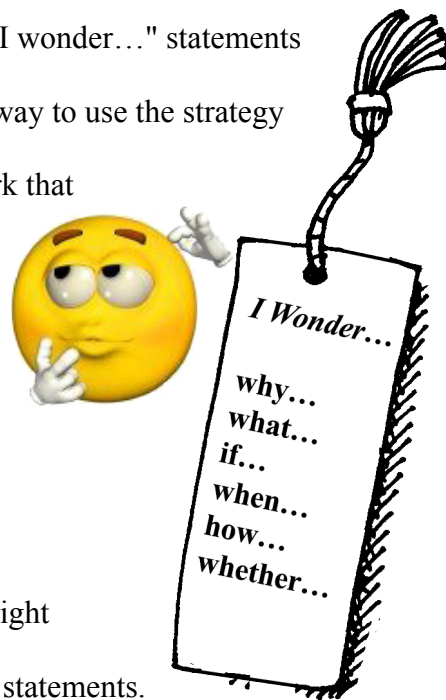
**Paired Questioning**

**Summary:**

In *Paired Questioning,* students engage in actively generating questions during reading. Paired

Questioning is a self-questioning reading comprehension strategy that involves generating

questions in order to guide thinking. While reading segments of the text, students take turns

generating text related questions and responding to them. When students finish, one partner

summarizes the important ideas in the text, and the other agrees or disagrees and justifies his or

her thinking.

**Diagram:**

**Instructional Connection:**

*Paired Questioning* is useful when

teaching mathematics. When looking at

the "Building Blocks of Geometry,"

students take turns reading the associated

text in pairs, and ask each other questions about the text between each section. Examples are:

"What is a physical model of a point/line/plane?" and "What does collinear/coplanar mean?" and

"What geometrical figure has endpoints?" Then, one student summarizes the text, and the other

student agrees or disagrees, and justifies their response. An example of a summary is "The

building blocks of geometry are the simple structures (points, lines, planes) that we combine to

create more complex shapes. We also use terms to describe how these structures relate to one

another (collinear, parallel, intersect)."

## Bookmark Technique

**Summary:**

Readers use the *Bookmark Technique* to monitor their comprehension while reading, and make evaluative judgments about aspects of the text. This technique is used with narrative and expository text, and works well with both in-class reading and homework assignments. The Bookmark Technique is a reading comprehension strategy that involves readers constantly asking themselves, "Does this make sense?" Teachers distribute the four bookmarks (depicted below), explain the *Bookmark Technique*, introduce the text, guide students on how to use the bookmarks, and then students practice on their own.

**Diagram:**



| Name_____ | Name_____ | Name_____ | Name_____ |
|---|---|---|---|
| **Bookmark 1** | **Bookmark 2** | **Bookmark 3** | **Bookmark 4** |
| The part I found most interesting was: | Something that confused me was: | A word I think the whole class needs to talk about is: | The visual that helped me understand the reading was: |
| I thought it was interesting because: | It confused me because: | I think it means: | It helped me because: |
| Page___ Paragraph___ | Page___ Paragraph___ | Page___ Paragraph___ | Page___ Paragraph___ |

**Instructional Connection:**

The *Bookmark Technique* is useful when teaching mathematics. Before students read about the mathematical concept of midpoint, hand out the four bookmarks, and describe the topic and how to use the bookmarks while reading. Read a section of the text with the whole class, and complete the first bookmark. For example, "The part I found most interesting was ancient mapmakers. I thought it was interesting because ancient mapmakers around the globe used the concept of midpoint to help them create navigational maps." Then, students complete the final three bookmarks on their own. An example for Bookmark 4 is "The visual that helped me understand the reading was the midpoint drawn on the xy-plane." An example for Bookmark 2 is "Something that confused me was how to find a midpoint from two coordinates. The reason it confused me is I didn't understand why the formula results in a midpoint."
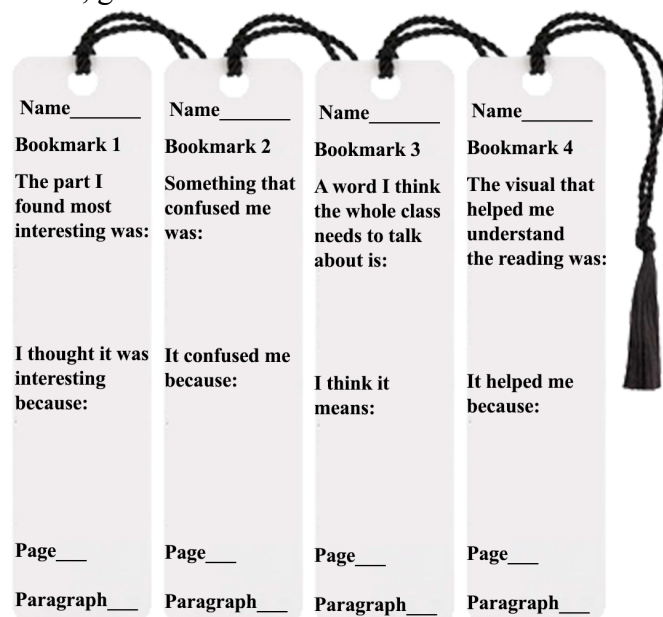
## Questions into Paragraphs (QuIP)

**Summary:**

*Questions into Paragraphs (QuIP)* is a reading strategy that involves extracting essential information from text. *QuIP* provides a framework for initiating research, structuring writing, and summarizing. Students choose a topic and develop three related research questions. Then, they respond to each question from two sources. When the graphic organizer is complete, students use the information to write a paragraph. Students use *QuIP* before reading (generating questions), during reading (reading the information provided by the two sources), and after reading (writing the summary).

**Diagram:**

| QuIP Research Grid | | | |
|---|---|---|---|
| Topic:_____ | | | |
| **Questions** | **Answers** | | **QuIP Paragraph** |
| | **Source 1:** | **Source 2:** | |
| **A.** | | | |
| **B.** | | | |
| **C.** | | | |

**Instructional Connection:**

*QuIP* is useful when teaching mathematics. When looking at regular polygons, students ask questions like "What properties are the same for all regular polygons?" and "What makes a regular polygon 'regular'?" and "How do I find the area of a regular polygon?" Then, the teacher gives students a text about regular polygons, access to the Internet, and URLs of some math sites. Students gather relevant information from these sources, place them on the research grid, and subsequently writes a paragraph summarizing their findings. An example of part of a summary is, "Regular polygons have congruent sides, and congruent interior angles."
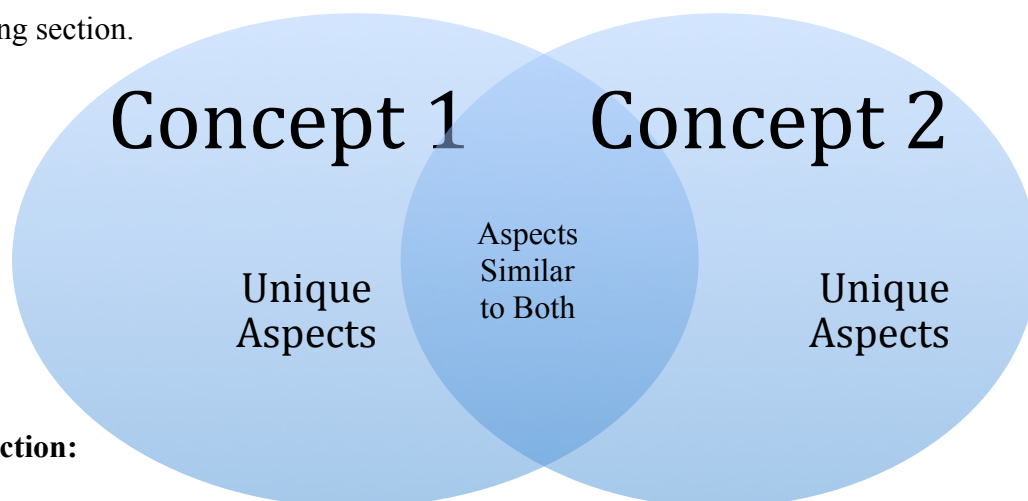
**Venn Diagram**

**Summary:**

The Venn Diagram is named for its creator, John Venn, who used it to express thoughts about logic. The diagram, which is represented by two interlocking circles, provides a format for us to note similarities and differences or two perspectives about a topic. The similarities appear in the overlapping sections of the circles; the differences appear in the outer sides of each circle. Students use Venn Diagrams as an evaluative comprehension strategy that involves making judgments while reading. Students read some text that describes two different perspectives or similarities and differences about a topic. Students label each circle (each one being a perspective or one of two things a student is comparing). Students then place common characteristics in the overlapping section, and non-common characteristics to the left or to the right of the overlapping section.

**Diagram:**

Concept 1    Concept 2

Unique Aspects    Aspects Similar to Both    Unique Aspects

**Instructional Connection:**

Venn Diagrams are useful when teaching mathematics. When looking at multiples, students generate a Venn diagram with the concepts of "multiples of two" and "multiples of three." Students then generate multiples of these kinds (2: [2,4,6,8,10,12]; 3:[3,6,9,12]), and place them in the appropriate locations on the diagram (2:[2,4,8,10], Both:[6,12], 3:[3,9]). Students then repeat the process with different multiples ("multiples of four", "multiples of five"). This process makes the concept of multiples less abstract by placing the relationships visually on a page.

## Semantic Question Map

**Summary:**

The *Semantic Question Map* is a form of previewing; a comprehension strategy that includes activating background knowledge, setting purposes for reading, and predicting what comes next based upon what was read. The *Semantic Question Map* is a variation on the *Semantic Map*, but its general design is fixed. The Teacher places a focus word on the board, and then raises several questions about it. The Teacher places the questions, which may be provided by the teacher or generated by the students, inside the ovals that extend from the focus word. Teachers use *Semantic Question Maps* when they want students to focus on particular aspects of the topic.

**Diagram:**
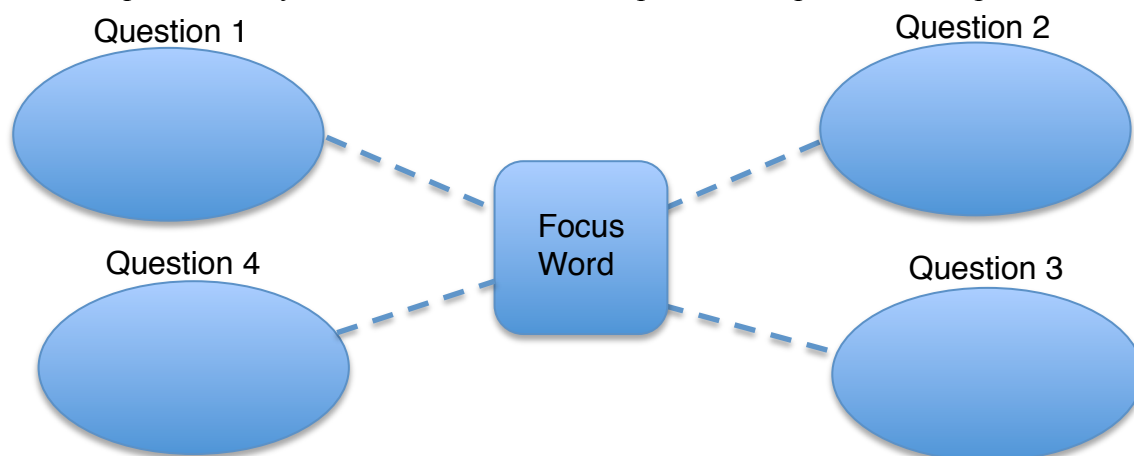


**Instructional Connection:**

The *Semantic Question Map* is useful when teaching mathematics. When looking at parallel lines in geometry, the teacher assigns "parallel lines" as the focus word, and prompts students to ask questions. Students may ask, "What shapes have parallel lines?" and "How can parallel lines in a shape help us figure out things about the shape?" and "What defines parallel lines?" Students try to answer these questions with what knowledge they already have. Students read a text on parallel lines, and revisit their responses to the questions. This process prepares students' minds to look for information regarding the focus word while reading. It also engages the reader as an active participant in the reading process.

# Concept of Definition Map

**Summary:**

The *Concept of Definition Map* is designed to help students construct meaning by making connections between their prior knowledge and new topics. It provides information such as a definition, a description, and examples. This graphic is used before, during, and after reading. When the map is completed, the class creates a *Concept of Definition Map* summary. When teaching summarizing, ask students to extract important information from the text. Students, however, often struggle in determining which information is important. Therefore, creating a summary based on the *Concept of Definition Map* provides students with the opportunity to use the important information. In the process, students learn that the important information includes components of the Map.

**Diagram:**

What are some examples?

What are they?

Rules

Commutative

Commutative Addition:
$6a + 5 = 5 + 6a$

Focus Word:

Associative

Associative Addition:
$(4x + 2x) + 7x = 4x + (2x + 7x)$

Algebraic Properties

Distributive

Distributive Multiplication:
$2x(6 + y) = 12x + 2xy$
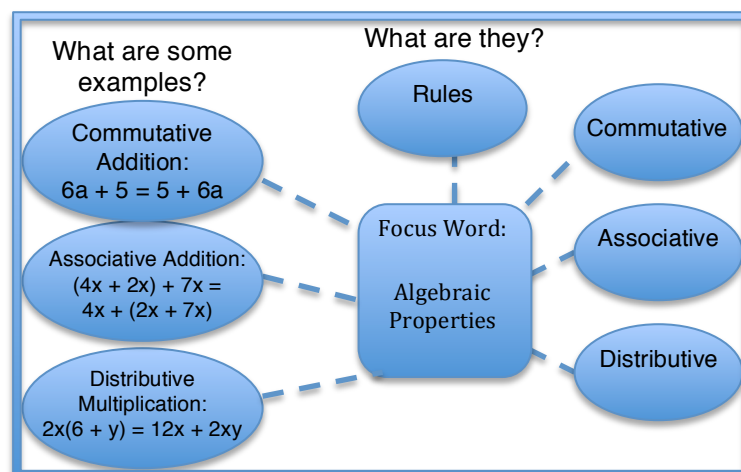
**Instructional Connection:**

A *Concept of Definition Map* is useful when teaching mathematics. When looking at algebraic properties, the teacher starts by brainstorming with the students what the term means (rules for manipulating algebraic expressions), ideas connected to the term (commutative, associative, distributed), and examples (see above). The teacher completes a *Concept of Definition Map* on the board, and instructs students to do so in their notes. Then, students read the text related to algebraic properties. The teacher instructs students to be on the lookout for the information to complete the Map. After students read the text, the class edits the Map together with the new information. In this case the students add the example of commutative addition, "$6a + 5 = 5 + 6a$."

# Semantic Feature Analysis Chart

**Summary:**

The *Semantic Feature Analysis Chart* is a graphic organizer that helps students make predictions about attributes related to specific words, sort by characteristics, and set a purpose for reading or researching. *Semantic Feature Analysis Charts* help students monitor their thinking and learn about words. Students use *Semantic Feature Analysis Charts* to compare and contrast the characteristics or qualities of multiple items or types of people. Students use this chart before they read to activate background knowledge, and after they read to add information and/or draw conclusions.

**Diagram:**

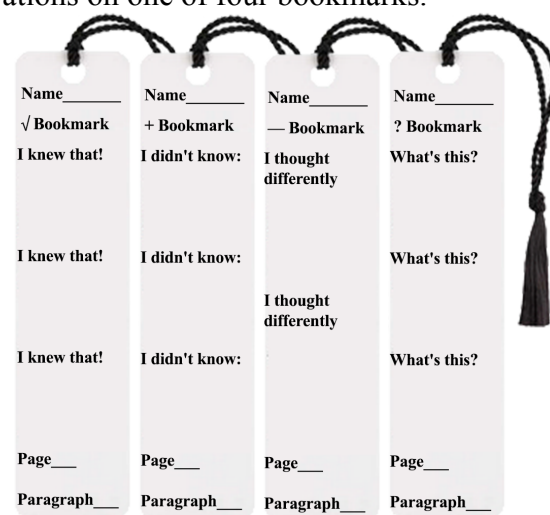| Characteristics<br><br>Categories | Parallel Sides | All Right Angles | Complementary Consecutive Angles | Congruent Opposite Angles | Congruent Opposite Sides | Area = b·h |
|---|---|---|---|---|---|---|
| Squares | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| Circles | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ |
| Parallelograms | ✔ | ⊘ | ✔ | ✔ | ✔ | ✔ |
| Rhombi | ✔ | ⊘ | ✔ | ✔ | ✔ | ✔ |
| Triangles | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ | ⊘ |
| Rectangles | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| ✔ = Yes | | ⊘ = No | | ? = Don't know | | |

**Instructional Connection:**

The *Semantic Feature Analysis Chart* is useful when teaching mathematics. When looking at properties of two-dimensional shapes, the teacher starts by brainstorming with the students the different kinds of two-dimensional shapes, different characteristics to compare, and whether each one of the shapes has these characteristics (see above).  The teacher completes a *Semantic Feature Analysis Chart* on the board, and instructs students to do so in their notes. Then, students read text related to the characteristics of two-dimensional shapes. The teacher instructs students to be on the lookout for the information to complete the chart. After students read the text, the class edits the chart together with the new information.

**I.N.S.E.R.T**

**Summary:**

The *Interactive Notation System to Effective Reading and Thinking* method (*INSERT*) is a

reading comprehension strategy that involves constantly asking, "Does this make sense?" and

adapting strategic processes to make the message clear. Students brainstorm what they know

about the topic, read the text, and insert four symbols as they read. Students place a checkmark in

the margin if the information verifies what is on their brainstorming list. Students place a plus

symbol if it is new information. Students place a minus symbol if the information contradicts

what is on their list. Students place a question mark if the information is something that is

confusing. After placing the symbol, students write their observations on one of four bookmarks.

**Diagram:**

| Name_____ | Name_____ | Name_____ | Name_____ |
|---|---|---|---|
| √ Bookmark | + Bookmark | — Bookmark | ? Bookmark |
| I knew that! | I didn't know: | I thought differently | What's this? |
| I knew that! | I didn't know: | | What's this? |
| | | I thought differently | |
| I knew that! | I didn't know: | | What's this? |
| Page___ | Page___ | Page___ | Page___ |
| Paragraph___ | Paragraph___ | Paragraph___ | Paragraph___ |

**Instructional Connection:**

*INSERT* is useful when teaching mathematics. When looking

at the properties of a polygon, the teacher has students

brainstorm what they know about polygons (perhaps that they

are two-dimensional and enclose a space). Then, students

break up into pairs, and take turns reading paragraphs to each other. Students pause between

paragraphs and decide together which symbols to place in the text, and what information to place

on the bookmarks. In addition to confirming what they learned in the brainstorm, they might also

learn that polygons have straight sides and can fit into the categories of equiangular, and

equilateral (+ Bookmark). They may have questions about the term vertex, regular polygon, and

n-gon (? Bookmark). They may also discover properties that they were mistaken about when

brainstorming (- Bookmark).

# List-Group-Label

**Summary:**

Students use *List-Group-Label* to preview and monitor information presented in informational text. This teaching idea is used before and after reading to activate background knowledge and to help students become familiar with how selected words relate to a concept and to other words. Students brainstorm around a "cue term," coming up with related words and grouping some into clusters. Students then read the text, and refine their list.

**Diagram:**

**Cue Term**: _____

**Before reading**: Brainstormed words and clusters

| Cluster I | Cluster II | Cluster III |
|---|---|---|
| Related Word 1 | Related Word 1 | Related Word 1 |
| Related Word 2 | Related Word 2 | Related Word 2 |
| … | … | … |

**Instructional Connection:**

*List-Group-Label* is useful when teaching mathematics. When looking at simple mathematical operations, the class brainstorms words used to describe basic mathematical operations. For example: subtract, sum, divided by, minus, equals, increased by, multiple, difference, take away, and add. The teacher writes this list on the board. Then, the class decides how to group the terms into clusters (addition, subtraction, multiplication, division, equals). Then, students read the text on mathematical operations. Finally, the class regroups to contribute more words/clusters to the list. Example words to add are: more, together, combined, decreased by, tripled, twice, quotient, ratio, out of, totals, and is. By completing this list and categorizing all the words, students become familiar with the different ways mathematical operations can be referred to in narrative text. The exercise also helps students categorize the terms, and to easily see what other terms imply the same operation.
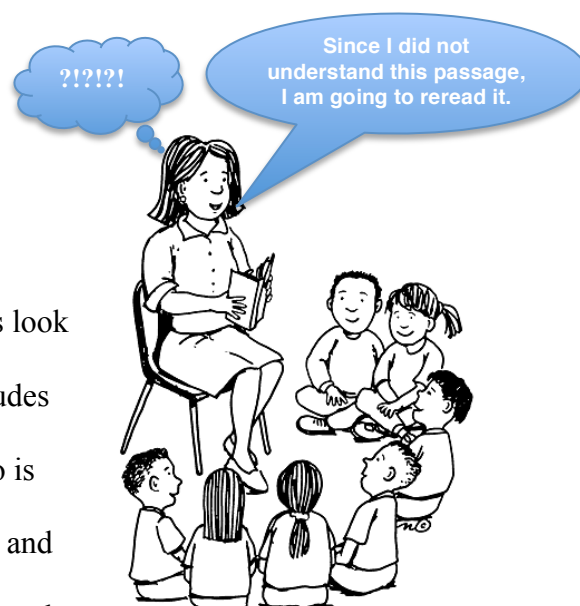
# Think-Aloud

**Summary:**

*Think-Alouds* help scaffold learning for students. The teacher selects a passage to read aloud to the students. The passage should require some strategic thinking to clarify understandings. Explain that *Think-Alouds* model strategic behavior and thoughts in the reading process. Prior to reading, the teacher describes connections they can make to the text. Then, as the teacher reads, they think aloud to demonstrate monitoring, visualizing, and summarizing. Students then break up into pairs and practice this technique with each other.

**Diagram:**

**Instructional Connection:**

*Think-Alouds* are useful when teaching mathematics. Let us look at the word problem "Rachelle's school photo package includes one large photo and several smaller photos. The large photo is similar to the small photo. The small photo is 2 inches long and 1.5 inches wide. If the height of the large photo is 10 inches, what is the width?" The teacher reads this problem to the students. The teacher pauses on the phrase "similar to the small photo," and says, "I recall that similar objects have proportional measurements." After reading the third sentence, the teacher says, "I notice there are two related numbers in the sentence, maybe this is the ratio statement? I also notice the terms 'long' and 'wide', which might be used to label a proportion box." After finishing reading the problem, the teacher says, "Since I suspect this is a proportion problem, even though I am not sure what the answer might be, I am going to draw a proportion box and label it to get me started."

**Content Area Inventory**

**Summary:**

In *Content Area Inventories*, students record their thoughts about content-related topics. *Content Area Inventories* promote reflection and provide students with an opportunity to express their feelings and share their prior knowledge about the content area they are studying. Teachers then alter their lesson plans to better engage their students.

**Diagram:**

| | |
|---|---|
| The best thing about [the math topic I am studying] is… | In math class, I like to work… |
| The worst thing about [the math topic I am studying] is… | When I finish a math problem from class, I feel… |
| One way that I use mathematics outside of school is… | When I use the math I learned in this class, I am proud of… |
| My favorite part of mathematics class is… | Regarding [this math topic], I wish I knew more about… |
| In math class, I like to work in groups so that I… | |

**Instructional Connection:**

*Content Area Inventories* are useful when teaching mathematics. When looking at percentage ratio word problems, an example student response is, "The worst thing about percentage ratio problems is knowing where to put numbers in a proportioned box. My favorite part of mathematics class is when I figure out a problem before others do. I like to work in groups so that I can see how other students think about a problem. I wish I knew more about how to label my proportion boxes." Teachers examine the responses from their students, and look for trends. Assuming the previous example was a typical response, the teacher responds by reviewing with the class how to determine where to put labels when constructing a proportion box. The teacher pays attention to how students answered the "I like to work…" question, to design the learning environment in a way most conducive to learning.

# Content History

**Summary:**

*Content History* invites students to contemplate previous experiences in a content area. For students, it promotes reflection, helps make connections between past and present day experiences, and cultivates self-understanding. For teachers, it provides insights into students' previous learning experiences that can be used to foster motivation and informal planning.

**Diagram:**

These prompts are offered to help create a math history. A math history details your mathematical development from earliest memory to now. These prompts are intended only to stimulate your thinking. Include any information you would like to make your history meaningful.

1. What is your earliest math memory?
2. Can you recall how or if you used numbers before you entered school?
3. Can you recall experiences from your math education in elementary?
4. Do you remember a person or activity that helped you learn about math?
5. What is one thing you would change about your math experiences?
6. Do you recall any ways you used math outside of school?
7. Do you feel comfortable using math now? Why? Why not?
8. Did you enjoy math in any particular grade? Why? Why not?
9. Offer advice to students just beginning to study math.
10. Name two ways you will use math after you graduate.

**Instructional Connection:**

*Content History* is useful when teaching mathematics. When looking at the first day of a high school ninth grade geometry class, students fill out *Content Histories*. Example responses being, "I was transferred from Hudson Wisconsin two years ago, and some of the math they were doing here did not make sense." Or, "I did well in math, except for in fifth grade." A teacher receiving these responses alters the way they deliver lessons. The teacher realizes that the student who transferred has holes in their mathematical exposure due to the Common Core being different than Minnesota standards. Particularly, if the student who transferred from Wisconsin did so between 6th and 7th grades, they have missed content related to angles and geometric figures, which Minnesota does in 6th grade, but Wisconsin does not do until 7th. The teacher would also look at the math content the other student missed in 5th grade (properties of three-dimensional figures, areas of triangles and quadrilaterals, surface area, and volumes of rectangular prisms). This information would inform the teacher about what content they need to more carefully review, and the need for some supports for specific students.

**Admit Slips**

**Summary:**

*Admit Slips* are used to assess prior knowledge when preparing to teach about a topic, or assess

student understanding of a topic about to be taught. When completing an *Admit Slip*, students

reflect on what they know about a particular topic. Students can write their responses on a

graphic organizer or on an index card. On the first side, students write what they already know

about a topic; on the second side, they write a question they have about that topic. Teachers

collect the slips before formally beginning class. Reading the slips allows teachers to respond in

the next class to questions.

**Diagram:**



**Instructional Connection:**

*Admit Slips* are useful when teaching mathematics. When beginning a unit on trigonometry,

some example "already know" response are: "… that trigonometry has to do with triangles." and

"… that trigonometry has to do with circles." and "… that it has something to do with soaking

your feet in the river." Some example questions are: "When does anyone use trigonometry in real

life?" and "Who invented trigonometry?" Given these responses, the next day the teacher verifies

that trigonometry does indeed have to do with circles <u>and</u> triangles. The teacher verifies that

there is a trigonometric mnemonic called SOHCAHTOA ("Soak a Toe-uh"), but that you do not

actually have to put your feet in a river. The teacher would also talk about how trigonometry is

used in the real world (astronomy, land surveying, oceanography, architecture, navigation, and

studying light and sound waves), and the history of its discovery (Egypt, Iraq, and Greece).

# Tickets Out

**Summary:**

*Tickets Out* ask students to reflect on what they learned that day, and what questions they have about it. The students' responses to what they have learned are recorded on the front of the graphic organizer, and any questions they may have are written on the back. Teachers collect the tickets as they stand at the door at the end of class. Teachers use these to determine what questions they should address the next class period.

**Diagram:**



What did I learn today?

------------------------
A question I have about what I learned…

**Instructional Connection:**

*Tickets Out* are useful when teaching mathematics. When looking at properties of polygons, some example 'What did I learn' responses are, "…that diagonals connect to opposite vertices of a polygon," and "…that geometry is really boring." Some example 'A question I have' responses are, "Do I have to memorize a new area equation for every polygon?" and "Why should I care about polygons?" The teacher addresses these issues the next day. Given the previous responses, the teacher attempts to make the content more engaging and entertaining to address students being bored (using manipulatives, polygon art-project, educational polygon videogame). The teacher clarifies that a diagonal connects two nonconsecutive vertices. The teacher lets the students know that they need not learn new area formulas for each polygon, but that there are shortcuts for regular polygons (involving dividing the polygon up into triangles and using the triangle area formula). The teacher also gives examples of the types of careers students might pursue, where this type of knowledge is useful (art, architecture, engineering, physics, videogame programmers).

# Internet Workshop

**Summary:**

*Internet Workshop* is especially useful for introducing students to websites for an upcoming unit and developing background knowledge. During such a workshop, students work individually, in collaboration with classmates, or in conjunction with international peers. Steps often include: students locating websites, developing an activity related to class learning goals, recording information in an electronic journal, and continued periodic workshop sessions. *Internet Workshop* is an effective way to help expand students' understanding of the topic being studied.

**Diagram:**

New Unit ➕ 🖥️ 🟰 Jumpstart ‼️

**Instructional Connection:**

*Internet Workshop* is useful when teaching mathematics. When looking at geometric transformations, begin the unit by explaining to the students that are going to visit a computer lab. On an overhead, show them how to create a Khan Academy website account (khanacademy.org/signup). Show them how the website is used to study every area of math, and how it to supplement any math class they are in. Explain that in this unit, students learn about geometric transformations. Give them handouts with this information, and bring them to the computer lab. Students register an account, and begin the online unit "Axis of Symmetry." In this online unit, students watch videos, take online quizzes, and earn points/badges for their efforts. The class visits the lab every Friday. Students complete "Exploring Rigid Transformations," "Dilations or scaling around a point," and "Transformations on the coordinate plane." As an assessment, the teacher tracks each student's online score total and badge tally.

# Gallery Images

**Summary:**

*Gallery Images* is a visualizing reading comprehension strategy that involves students creating mental images of the text as they read. *Gallery Images* help us to create visualizations while reading and provide a format for sharing our mental images. This technique is usually used after reading informational text. Students use this technique by sketching images as they read content area text. They write a description for each image, share their images with a partner or group, and discuss their different visualizations.

**Diagram:**
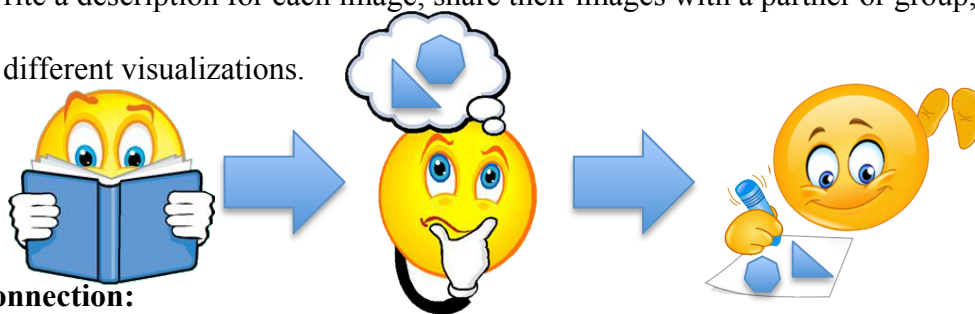


**Instructional Connection:**

*Gallery Images* are useful when teaching mathematics. When looking at the Law of Sines, students read a problem individually, "Jack is on one side of a 200-foot-wide canyon and Jill is on the other.  Jack and Jill can both see the trail guide at an angle of depression of 60 degrees. How far are they from the trail guide?" Then, students attempt to draw a diagram representing the scenario (triangle with 200 foot top length). Students then write a sentence or two indicating what type of mathematical tools one might need to tackle the problem (interior angle sum of a triangle, properties of triangles). Next, they compare their drawing to the drawings of other students at their table before working with their tablemates to answer the question.  When they subtract the two 60° angles (depressions) from 180° (interior angle sum), they learned that the last angle is also 60°. They then realize the triangle is equilateral; so all the side lengths are equal. Therefore, the side lengths that represent the distance from Jack or Jill to the trail guide are also 200 feet.