How to Build Cognitive Skills in All Content Areas

By Melinda Zeares, *teacher, Middle College High School at El Centro College, Dallas, TX*

Introduction

College Readiness must be the educational buzz word of the decade. Everywhere, educators, parents, politicians, and the Media are talking about how best to ensure that more students not only go to college, but are successful in the endeavor. As the economy declines, our interest in a college education for all increases. Slogans of “college and career ready” abound and the research has now reached the point of being overwhelming, especially to the teacher “in the trenches”.

One of the leading researchers is Dr. David Conley whose Educational Policy Improvement Center (EPIC) provides a rich array of research, publications, tools, and techniques and has been a catalyst for change nationwide. While college readiness is a complex topic involving many dimensions, helping students develop Key Cognitive Strategies is one of the essential components. (Conley, 2010)

One approach to college readiness for all students is to establish Early Colleges. Walk into an early college classroom and you will see kids working collaboratively as they write and discuss and answer challenging questions from their teachers and peers. You will see accelerated learning where teachers scaffold their lessons to help students master difficult concepts at an early age. But look closer. The activities being done are often the same ones done in any non-early college classroom. On the surface, we are differentiated. We are implementing a variety of instructional strategies we have been trained to use and are told these strategies will develop the key cognitive skills our students need. Ask classroom teachers, though, to name the number one thing they need and they will most likely tell you “the right materials.” If students sit in collaborative groups to write about and discuss a low-level worksheet, they would probably learn more from well-delivered direct teaching.

The research and training still leaves classroom teachers with unanswered questions that erode their effectiveness. Dr. Conley talks about “assignments that require and reward persistence”. (Conley, 2010) What are those assignments? Where can teachers find them? He also mentions, “classroom embedded performance tasks.” I’m the classroom teacher. I have 100 students and no time. What are these tasks and how do I embed them in my classroom?

We know how to teach and we have learned the cognitive strategies we have come to believe will move our students closer to being college ready. We still ask, where are the activities? I call it the “Emperor’s New Clothes Syndrome.” No one really wants to voice, what is to any classroom teacher, the obvious. We need new and innovative or perhaps simply repurposed activities for our students to use while they sit together, write, talk, and answer those difficult questions.

This article offers some of those activities combined with ideas for using them in combination with effective teaching methods to develop the cognitive skills. I hope they will serve as a conduit to your own “bag of tricks” and help stimulate your creativity so you can write your own customized to your discipline. It’s the children who will benefit!

Activities

First, as a framework, let me explain that I prepare a weekly calendar for my students. Each day, the calendar contains the Essential Question(s) for the lesson, the Essential Problem we will do in class, the Prepare for Class assignment, book pages for reference, and such things as scheduled quizzes, tests, and school events.

These activities are not presented in any hierarchy or order. The forms and sheets used for the activities have been placed on our school’s website and can be downloaded without a password. There are also a few examples of student work. (Zeares, 2010)

Activity 1: Prepare for Class (PFC)

Format: assigned daily – done at home
Rationale: College instructors want students to be prepared for class. To a high school student, “prepare for class” means “do your homework.” To a college instructor, it means, “read ahead.”
Description: Students are taught to use a Cornell Notes form at home to read ahead in their textbook, take notes, write questions they do not understand, and write a summary of what they learned. The readings are carefully chosen to scaffold the study-ahead habit necessary for college success. Students are assigned a couple of pages, or maybe only a paragraph or a definition. In class, students use their PFC forms during group work, while the teacher is presenting content to the class as a whole, and to ask clarification questions of their peers and the teacher. (Zeares, 2010)

“Another thing that surprised me is how we teach ourselves. I was never taught to go home, open a book, and learn. …I had trouble with this, but after figuring out that there is no way out but to learn the lesson, I did. … Ms. Zeares is raising us to be college ready students, not freshmen.” – 9th grade Geometry student

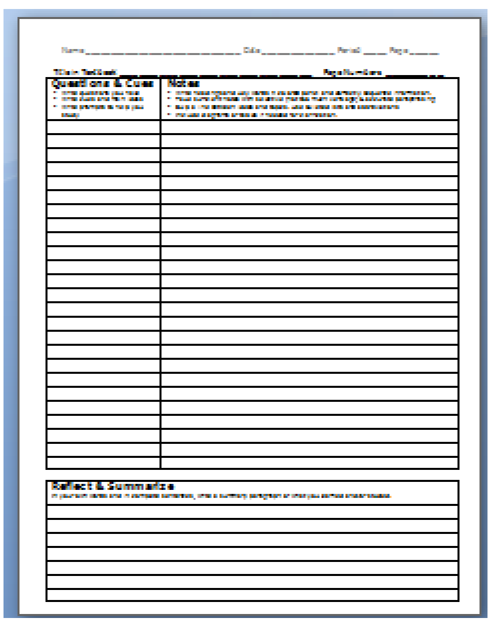

Questions & Cues | Notes
Reflect & Summarize

Figure 1: Prepare for Class (PFC) Blank Form

Activity 2: Collaborative Group Work

Format: assigned daily in some way – always done in class
Rationale: Research shows that students learn best from each other
Description: The teacher prepares or finds a number of problems that follow from the PFC work done the previous evening. Students may not use textbooks. Using only their PFC forms, they work all problems on the sheet. The number of problems should match the number of groups. They first review the problems and have a chance to ask for clarification from the teacher and the class. The use of such aids as formula charts in math is not allowed; however, students may use whatever they have recorded on their PFC sheets. After all problems are worked, one problem is randomly assigned to each group. Students are then given just a few minutes to prepare chart paper with the work from their assigned problem. Groups are chosen to present their assigned problem to the class. Students must take notes from the presentations and ask questions of the presenters and the class, not the teacher. Students, not the teacher, answer all questions. (Zeares, 2010)

Activity 3: What's Essential?

Format: Essential Problem done most days – done in class
Rationale: Students learn by doing and teaching; not by watching the teacher do and teach.
Description: The teacher writes or finds at least one assignment that requires previous knowledge to be used along with new knowledge. These capture the most enduring problems the students absolutely must learn to solve or the essential products students must be able to produce for the course. The Essential Problem must be worked independently first so that the teacher and the student can judge understanding. This is followed by collaborative sharing and reporting. The difference in Activity 2 and Activity 3 is in the type of problems chosen. For the first round of collaborative group work following the PFC, the problems are focused on the new knowledge and skills just learned. The work helps students master the new material. Essential Problems, on the other hand, include previous knowledge and help students integrate and synthesize their learning across lessons. In a subject such as math, Essential Problems are prepared almost daily. For a discipline with essential products, it might be necessary to have an Essential Problem (or Product) of the week or unit rather than daily. The important thing is that the teacher identifies the most essential problems and products for the course and then systematically and purposefully ensures that students have mastered them. (Zeares, 2010)

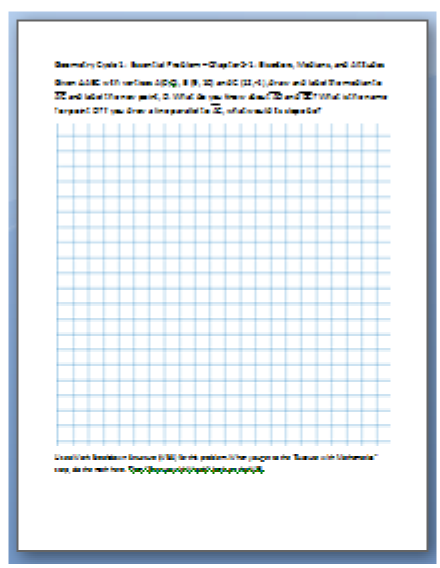


Figure 2: Example of Essential Problem

Activity 4: Haikus Aren't Just for English Class

Format: done periodically – usually in class but may be a project prepared outside class

Rationale: The use of poetry can be a powerful tool for students to use to summarize concepts or learn vocabulary.

Area Haiku
Covers the surface
Of a 2-dimensional
Figure totally

Description: Working collaboratively, students are challenged to write a poem that captures the essence of the concept they are learning and/or illustrates the use of essential vocabulary. In addition to being a valuable learning tool, most teenagers love to write poetry. Being a math teacher, I start with what I consider the most "mathematical" poetry form, the Haiku. Other forms may be used effectively as well. The diamante is excellent for contrasting concepts. Cinquains are a good way to deepen vocabulary understanding. An "I Am" poem could also be used. In Geometry, which requires a huge amount of vocabulary be learned, I use modified "I Am" poems to teach technical characteristics of shapes.

"What I enjoyed the most was writing Haiku poems." – 9th grade Geometry student

Activity 5: Triple the Learning (TTL)

Format: done when needed – usually in class – a good activity to leave for a substitute teacher as long as suggested student responses are included.

Rationale: Some Essential Questions may require scaffolding for students to answer adequately.

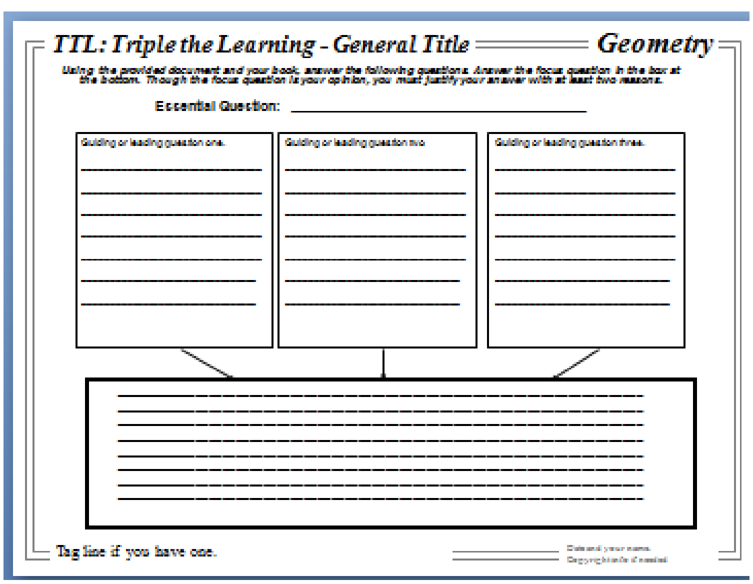
Description: I write essential questions for all of my lessons. Many of these require declarative knowledge or procedural knowledge. Some more complicated essential questions require students to use conditional knowledge. For the latter, I have designed a template to guide students to arrive at, and be able to defend, an adequate answer.

Examples: - Declarative – Asks What – What is an apothem? Explain its use in computing area.

Procedural – Asks How – How is an apothem of a polygon like an altitude of a triangle? Include a sketch to illustrate your comparison.

Conditional – Asks When or Why – Does a scalene triangle have an apothem? Why or why not?

For conditional knowledge, students must often remember prior learning in


TTL: Triple the Learning - General Title ———— Geometry

Using the provided document and your book, answer the following questions. Answer the focus question in the box at the bottom. Though the focus question is your opinion, you must justify your answer with at least two reasons.

Essential Question: ____________________

Guiding or leading question one.	Guiding or leading question two	Guiding or leading question three.

Tag line if you have one.

Figure 3: Triple the Learning (TTL) Blank Form

order to arrive at an answer. These questions also have multiple entry points and require a higher level of reasoning. The template I use is two-sided. On the front, background information is presented. This serves as a mini-lesson that students can use independently in collaborative groups with little input from the teacher. On the other side of the paper, there is a hierarchy of boxes. The top layer of boxes contain guiding or leading questions that break the main essential question into pieces. Students use their answers to the guiding questions to compose an answer to the essential question.

"What surprised me the most about the class so far was the amount of writing we had to do. I have written more in this class than in my English class."- 10th grade Geometry student

Activity 6: Brain Organizer Form

Format: used for the Essential Problem – used in class and sometimes for homework

Rationale: Writing to learn is a research-proven method of helping students think about what they are learning and define that learning in writing for the sake of learning, rather than for the sake of writing. It is writing as a tool as opposed to writing as a skill. (Douglas Fisher, 2007)

Description: This activity provides a structure for writing to learn. There are many such structures. Indeed, whole books have been written on the topic. This is a structure I have designed with my students. It works especially well for math problem solving, but with a little tweaking, it could be used for any subject. It uses writing to learn to structure problem formulation as well as problem solving. My kids like to call it a "brain organizer". They are asked to follow 5 steps in solving any complicated problem, such as their Essential Problem of the day or test problems:

The boxes and bubbles contain the following:

1. **Observe** - Write what you see & recognize in the problem. What is given?
2. **Question** - What questions need to be answered? Number as you list.
3. **Plan** - What does it mean you must do? Must have at least one step for each question.

   Now solve and explain. Follow your plan.
4. **Do the Math** – work out the math
5. **Explain What You Did** – Explain the former execution in words using short, but complete sentences.

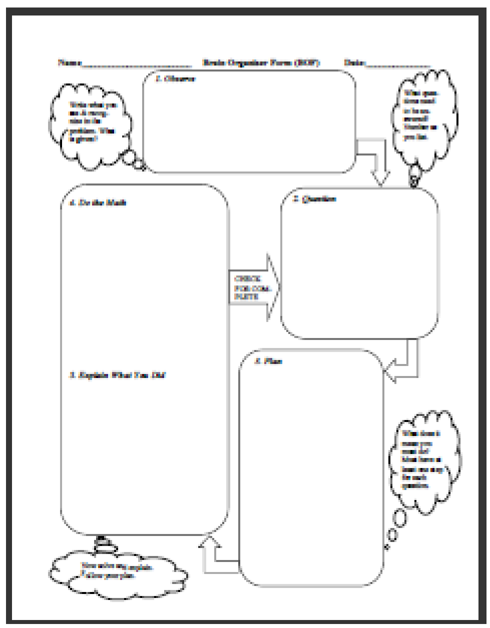


Figure 4: Brain Organizer Form (BOF)

About the Author:

Melinda Zeares is currently the geometry teacher at Middle College High School at El Centro College in Dallas, Texas. Previous experience includes 27 years as an Elementary Mathematics and Computer Lab teacher and five years of product development and marketing at Texas Instruments. Education includes a Masters of Science, Special Education and a Bachelors of Science, Education, Contact information: mzeares@dallasisd.org

TTL: Triple the Learning – General Title — *Subject*

Information box.

Topic –

Section: Section boxes will grow as you type.

Section:

Section:

Tag line if you have one.

Date and your name
Copyright info if needed

TTL: Triple the Learning - General Title — Geometry

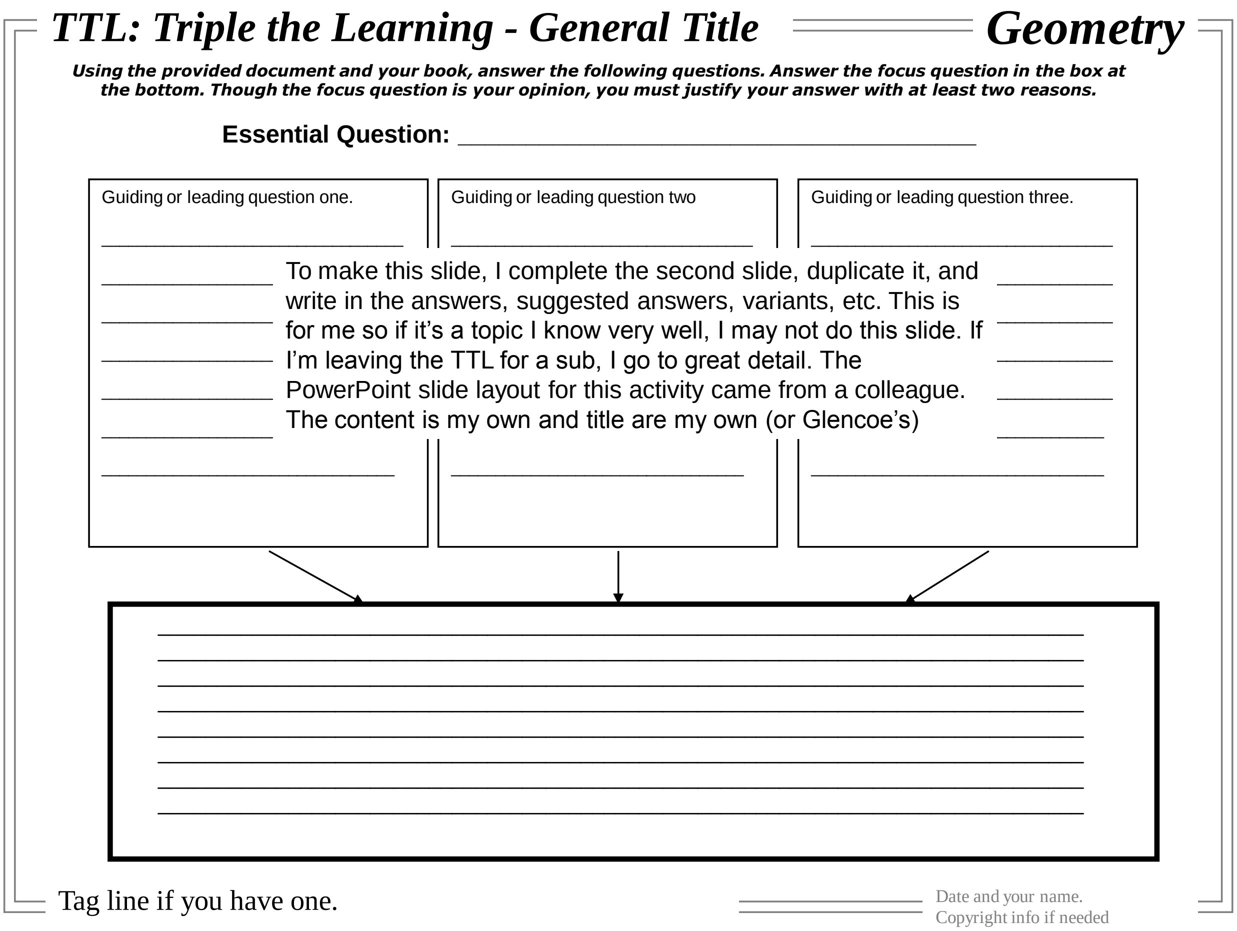
Using the provided document and your book, answer the following questions. Answer the focus question in the box at the bottom. Though the focus question is your opinion, you must justify your answer with at least two reasons.

Essential Question: ______________________________________

Guiding or leading question one.	Guiding or leading question two	Guiding or leading question three.

Tag line if you have one.

Date and your name.
Copyright info if needed



TTL: Triple the Learning - General Title **Geometry**

Using the provided document and your book, answer the following questions. Answer the focus question in the box at the bottom. Though the focus question is your opinion, you must justify your answer with at least two reasons.

Essential Question: ____

Guiding or leading question one.	Guiding or leading question two	Guiding or leading question three.
________________________	________________________	________________________

To make this slide, I complete the second slide, duplicate it, and write in the answers, suggested answers, variants, etc. This is for me so if it's a topic I know very well, I may not do this slide. If I'm leaving the TTL for a sub, I go to great detail. The PowerPoint slide layout for this activity came from a colleague. The content is my own and title are my own (or Glencoe's)

Tag line if you have one.

Date and your name.
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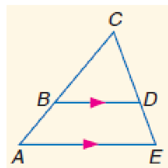
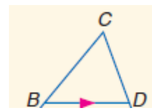
Topic – The Triangle Proportionality Theorem - based on parallel lines and proportional parts

Street maps frequently have parallel and perpendicular lines. In Chicago, because of Lake Michigan, Lake Shore Drive runs at an angle between Oak Street and Ontario Street. City planners need to take this angle into account when determining dimensions of available land along Lake Shore Drive.

Proportional Parts of Triangles Look at the figures below. Nonparallel transversals (AC and EC) that intersect parallel lines (BD and AE) can be extended to form similar triangles. So the sides of the triangles are proportional. One of the parallel lines (AE) would form the base of the large triangle. The other parallel line (BD) would form the base of a smaller triangle embedded in the large triangle. To see the similar triangles, lift the little triangle off the big one and draw it separately like the illustration.

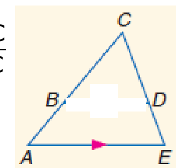


Original Triangle



Little Triangle BCD

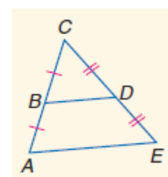
$$\frac{BC}{AC} = \frac{DC}{EC}$$



Big Triangle ACE

The Triangle Proportionality Theorem states that in the case above, the segments of the sides of the original triangle are also proportional. In this example, this proportion would be true. $\frac{BA}{CB} = \frac{DE}{CD}$ Could you write other true proportions?:

Midsegment Theorem In the illustration above, BD doesn't have a specific name. Look at the illustration to the right. If B were the midpoint of AC and D were the midpoint of CE, then BD would be called a midsegment. A midsegment is half of the side to which it is parallel. Therefore the length of BD (the midsegment) would be one-half of AE.



Read, interpret, think, write, and never trust your eyes.

Spring 2010 M. Zeares

TTL: Triple the Learning - Glencoe 7-4 — *Geometry*

Using the provided document and your book, answer the following questions. Answer the focus question in the box at the bottom. Though the focus question is your opinion, you must justify your answer with at least two reasons.

Essential Question: Why is the Triangle Proportionality Theorem True?

Compare and contrast the midsegment of a triangle with the median of a trapezoid.	How is the median of a triangle related to the median of a trapezoid and the midsegment of a triangle?	Sketch a median of a trapezoid. Are the segments of the legs proportional? Why or why not? Find a reference from your PFC.
______________________________	______________________________	______________________________
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Read, interpret, think, write, and never trust your eyes.

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Using the provided document and your book, answer the following questions. Answer the focus question in the box at the bottom. Though the focus question is your opinion, you must justify your answer with at least two reasons.

Essential Question: Why is the Triangle Proportionality Theorem True?

Compare and contrast the midsegment of a triangle with the median of a trapezoid.

Same – they both connect midpoints; they are both ½ of something; they are both parallel to something

Different – the midsegment is half the base of the triangle without adding anything else while the median is half the sum of the two bases. The midsegment is parallel to only one other line while the median is parallel to both bases of the trapezpoid.

How is the median of a triangle related to the median of a trapezoid and the midsegment of a triangle?

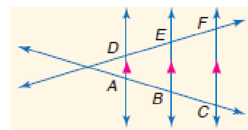
The median of a triangle has the same name but it intersects the base of the triangle while the median of a trapezoid is parallel to both bases.

The median of a triangle cuts the base into two congruent segments at the midpoint of the base; the median of a trapezoid cuts the legs of the trapezoid into congruent segments.

They both touch a midpoint of another side

Sketch a median of a trapezoid. Are the segments of the legs proportional? Why or why not? Find a reference in the book to prove your point.

Yes they are proportional because on p. 408 it says if three or more parallel lines intersect 2 transversals, then they cut off the transversals proportionally. A trapezoid has 3 parallel lines (2 bases and the median) and two transversals



Answers may vary. Some points that might be mentioned –
- A triangle is formed by 2 intersecting lines with a transversal.
- The line drawn parallel to the base is like having 2 parallel lines so corresponding angles would be congruent which would make the base angles of the little triangle congruent to the base angles of the big triangle
- The triangles formed are similar so the sides are proportional
- The little "top" triangle is part of the bigger triangle so 2 of the segments are identical
- It has to do with the things we learned about what makes lines parallel
- We can use the theorems we know about parallel lines and algebra (substitution) to prove the segments are proportional

Read, interpret, think, write, and never trust your eyes.

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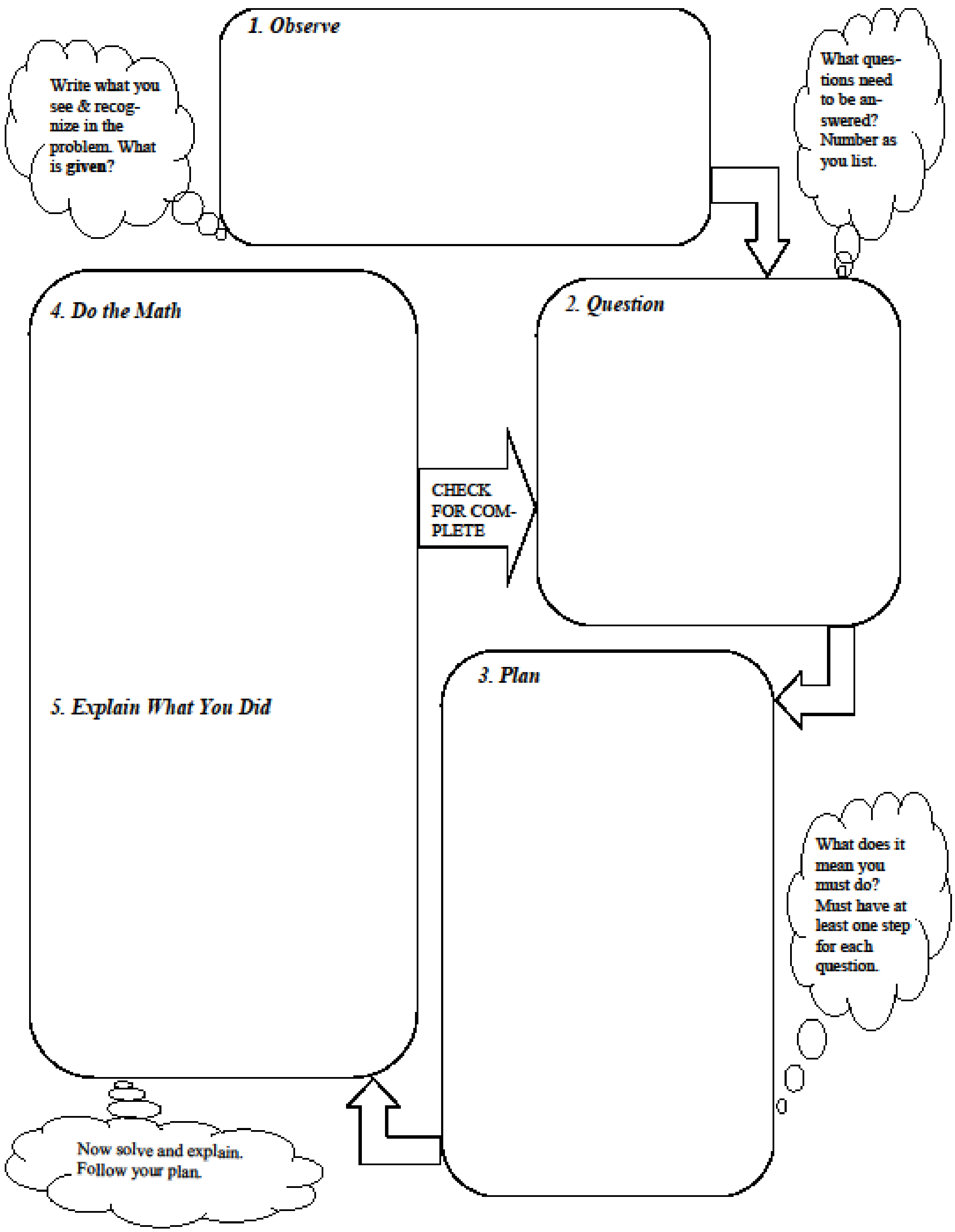
Name________________________ **Brain Organizer Form (BOF)** **Date:**______________



Prepare for Class Form

Title in Textbook ______________________________ Page Numbers _____________

Questions & Cues	Notes
- Write questions you have - Write cues and main ideas - Write prompts to help you study	- Write headings and key words in colored pencil and correctly sequence information. - Take sufficient notes with selective (not too much verbiage) & accurate paraphrasing - Skip a line between ideas and topics. Use bulleted lists and abbreviations - Include diagrams or tables if needed for clarification.

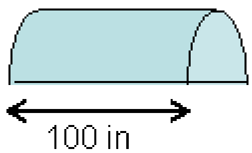
Reflect & Summarize
In your own words and in complete sentences, write a summary paragraph of what you learned and/or studied.

Geometry Cycle 1: Essential Problem – Chapter 5-1: Bisectors, Medians, and Altitudes

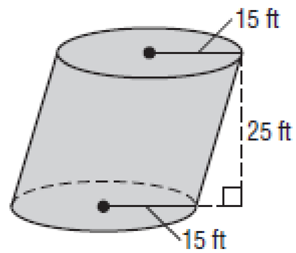
Given ΔABC with vertices A (0,0), B (9, 10) and C (12,-4), draw and label the median to $\overline{AC}$ and label the new point, D. What do you know about $\overline{AD}$ and $\overline{DC}$? What is the name for point D? If you drew a line parallel to $\overline{AC}$, what would its slope be?

Use a Work Breakdown Structure (WBS) for this problem. When you get to the "Execute with Mathematics" step, do the math here. Then "Execute with Words" back on the WBS.

1. Find the volume of the object below if the semi-circular base has a diameter of 20 in and the height of the half cylinder is 100 in. Round your answer to the nearest whole inch.

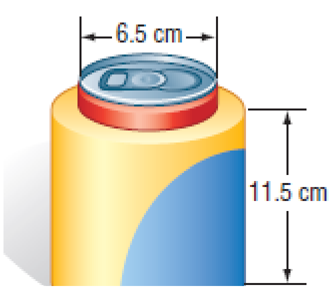


2. Using accurate mathematical vocabulary, describe the figure below and find its volume. Explain each step you did and why you did it. Leave your answer in terms of pi.



3. A can 12 centimeters tall fits into a rubberized cylindrical holder that is 11.5 centimeters tall, including 1 centimeter, which is the thickness of the base of the holder. The thickness of the rim of the holder is 1 centimeter. What is the volume of the rubberized material that makes up the holder?

Do not work this problem. Explain how to work it including all numbers and formulas you would use. Justify your explanation.



4. Half-cylinder aquariums are very popular. In the picture below, the water fills the clear part of the aquarium which rests on a solid base and is covered with a solid top. The diameter is 22 inches and the height of the clear section is 2 feet. Find the volume in cubic inches of the aquarium. You may leave your answer in terms of pi.