
Reading and Writing Arithmetic

by

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Editorial Comment

The BCCC Formula -

This formula, presented on page 88, was developed by Mary Langer Smith and Karen Jacobsen Nielsen to aid in the instruction of reading, not only in mathematics but in all content areas. This formula deals basically with vocabulary development. An explanation follows along with a lesson plan and some working examples in mathematics.

The Four Vocabularies -

There are four "vocabularies" available to students and to people in general. The four - listening, speaking, reading and written - are acquired in a hierarchical sequence. The four vocabularies are explained in greater detail on page 90, along with a list of typical mathematical words found in elementary arithmetic texts which teachers can use for their own reference. Also included is a lesson plan dealing with mathematics vocabulary.

Math Word Puzzle -

Children enjoy puzzles. Therefore, on page 92, a puzzle is presented which will help the children develop their mathematical vocabularies by discovering the terms in the given array of letters.

Vocabulary Development Exercise -

On page 93 is another exercise useful in developing mathematical vocabulary. This exercise can be used with nearly any concept being taught in any subject area. Another lesson plan has been provided along with two worksheets, the first one being a classroom exercise and the second being a form of evaluation.

Cloze Procedure -

Another vocabulary development procedure, called the Cloze Procedure, can also be used in the subject of mathematics. It is discussed fully in a section beginning on page 94, which includes a sample exercise on the history of the metre. The full essay is provided, along with a sample in cloze form.

Key Words in Written Directions -

It is a good idea to give children some instruction on following directions. One excellent method is to look for key words within the directions and to know exactly what steps are to be taken from these key words. On page 97, we have several examples of various direction-giving key words and how they can be used in mathematics. Following this is an exercise which tests a student's ability to follow directions.

Procedure for BCCC Formula _____

Formula -

- B Beginning sound of first letter(s).
- C Context - Read as far as needed to figure out the word.
- C Construction - Divide the word into its parts.
- C Check - Use dictionary or glossary.

Example to explain the formula -

- B Beginning Sound A consonant cluster must be sounded together.
- C Context Context is the only way to determine if the word is object' or ob'ject.
- C Construction Transportable trans/port/able
(Teach roots and affixes to assist in identification.)
- C Check Use reference materials.

Procedure -

Select a paragraph or selection which you wish the student to read. Underline selected words to be identified and defined according to context. Have the student do the following:

- Look at the underlined word(s). If it is not familiar, use the B in the formula.
- If the sound doesn't help, try the first C.
- Look back at the word. Did the way it was used in the sentence help decide what it was? If not, try the next C.
- If the beginning sound and context did not help, did the construction give any clues? If not, consult the dictionary or glossary.
- Sound out the beginning letter(s).

- Read the sentence for clues to the word. Context clues are the most important single aid for readers if they do not recognize a word at sight. Tell students to read to the end of the sentence or paragraph to see if they are able to identify the word. With attention focused on meaning from context, they will often discover what the word is.
- Divide the word into parts. Look for prefixes and suffixes. Identify the root word. Try to sound out the word by syllables.
- As a last resort, check the dictionary or glossary.

Sample Lesson -

Lesson title: Circle formulas

Lesson objective:

Using the circle formulas $C=\pi d$ and $A=\pi r^2$, students will solve story problems.

Reading skill objective:

Practice in using BCCC strategy on unknown words in story problems.

To achieve the reading objective the teacher will:

Review BCCC Strategy Chart on the bulletin board. Remind students of index and glossary in the text for help with definitions. Provide worksheet with underlined words divided into syllables.

To achieve the lesson objective the teacher will:

Provide a worksheet with underlined words and problems using the circle formulas. Review formulas and discuss any questions on substitution.

Evaluation -

Achievement of reading skill will be evaluated by:

Observation of student behavior during assignment and correcting worksheet.

Achievement of lesson objective will be evaluated by:

Correcting assignment.

Directions -

Use the BCCC formula on those underlined words. Write definitions you don't know in the chart provided below. Apply the proper circle formula to each question. Formulas are $C = \pi d$ and $A = \pi r^2$. $\pi = 3.14$ for our use.

1. The *diameter* of a circle is 5.5 centimetres. What is the area?
2. A circle has a *radius* of 9 units. What is the area?
3. A circle has a diameter of $1\frac{1}{4}$ units. What is the *circumference*?
4. The area of a *square* is 625 square feet. What is the largest circle that can be *inscribed* in the square?
5. A wheel is 24 inches in circumference. If this wheel is on a *vehicle* that travels one mile, how many *revolutions* will the wheel make?
6. Two *concentric* circles are drawn. The radius of the smaller is 8 units and the larger is 12 units. What is the *difference* in the circumference of the two?

Key Word

Definition

1. di am e ter
2. cent i me tre
3. ra di us
4. cir cum fer ence
5. square
6. in scribe
7. ve hi cle
8. rev o lu tion
9. con cen tric
10. dif fer ence

Process for Developing the Four Vocabularies _____

The natural order for the development of vocabulary at any age or level begins with *listening*. As the teacher talks, using special terms correctly, the students establish a relationship between the words and the concepts. After carefully guided concrete and semi-concrete experiences with the concepts, the students are encouraged to verbalize and demonstrate ideas, thus moving the words into the *speaking* vocabulary. It is critical that these steps be carefully followed to avoid failure when the terms are transferred into the *reading* vocabulary. Numerous experiences with identifying the written symbols or words places them into the reading vocabulary. The most advanced and therefore the most difficult is the *written* vocabulary. It synthesizes all the preceding skills.

Because various subjects employ certain words and symbols to convey meanings specific to them, there has always existed the problem of translating English expressions into technical language and vice versa. Our research has shown that the most difficult task for the student is posed by the special vocabulary and symbols which have one meaning in everyday life, but take on a different meaning in the context of the subject being studied. Therefore, every teacher must be concerned with teaching the specific meanings needed to comprehend and use the vocabulary of their discipline.

Knowledge of special vocabulary or symbols is cumulative. A weakness in either of these will result in incomplete knowledge of a concept. Since one concept is often built on another, the student must learn the language used by the teacher and the text and learn it thoroughly and carefully.

"Must-Know" Mathematical Words _____

This list has been drawn from recent elementary arithmetic texts. Cardinal, ordinal, and measurement words have not been included but must be taught as needed.

It is recommended that the teacher survey the text in use and identify essential vocabulary beyond this list to be taught as needed.

above	divisible	long	ruler
add	dollar	lowest	
addition	double		second,
addend		matching	segment
alike	each	measure	sentence
angle	equal	minus	set
arithmetic	equation	missing	short
around	error	money	shape
	estimate	more	side
backward	example	multiplication	sign
begin	even		similar
below	exercise	nickel	size
between		number	solve
	factor	numeral	square
center	false		straight
chart	fewest	odd	subtract
check	figure	opposite	sum
circle	final	order	
clockwise	fraction	outside	table
collection			take away
column	graph	pair	term
common	greater	parallel	test
compare	greatest	pattern	times
complete	group	penny	total
connect		place	triangle
corner	half	plus	true
count	height	point	
correct	hour	prime	unequal
curve		problem	unit
	identical	product	unlike
decrease	inside		
definition		quarter	value
diagonal	join		vertical
difference		rectangle	
digit	large	regrouping	weight
dime	least	remainder	whole
direction	length	reverse	width
distance	less	right	
divide	like	round	
division	line	row	

Sample Lesson -

Lesson title: General Math Words

Lesson objective:

Math vocabulary drill for familiarity.

Reading skill objective:

1. Identify word parts (prefixes, suffixes, and roots).
2. Determine origin - Latin or Greek.

- To achieve the reading objective, the teacher will:
Prepare the students the day before by discussing prefixes, suffixes, and roots of words of Latin and Greek origins.
- To achieve the lesson objective, the teacher will:
Provide a puzzle containing math words, a sheet providing outline of work to be done and dictionaries for reference. Provide oral instruction of a general nature discussing what to look for in a word and how to use the dictionary for the purposes of this lesson.

Evaluation -

- Achievement of reading skill will be evaluated by:
The student's ability to identify the word parts and meanings.
- Achievement of lesson objective will be evaluated by:
Checking the worksheets provided in this lesson.

Steps for Constructing a Word Search _____

1. Develop a list of words related to the topic being covered.
2. Make a grid large enough to fit all the words in.
3. Arrange the words in the grid horizontally, vertically, and diagonally, interlocking where possible.
4. Fill in the blank spaces with random letters. (Part or all of the word list may be provided to guide the student in the search.)

MATH WORD PUZZLE:

- bisect
- parallel
- polygon
- diagonal
- factor
- arc
- trig
- vertex
- finite
- proportion
- absolute
- log
- origin
- decimal
- joint
- integer
- median
- transversal
- multiples

A B S O L U T E V E R T E X
P A R A L L E L F A C T O R
O H O N R K W D E C I M A L
L I T D E M I Q C Z U P D C
Y N A F E R A S U W E M M I
G F R U F E C J I T R U D R
O I E R W A T O L B O L A C
N N M D L S W I A B P T E U
L I U E W R Q N T L I I R M
K T N S H M W T E O S P W F
K E P P E D W L R W B L V E
L U A D T J A W A I H E W R
O R I G I N R T L R G S V E
G A P R O P O R T X O N X N
N H F G I N T E G E R K D C
G C A U R L T N E N O P X E
G I T R A N S V E R S A L H
D J R T C H D L T C E S I B

Sample Lesson -

Lesson title: Geometry Vocabulary

Lesson objective:

To learn and show through demonstration some basic geometry terms.

Reading skill objective:

Using dictionary markings for word pronunciation and definitions, have students learn vocabulary.

To achieve the reading objective the teacher will:

Provide a worksheet with words and definitions for study (Worksheet I).

To achieve the lesson objective the teacher will:

Provide Worksheet II to demonstrate knowledge of vocabulary after students have studied the words.

Evaluation -

Achievement of reading skill will be evaluated by:

Observation of team work.

Achievement of lesson objective will be evaluated by:

Checking Worksheet II for correct answers.

GEOMETRY VOCABULARY WORKSHEET I:

Directions -

Study the pronunciation of the word. Use a dictionary if necessary. Say the word. Then read the meaning of the word carefully. Be sure you can use it. Work with a partner and take turns saying words out loud and reading the sentences.

1. When two straight lines meet, they form an *angle*.
2. The point at which two lines meet to form an angle is called the *vertex*.
3. A part of a curved line is an *arc*.
4. The distance from the center of a circle to any point in its *circumference* is the *radius*. *Radii* is the plural of radius.
5. A *sector* is the part of a circle bounded by an arc and two radii.
6. A line parallel to the horizon or perfectly level is *horizontal*.
7. A line which extends straight up and down is *vertical*.
8. An *oblique* line is neither vertical nor horizontal.
9. When two lines meet to form a square corner, each is *perpendicular* to the other.
10. A four-sided figure having equal angles and sides of equal length is a *square*.
11. A *triangle* is a three-sided figure.
12. A four-sided figure of which both pairs of opposite sides are parallel is called a *parallelogram*.

13. A four-sided figure of which only two sides are parallel is a *trapezoid*.
14. A *hexagon* is a plane figure with six sides.
15. Any plane figure enclosed by straight lines regardless of the number is a *polygon*.
16. The distance around any figure bounded by straight lines is the *perimeter*.
17. Equal in length, size, value, or amount makes things *equivalent*.

GEOMETRY VOCABULARY WORKSHEET II:

Directions -

See how well you know the meanings of the words you studied. Write or draw answers to the blanks below.

1. A figure with four equal sides is a _____.
2. The two circles are the same size. They are _____.
3. Susan measured the distance around the rectangle. She found its _____.
4. A plane figure that has six sides is known as a _____.
5. Draw a horizontal line:
6. Draw a vertical line:
7. Draw an oblique line:
8. Draw two lines that are perpendicular to each other:
9. Draw a parallelogram:
10. Draw a square:
11. Draw a triangle:
12. Draw two polygons:
13. Draw a trapezoid:
14. Draw an angle. Label the vertex and sides.
15. Draw a circle. Make a sector in it. Label the arc, the sector, and one of the radii.

Procedures for Cloze _____

Teacher -

- Prepare a cloze passage deleting selected terms, that is... if for vocabulary words studied, choose nouns, verbs, or adverbs.
- Introduce practice exercises to class prior to use as a measure. This must be teacher-directed. Instruct the students in the steps to success. Show them how to use context to determine an acceptable word.

Instructions for Students -

- Read the entire cloze passage silently. This allows you to look at the passage as a whole.
- Reread the selection, writing in the word you think fits the blank.
- Try to evaluate why you have chosen a word for the blank. (If the teacher has asked you to give a reason for your choice, write that in.) Does the word sound right? If so, it is usually right.

Follow-up -

Compare your completed paragraph with the original.

Teacher Follow-up -

Discuss the completed activity with the class. This will allow everyone to hear alternatives. If the choices are semantically and syntactically correct, they should be accepted (except where you demand the exact response). Point out context clues to provide students with useful reading techniques.

Preparation -

Selection:

Prose with quoted words not exceeding 10 words per 300 words of text.

Length:

For *testing* comprehension and vocabulary, use long selections of from 250 to 300 words, deleting at least 50 words.

For *teaching* vocabulary and concepts in context, use short selections of 50 to 150 words with 10 to 20 percent deletion.

Word deletion:

Random or every *n*th words. Random word deletion is best for most reading comprehension exercises. Nouns, verbs, and adverbs are best for study of vocabulary in most content areas. Conjunctions, pronouns, articles, and verb auxiliaries are of questionable value.

For 10 percent deletion, delete every 10th word; for 20 percent, delete every 5th word.

Administration - Students read silently.

Ages, time required:

Intermediate and secondary students. Untimed.

Scoring -

Exact word synonym:

Essential for concept and vocabulary testing purposes. Allowed when using cloze to determine if the student can understand the written materials of your classroom.

Score:

A minimum score of 60 percent should be expected to assure the student's understanding of the material. Divide total words into correct words.

$$\frac{.60 = 60\% \text{ comprehension cloze scores}}{50 \text{ total words} / 30 \text{ correct words}}$$

A Brief History of the Metre _____

Early units of measurement were based on the length of toes, hands, and other parts of the body. The king's measurements were very often used as the units of measure for everyone.

During the French Revolution which started in 1789, however, the fighting people cut off the king's head.

Then they wanted to do away with anything that had to do with the hated king, so the metric system was made. It wasn't easy to find a good standard unit of length, but finally French scientists agreed to use one ten-millionth part of the distance from the Equator to the North Pole. They used the line called a meridian that goes through Paris.

It took seven years to do the necessary measuring of the meridian, but the new unit was finally done in 1799. It was called a metre and is the same length used today.

The metric system was made the law in France in 1790, even before the measured metre was made. It didn't help the measurement problem, however. The common people were still very happy using the dead king's measurements and didn't want to change. Spies and police were used to make the people use the new system. To sell anything by the dozen or by 12s was a crime. Everything had to be bought by 10s. The people got so unhappy about the forced changes that in 1793, they cut off the head of the leader of the metric system. It didn't do any good, though. The metric system was there to stay and the people just learned to live with it after awhile.

This is a good lesson for the people in the United States. Even chopping off heads won't stop the metric system. No matter how hard we fight metrics, it is here to stay. We might as well learn to live with it sooner than later.

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Key Words in Written Directions _____

Key Words - Examples of how they can be used in mathematics:

1. *Explain* the process of division of fractions.
What is the process of division of fractions?
How does the process of division of fractions work?
Why does the process of division of fractions work?
2. *Describe* how to subtract signed numbers.
3. *Discuss* three different methods of finding square roots.
Give the processes involved in guess and check, division-average method, and calculation methods of finding square root. Give one advantage and one disadvantage of each.
4. *Define* a prime number.
5. *Compare* a composite number with a prime number.
In what two ways are they alike and in what two ways are they different?
6. *Enumerate* the steps in calculating square root.
7. *Prove* that $4 + 4 = 13$ five.
8. Outline the process or operation of long division.
9. Evaluate the idea of having rules to add signed numbers.
10. Summarize the three rules that can be applied to addition of signed numbers.
11. Simplify.

An Activity _____

Reading, Understanding, and Following Written Directions

Objective: To follow written directions.

Directions:

1. Read the directions that must be followed in order to complete the activity below.
2. Put all answers on another sheet of paper.
3. Read completely each step. Then do what it says.
4. If you are unable to complete the assignment by following these written directions, I will be happy to help you by giving oral directions. However, there is a limitation to these directions. I must be able to answer your questions with only "yes" or "no."

Steps:

1. For this investigation, cut three strips of paper two inches wide and eleven inches long.
2. Hold one end of a strip in one hand.
3. With your other hand, bring the two ends together.
4. Take one end, give it a half twist and tape the two ends together.
5. A band twisted this way is called a Moebius strip.
6. With your pencil, draw a line down the middle of the strip until you have gone its full length. Do you return to your starting point?
(1) _____.
7. On the basis of this experiment, how many surfaces does the strip have?
(2) _____.
8. Run your finger along one edge of the strip. How many edges can you trace?
(3) _____.
9. If you were to cut with a pair of scissors along the line you have drawn and continue to cut until you returned to your starting point, will you get two strips? (4) _____.
Will this cut add another edge? (5) _____.
Will this cut add another surface? (6) _____.
10. If you were to make two complete trips around the strip with one continuous cut, what would you predict will happen? (7) _____.
11. With your scissors, cut along the line you have drawn and continue to cut until you return to your starting point. What happened? (8) _____.
Does this agree with your prediction in answer 4? (9) _____.
12. Make a second Moebius strip. Cut it parallel to an edge one-third of the way into the strip. Continue cutting until you are back to your starting place.
13. What is the result? (10) _____.

14. How do your loops compare in length and width? (11) _____.
15. How does the result compare with your guess in answer 7? (12) _____.
16. Make a third Moebius strip.
17. Cut it one-fourth the distance from the edge until you return to the starting place.
18. What is the result? (13) _____.
19. How is it different from your other strips in length and width?
(14) _____.
20. Without cutting another strip, what do you think the results would be if you cut it in fifths? (15) _____.