



English Language Development in Mathematics

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Abstract

The English Language Development Institutes in Mathematics Content (ELDI-MC) provides up to 80 hours of professional development for teachers of English Learners in mathematics grades 4th-8th. The goal of the institute to make mathematics accessible to English Language students while simultaneously increasing English language development, improving students' mathematical content knowledge through the implementation of ELD strategies and ELD standards-based instruction, and the integration of language learning techniques.

ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 1

INTRODUCTION AND ASSESSMENT

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants are introduced to institute goals and objectives.
--

Focus Question

How do you design instruction based on the California Mathematics Standards with attention to ELD goals and strategies?

Mathematics

- | |
|---|
| <input type="checkbox"/> Introduction to the California Mathematics Standards |
|---|

Language

- | |
|---|
| <input type="checkbox"/> Discuss ELD goals and objectives for the institute |
|---|

Problem of the Day	Homework/Article
Dragons	<i>Cummins's Article: The Role of Primary Language Development in Promoting Educational Success for Language Minority Students</i> Adapted by Connie Williams

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

Addition and Subtraction of Whole Numbers		K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
UNDERSTAND AND DESCRIBE	<ul style="list-style-type: none"> Simple addition and subtraction 								
MEANING		<ul style="list-style-type: none"> Demonstrate meaning of addition and subtraction. Use inverse relationship of addition and subtraction. Show meaning of addition and subtraction. 	<ul style="list-style-type: none"> Identify: 1 more than, 1 less than, 10 more than, 10 less than. Know addition and subtraction facts to 20. 	<ul style="list-style-type: none"> Understand and use inverse relationship of addition and subtraction to solve problems. 		<ul style="list-style-type: none"> Understand relationships between operations. 			
FACTS									
COMPUTATION	<ul style="list-style-type: none"> Use concrete manipulatives to get answers with numbers <10 	<ul style="list-style-type: none"> Solve addition and subtraction with 1 and 2 digit numbers. Find the sum of three one digit numbers. 	<ul style="list-style-type: none"> Estimate, calculate, and solve problems with addition and subtraction. Sum or difference of 2 numbers, 3 digits long. Mental arithmetic with addition and subtraction. 	<ul style="list-style-type: none"> Calculate and solve problems with addition and subtraction. Sum or difference of numbers from 0 to 10,000. 	<ul style="list-style-type: none"> Estimate and compute addition and subtraction of whole numbers. Demonstrate an understanding of ability to use STANDARD ALGORITHM for addition and subtraction of multidigit numbers 				
PROBLEM SOLVING		<ul style="list-style-type: none"> Use addition and subtraction to solve problems. 							
ALGEBRAIC THINKING		<ul style="list-style-type: none"> Write and solve number sentences with addition and subtraction. Understand symbols +, -, =. Create problem situations that lead to number sentences. 	<ul style="list-style-type: none"> Model, represent and interpret. Use commutative and associative properties. Relate problem situation and number sentences. Solve from simple graphs, charts, and number sentences. 						

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	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
Multiplication and Division of Whole Numbers								
MEANING			<ul style="list-style-type: none"> Use repeated addition, arrays, counting by multiples to do multiplication. Use repeated subtraction, equal sharing, and forming equal groups with remainders to do division. 	<ul style="list-style-type: none"> Use inverse relationship to compute and check results. Understand the properties of 0 and 1 in multiplication and division. 	<ul style="list-style-type: none"> Solve problems and understand the relationships between the operations. 			
FACTS			<ul style="list-style-type: none"> Know multiplication tables of 2's, 5's, and 10's and commit to memory. 	<ul style="list-style-type: none"> Memorize to automaticity the multiplication tables from 1 to 10. 		<ul style="list-style-type: none"> Prime factorization of all numbers to 50 using exponents. 		
COMPUTATION			<ul style="list-style-type: none"> Model and solve simple problems in multiplication and division. 	<ul style="list-style-type: none"> Calculate and solve problems involving multiplication and division. Solve simple problems involving multiplication of multidigit numbers by 1 digit. Solve simple problems involving division of multidigit numbers by 1 digit evenly. 	<ul style="list-style-type: none"> Understand and use the STANDARD ALGORITHM for multiplying a multidigit number by a 2 digit number and divide a multidigit number by a 1 digit number. Use relationship to simplify computation and check results. 	<ul style="list-style-type: none"> Demonstrate proficiency with division → long division with multidigit divisors. 		
PROBLEM SOLVING				<ul style="list-style-type: none"> Determine unit cost if given total cost and number of units. Multiplication and division of money amounts in decimal notation by whole numbers 	<ul style="list-style-type: none"> Solve problems involving multiplication of multidigit numbers by 2 digit numbers. Solve problems involving division of multidigit numbers by 1 digit numbers. 			
ALGEBRAIC THINKING					<ul style="list-style-type: none"> Use and interpret formulas to answer questions about quantities. 			

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Fractions	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
FRACTION SENSE			<ul style="list-style-type: none"> Recognize, name, and compare unit fractions from $\frac{1}{12}$ to $\frac{1}{2}$. Recognize fractions of a whole and parts of a group. Know that when all fractional parts are included, the result is equal to the whole and to one. 	<ul style="list-style-type: none"> Compare fractions represented by drawings and concrete materials to show equivalents. 	<ul style="list-style-type: none"> Explain different interpretations of fractions: Parts of a whole Parts of a set Division of whole number by whole number Explain fraction equivalents. Write the fraction represented by a drawing of the parts of a figure. Represent a given fraction by using drawings. 	<ul style="list-style-type: none"> Identify and represent on a number line decimals, fractions, and mixed numbers. 	<ul style="list-style-type: none"> Compare and order positive and negative fractions. 	<ul style="list-style-type: none"> Convert fractions to decimals and use in estimations, computations, and applications. Differentiate between rational and irrational numbers.
RELATIONSHIP BETWEEN FRACTIONS AND DECIMALS				<ul style="list-style-type: none"> Know and understand that fractions and decimals are two representations of the same concept. 	<ul style="list-style-type: none"> Relate a given fraction to a simple decimal on a number line. Write tenths and hundredths in decimal and fraction notation for halves and fourths. Identify on a number line the relative position of fractions, mixed numbers, and decimals. 			
OPERATIONS				<ul style="list-style-type: none"> To add and subtract fractions in context. Add and subtract simple fractions. 		<ul style="list-style-type: none"> Solve simple problems including ones arising in concrete situations, involving the addition and subtraction of fractions and mixed numbers (like and unlike denominators of 20 or less) and express answers in simplest form. Understand the concept of multiplication and division of fractions. Compute and perform simple multiplication and division of fractions and apply these procedures to solving problems. 	<ul style="list-style-type: none"> Solve problems involving addition, subtraction, multiplication, and division of positive fractions and explain why a particular operation was used for a given situation. Explain the meaning of multiplication and division of positive fractions and perform the calculations. Determine the LCM and GCD of whole numbers and use them to solve problems with fractions. 	<ul style="list-style-type: none"> Add, subtract, multiply, and divide with rational numbers (integers, fractions, and terminating decimal). Add and subtract fractions by using factorings to find common denominators.

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ALGEBRA TOPICS	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
INTEGERS					<p>Increase facility with 4 operations with positive and negative integers.</p> <p>NS1.5: Identify and represent on a number line positive and negative integers.</p> <p>NS2.1: Add with negative integers; subtract positive integers from negative integers.</p>	<p>Master 4 operations with positive and negative integers.</p> <p>NS1.0: Compare and order positive and negative fractions, decimals, and mixed numbers.</p> <p>NS1.1: Compare and order positive and negative fractions, decimals, and mixed numbers on a number line.</p>		
TERMINOLOGY, VARIABLES, AND EXPRESSIONS				<p>AF1.1: Represent relationships of quantities in the form of mathematical expressions, equations, or inequalities.</p> <p>AF1.3: Select appropriate operational and relational symbols to make an expression true.</p>	<p>AF1.0: Use and interpret variables, mathematical symbols, and properties.</p> <p>AF1.1: Use letters, boxes, or other symbols to stand for any number in simple expressions or equations.</p>	<p>AF1.0: Write verbal sentences as algebraic expressions and equations; evaluate algebraic expressions.</p> <p>AF1.2: Write and evaluate an algebraic expression, using up to three variables.</p>	<p>AF1.0: Express quantitative relationships using algebraic terminology, expressions, equations, inequalities, and graphs.</p> <p>AF1.1: Use variables and appropriate operations to write an expression, an equation, an inequality, or a system of equations or inequalities.</p> <p>AF1.4: Use correct algebraic terminology.</p>	

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ALGEBRA STANDARDS	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
<p>1.0 – Properties of subsets of integers, rationals, irrationals, and real numbers (closure)</p> <p>1.1 – Use properties of numbers to show whether assertions are true or false.</p>			<p>AF1.1: Use the commutative and associative rules to simplify mental calculations and to check results.</p>	<p>NS2.6: Understand the special properties of 0 and 1 in multiplication and division.</p> <p>AF1.0: Select appropriate properties to represent, describe, simplify, and solve simple number relationships.</p> <p>AF1.5: Recognize and use the commutative and associative properties of multiplication.</p>	<p>AF1.0: Students use and interpret variables, mathematical symbols, and properties to write and simplify expressions and sentences.</p> <p>AF2.1: Know and understand that equals added to equals are equal.</p> <p>AF2.2: Know and understand that equals multiplied by equals are equal.</p>	<p>AF1.3: Know and use the distributive property in equations and expressions with variables.</p>	<p>AF1.3: Apply commutative, associative, and distributive properties to evaluate expressions.</p>	<p>NS1.0: Know the properties of rational numbers. CAHSEE</p> <p>NS1.1: Read, write, and compare rational numbers in scientific notation. CAHSEE</p> <p>NS1.2: Add, subtract, multiply, and divide rational numbers and take positive powers. CAHSEE</p> <p>AF1.3: Simplify numerical expressions by applying properties of rational numbers.</p>
<p>2.0 – Understand and use: take the opposite, find the reciprocal, take a root, raise to fractional power, and rules of exponents.</p>						<p>NS1.3: Understand and compute positive integer powers of nonnegative integers; compute examples as repeated multiplication.</p> <p>NS1.4: Prime using exponents.</p>		<p>NS2.0: Use exponents, powers, and roots and use exponents in working with fractions. CAHSEE</p> <p>NS2.1: Multiply and divide expressions involving exponents with a common base. CAHSEE</p> <p>NS2.3: Multiply, divide, and simplify rational numbers by using exponent rules. CAHSEE</p> <p>NS2.4: Use the inverse relationship between raising to a power and extracting the root of a perfect square integer; for an integer that is not square, determine without a calculator the two integers between which its square root lies and explain why. CAHSEE</p> <p>AF2.0: Interpret and evaluate expressions involving integer powers and simple roots. CAHSEE</p> <p>AF2.1: Interpret positive whole-number powers as repeated multiplication and negative whole-number powers as repeated division or multiplication by the multiplicative inverse. Simplify and evaluate expressions that include exponents. CAHSEE</p> <p>AF2.2: Multiply and divide monomials; extend the process of taking powers and extracting roots to monomials when the latter results in a monomial with an integer exponent. CAHSEE</p>

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ALGEBRA STANDARDS	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
<p>3.0 – Students solve equations and inequalities involving absolute values.</p>								<p>NS2.5: CAHSEE Understand the meaning of the absolute value of a number; interpret the absolute value as the distance of the number from zero on a number line; and determine the absolute value of real numbers.</p>
<p>4.0 – Students simplify expressions before solving linear equations and inequalities in one variable, such as $3(2x-5) + 4(x-2) = 12$.</p>					<p>AF1.2: Interpret and evaluate mathematical expressions that now use parentheses. AF1.3: Use parentheses to indicate which operation to perform first when writing expressions containing more than two terms and different operations.</p>		<p>AF1.1: Write and solve one-step linear equations in one variable. AF1.3: Apply algebraic order of operations and the commutative, associative, and distributive properties to evaluate expressions; and justify each step in the process. AF1.4: Solve problems manually by using the correct order of operations or by using a scientific calculator.</p>	<p>AF1.2: CAHSEE Use the correct order of operations to evaluate algebraic expressions such as $3(2x + 5)$.</p>

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ALGEBRA STANDARDS	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
<p>5.0 – Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.</p>			<p>AF1.3: Solve addition and subtraction problems by using data from simple charts, picture graphs, and number sentences.</p>	<p>AF1.2: Solve problems involving numeric equations or inequalities. AF2.1: Solve simple problems involving a functional relationship between two quantities. AF2.2: Extend and recognize a linear pattern by its rules.</p>	<p>AF2.0: Know how to manipulate equations.</p>	<p>AF1.5: Solve problems involving linear functions with integer values; write the equation; and graph the resulting ordered pairs of integers on a grid.</p>	<p>AF1.0: Solve simple linear equations, then graph and interpret the results.</p>	<p>AF4.0: CAHSEE Students solve simple linear equations and inequalities over the rational numbers. AF4.1: CAHSEE Solve two-step linear equations and inequalities in one variable over the rational numbers, interpret the solution or solutions in the context from which they arose, and verify the reasonableness of the results.</p>
<p>B 6.0 – Students graph a linear equation and compute the x- and y-intercepts (e.g., graph $2x + 6y = 4$). They are also able to sketch the region defined by linear inequality (e.g., they sketch the region defined by $2x + 6y < 4$).</p>					<p>AF1.5: Understand that an equation such as $y = 3x + 5$ is a prescription for determining a second number when a first number is given.</p>	<p>AF1.1: Use information taken from a graph or equation to answer questions about a problem situation. AF1.4: Identify and graph ordered pairs in the four quadrants of the coordinate plane. AF1.5: Solve problems involving linear functions with integer values; write the equation; and graph the resulting ordered pairs of integers on a grid.</p>	<p>AF1.0: Solve simple linear equations, then graph and interpret the results.</p>	<p>AF1.0: CAHSEE Use variables in simple expressions; compute value of expressions for values of variables; plot and interpret results. AF1.5: CAHSEE Represent quantitative relationships graphically. AF3.0: CAHSEE Graph and interpret linear and some nonlinear functions.</p>

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ALGEBRA STANDARDS	K	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th
<p>B 7.0 – Verify that a point lies on a line, given an equation of the line. Students are able to derive linear equations by using the point-slope formula.</p> <p>Geometric Connections</p>			Recognition of fractions.	Fraction representation.				<p>AF3.3: Graph linear functions, noting that the vertical change (change in y-value) per unit of horizontal change (change in x-value) is always the same.</p> <p>AF3.4: Plot the values of quantities whose ratios are always the same. Fit a line to the plot and understand that the slope of the line equals the quantities.</p>
					<p>AF1.4: Use and interpret formulas to answer questions about quantities and their relationships.</p>		<p>AF3.0: Investigate geometric patterns and describe them algebraically.</p> <p>AF3.1: Use variables in expressions describing geometric quantities (formulas).</p> <p>AF3.2: Express in symbolic form simple relationships arising from geometry.</p>	

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ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 2

INTRODUCTION TO PATTERNS

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants explore simple repeating patterns. Today is the foundation for the rest of the institute.

Focus Question

How do you plan to integrate the ELD Standards into your daily instruction of rigorous mathematics?

Mathematics

- Describe, extend, and explain ways to get to a next element in simple repeating patterns
- Explore functions

Language

- Introduction to the CA English Language Development Standards
- Integrate second language acquisition theory and mathematics by examining how the use of manipulatives strengthen the internal representations that students make with prior and newly acquired knowledge
- Examine Cummins' Quadrants and the implication for teaching EL students

Problem of the Day

Kisses

Homework/Article

Adapting mathematics Instruction for English Language Learners – The Language-Concept Connection
Leslie Garrison
Jill Kerper Mora

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

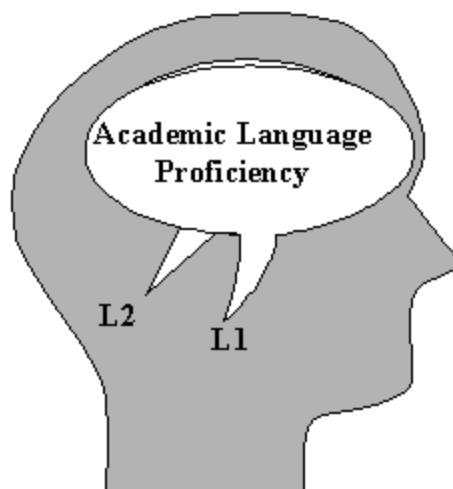
Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

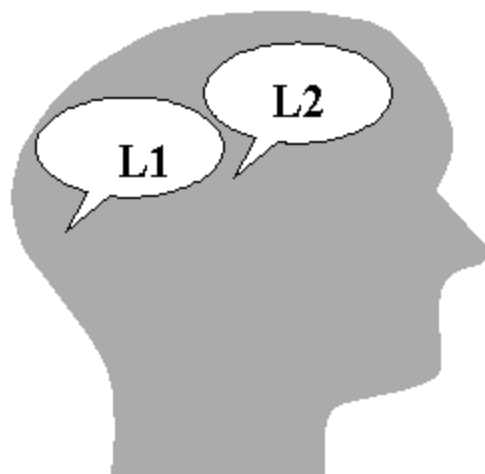
Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

Common Underlying Proficiency



Separate Underlying Proficiency



BICS / CALP

BICS and CALP in a nutshell.

	B.I.C.S.	C.A.L.P.
What the acronym stands for:	Basic Interpersonal Communication Skills	Cognitive Academic Language Proficiency
Sources in English for students:	Conversation, jokes, informal interactions, ESL instructions	Lectures, textbooks, literature, SDAIE instruction
Degree of Transfer from L1 to L2:	Little	Extensive
When developed in L1	Mostly by age 5 or 6 (with or without schooling)	Continues to develop throughout life, as long as there is cognitive growth
When developed in L2 (when students catch up with English-only students)	After 2-3 years of optimum comprehensible input	After 5-7 years of optimum schooling
Correlation with academic success	Little	High

L₁ = students' first language (Spanish, Chinese, Japanese, Arabic, etc.)

L₂ = English

ILLUSTRATION OF DR. JIM CUMMINS' GRID (4 QUADRANTS)

Cognitively Undemanding (BICS)

Initial levels ESL?
 Total Physical Response
 Following Directions
 Face-to-Face Conversation
 Getting Absence Excuse
 Buying popcorn
 Oral Presentations
 Content Classes (Art,Music)

Telephone Conversation
 Note on the Refrigerator
 Written Directions, Instructions
 (No diagrams or illustrations)

Context Embedded	A	C	Context Reduced
	B	D	
Demonstrations, Experiments A-V Assisted Lessons Plane Geometry Projects and Activities Health Instruction Social Studies Science Experiments		Standardized Tests CTBS, SAT 9, CAT6 Reading / Writing Math Concepts and Applications Explanations of New Abstract Concepts Lecture with few Illustrations Social Science Texts Mainstream English Texts Most Content Classes	

Cognitively Demanding (CALP)

All of the activities above the solid black line (included in quadrants A and C) fall into the category that Dr. **Cummins** calls Basic Interpersonal Communicative Skills or BICS. As you can see the activities in quadrant A are context rich (as indicated by being left of the dotted line). In quadrant A you receive context clues to help with understanding. In quadrant C, you receive less or none of the context clues to help you (as indicated by being right of the dotted line). However none of the activities in either A or C are cognitively demanding.

When you go to the activities below the solid black line, you find activities which are cognitively demanding. The activities in quadrant B are cognitively demanding but they are also context embedded. You receive context clues to help you with understanding. To the contrary, the activities found in quadrant D are context reduced meaning that you won't have context clues to assist with understanding.

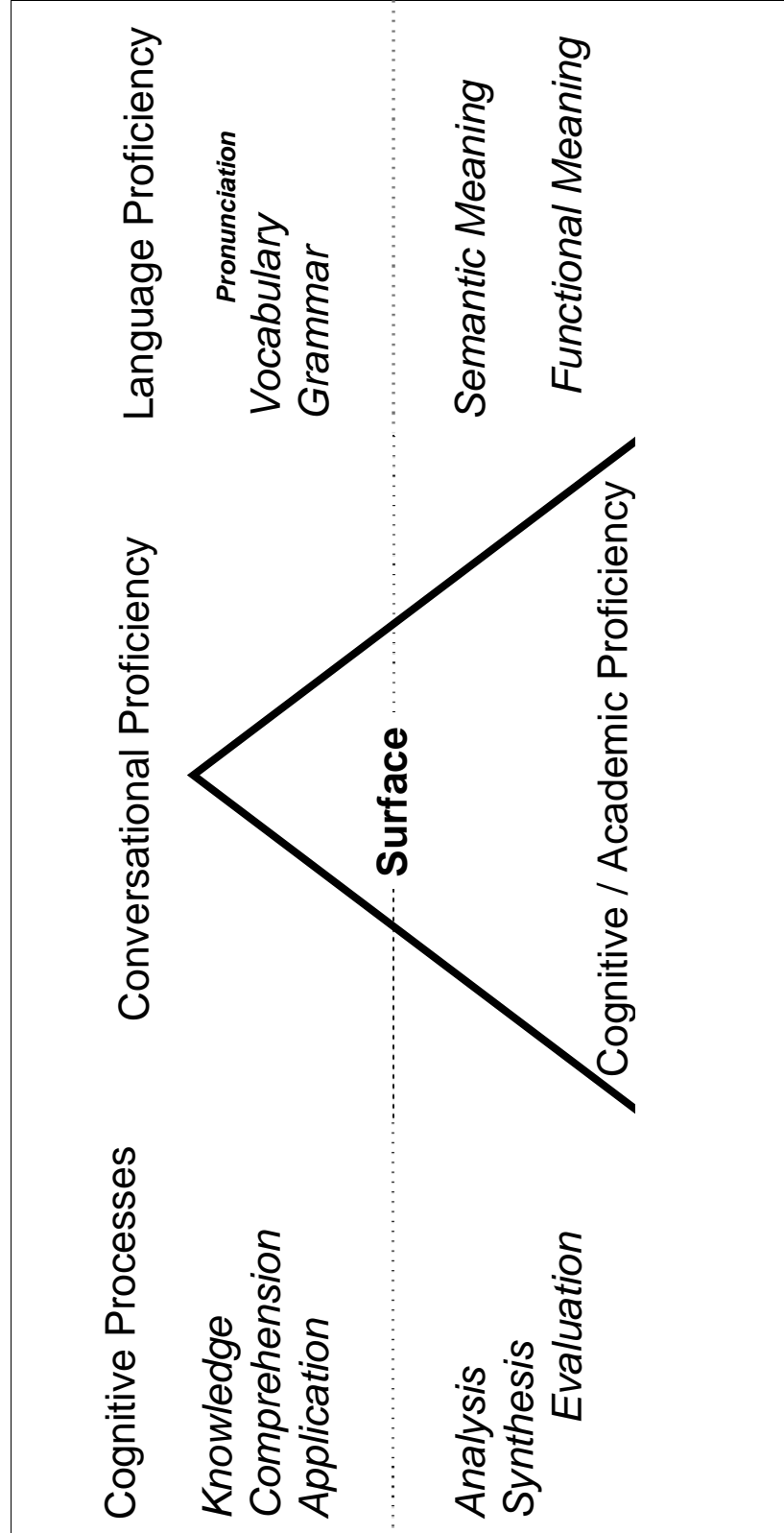
The ultimate goal is to take students from quadrant A, where they have conversational skills but still need context clues to comprehend well, to quadrant D where they will have success with cognitively demanding tasks without context clues.

How do you do that?

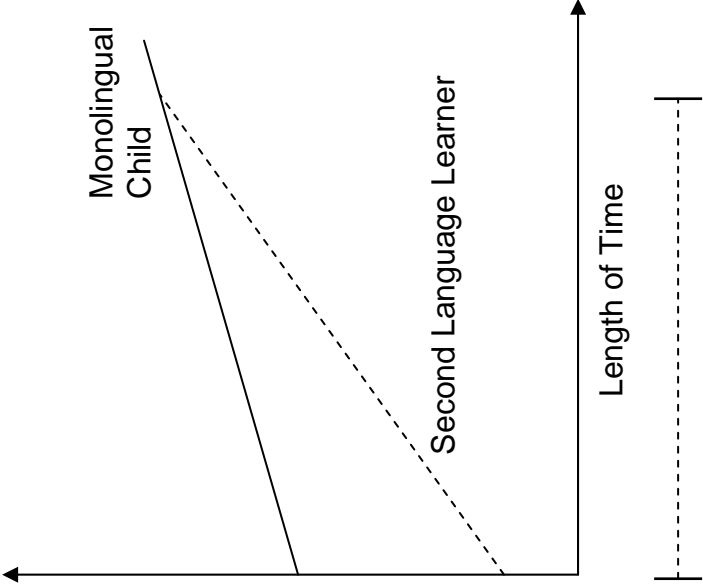
The answer lies in quadrant B where students receive instruction in cognitively demanding grade level tasks but still have the support from specially designed instruction to assist them with understanding. This is why SDAIE instruction is so important for the student who is limited in English, and why teachers must provide context rich instruction.

Also, it is important to understand that a student may exhibit language which appears fluent in general conversational settings, but who may still have difficulty in academic settings. He may have the basic fluency to be successful with cognitively undemanding tasks but may lack the literacy required for academically and cognitively demanding activities. The teacher needs to be aware of the needs of the English Language Learner in order to design the instruction with all of the supports needed. With that support in place the student will eventually be able to move into quadrant D activities with great success.

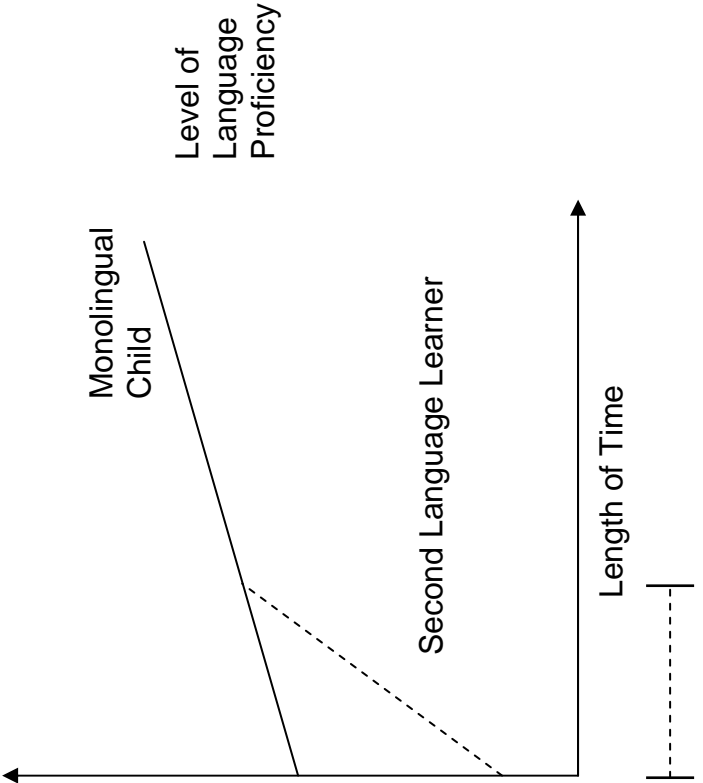
FOUNDATIONS OF BILINGUAL EDUCATION



LEVELS OF LANGUAGE PROFICIENCY COMPARISON

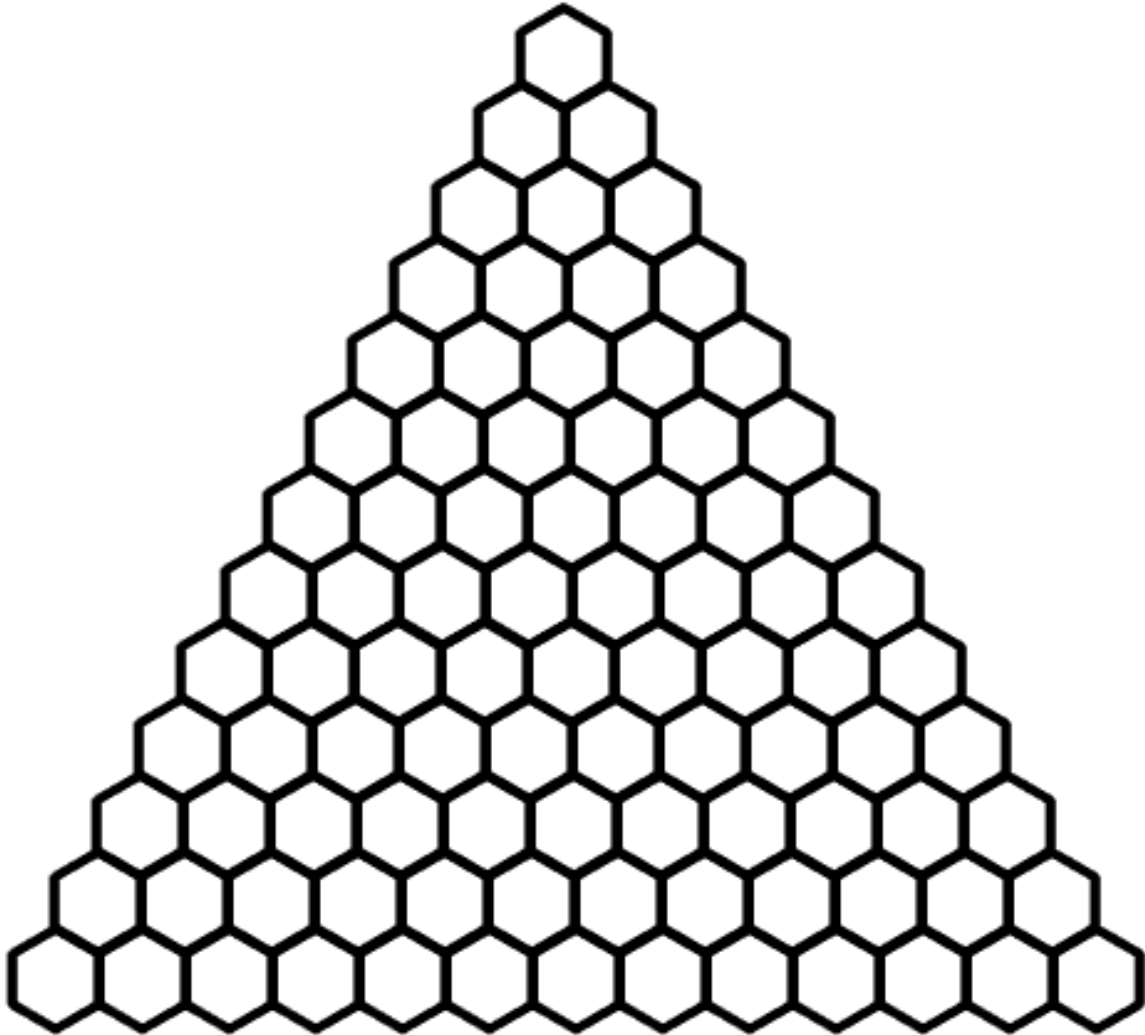


It takes approximately **five to seven years** for the second language learner to reach the same level of proficiency as a monolingual in **context reduced** language proficiency.



It takes approximately **two years** for the second language learner to reach the same level of proficiency as a monolingual in **context embedded** language proficiency.

PASCAL'S TRIANGLE



PASCAL

LAUNCHER OF THE COMPUTER AGE

Biographical Information:

Blaise Pascal (pahs-KAHL) was born on June 19, 1623 in Clermont-Ferrand, France. His father worked for the government as a lawyer and also was a gifted mathematician. Pascal's mother dies when he was only three, so he and his two sisters were raised by their father. Pascal was a sickly child, and suffered from debilitating problems throughout his life.

When Pascal was seven years old, the family moved to Paris. Although the young genius was educated at home, Paris provided many opportunities for intellectual stimulation, including attendance at meetings of the prestigious French academy.

Pascal never married, dedicating his life to creative work in mathematics, physics, philosophy, and religion. He died in 1662, at the age of 39, of a malignant stomach ulcer.

Contributions:

Pascal made a significant impact on geometry and other branches of mathematics, but he left an equally profound mark on theology and philosophy. He invented and sold the first adding machine. His studies in hydrostatics made possible the syringe and hydraulic press, and his interest in probability theory opened a whole new field of mathematics. Pascal's interests ranged from the very practical, such as designing a wheelbarrow, to the deeply introspective, such as exploring the nature of pain. His most famous work is *Pensees*, ("Thought"), a collection of personal meditations.

Quotations by Pascal:

"All the troubles of man come from his not knowing how to sit still."

What goes beyond geometry goes beyond man."

There is a God-shaped vacuum in the heart of each person which cannot be satisfied by any created thing, but only by God, the creator."

"I have made this letter longer than usual because I lacked the time to make it short."

Anecdotes:



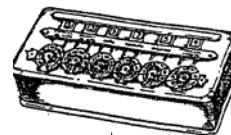
Child Prodigy

One day Pascal's father came home to find his young son doing geometry on the floor with a piece of charcoal. Without formal schooling or even access to books, the 12-year old had rediscovered many of the geometric properties described by Euclid. Immediately, his father provided Pascal with books on mathematics, thus unlocking a world of fascination for his son.

The First Calculator

When Pascal was 17, his father's job involved considerable tax accounting. Every evening, the elder Pascal labored over his books, trying to get the accounts to balance. His son determined to find an easier way to handle the long columns of computations, and set out to design an "arithmetic machine" to do the tedious sums.

After much experimentation, Pascal succeeded in building the first calculator, a contraption which used gears to add and subtract. Because of its high price, not many workers could afford the machine, but over 50 of them were manufactured. A copy was given to the king, and of course, one was used regularly by Pascal's father, which found his burden greatly relieved.



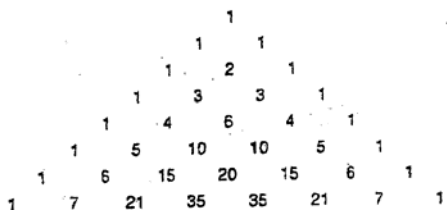
A Computer Language

Pascal's contemporaries considered his adding machine his greatest achievement. Today, experts in technology have acknowledged the important contribution Pascal made by naming a computer after him. "Pascal" is a high level computer language designed largely by Niklaus Wirth at Zurich in the early 1970's.

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HISTORICAL CONNECTION IN MATHEMATICS

PASCAL

LAUNCHER OF THE COMPUTER AGE



Pascal's Triangle:

Like most good mathematicians and scientists, Pascal recognized the importance and power of patterns. He spent much time exploring and writing about the "arithmetic triangle," a triangular array of numbers which had been handed down by Chinese mathematicians centuries earlier. He discovered so many new properties of the triangle, and solved so many problems using it, that the triangle became known as "Pascal's Triangle."

A Convincing Conversion

One day as Pascal was out driving, his horses became spooked and bolted over the wall of the bridge at Neuilly. Fortunately, the braces broke and Pascal's carriage dangled on the precipice as the horses plunged to their deaths. He interpreted this as a sign: he would give himself fully to religion, forsaking his work in mathematics and science.



The Toothache Remedy

For a time, Pascal completely gave up his work in mathematics and science to devote himself to theology. He promised God not to even think about his earlier pursuits.

During this period, Pascal was struck by a terrible toothache which nothing seemed to relieve. In a desperate effort to take his mind off the pain, he allowed himself to think about the cycloid, the curve traced by a point on a circle as the circle rolls along a straight line. Suddenly, Pascal noticed that his toothache was gone! He took this as a sign that it was permissible to study the cycloid, and devoted the next eight days to exploring its many properties. In this time, he succeeded in solving many of the problems connected with the cycloid which had baffled his contemporaries for years. He found, for instance, that the cycloid curve is the fastest path between two non-vertical points and the two steel balls,

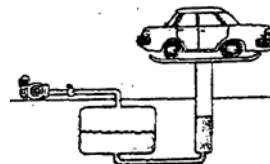
placed at different points on the curve, will always reach the end at the same moment.

Gambling Leads to God

Pascal first became interested in probability when some friends approached him with a gambling question. It seems they had been losing money and they hoped the mathematician could help turn their luck around. Although he was not personally interested in gambling, Pascal's correspondence with Fermat on this subject led to the development of probability theory.

Pascal's Wager

One application of Pascal's probability theory is seen in "Pascal's wager." In this argument, Pascal expressed the conviction that belief in God is rational: if God does not exist, one will lose nothing by believing in him anyway, whereas if he does exist, one stands to lose everything by not believing.



An application of Pascal's discoveries

Practical Projects

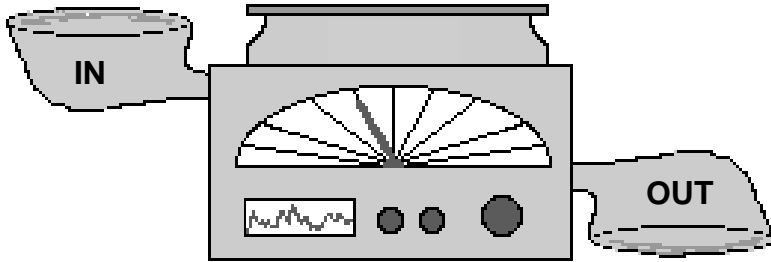
Much of Pascal's theoretical findings have had very practical applications in the modern world, but even during his lifetime he was concerned with solving problems in his community. His work with fluid pressure led to the development of hydraulic systems. He is credited with inventing the one-wheelbarrow. During his last years, Pascal designed a public transportation system for the city of Paris. The plan was actually utilized for the first time in 1662, the year Pascal died.

Pensees

Pascal often wrote his thoughts in brief fragments, sometimes on small scraps of paper. After his death, his sister, Gilberte, found his desk drawers and closets cluttered with these profound but disorganized insights. Together with others, she arranged them as best she could, and published them as *Pensees*, Pascal's best known work.

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HISTORICAL CONNECTION IN MATHEMATICS

A FUNCTION MACHINE



IN	OUT
5	11
6	12
9	15
8	
12	
10	

QUICKWRITE

Write what you know about ELD, content-based ELD, and Standards-based lessons, including questions or concerns you may have

What I know about ELD, etc.	Questions & concerns	What I Learned

English Language Development (ELD)

English language Development (ELD), a curricular subject, is the teaching of English. It is sometimes called “English as a Second Language” or “ESL.” English Language Development is a broader term in that it refers to all of the aspects of literacy in English and not just oral language fluency. Included in ELD are Listening, Speaking, Reading, and Writing. The measurement tool that is used in California to determine the level of development in English is called the California English Language Development Test or CELDT. The levels determined by the CELDT are Beginning, Early Intermediate, Intermediate, early Advanced, and Advanced. The state ELD standards are used as a guide to bring the student from beginning levels to advanced levels of fluency and literacy in English, eventually enabling the student to participate in mainstream English Language arts.

Content-Based English language Development (ELD)

Current research shows that the most effective English Language Development programs are those that use content rich materials during ELD instruction. The reason for this that not only is the instruction developing basic interpersonal communication skills, or what Dr. Jim Cummins calls BICS, but it is also developing academic language and vocabulary, leading to Cognitive Academic Language Proficiency.

Specially Designed Academic instruction in English (SDAIE)

SDAIE is a methodology used for **grade level appropriate content instruction** in English. It is used to enable Limited English Proficient students to access the core curriculum that is defined by the grade level standards for each curricular area. *(As you know, during ELD time the content is lowered to levels below the grade level of the student to make the English being taught more comprehensible, but during math, science, history, geography, and other content area instruction we never lower the level of the content being taught, rather, we use special strategies to make the grade level content accessible to the English Learner.)* SDAIE includes such strategies as modified teacher speech, frequent comprehension checks, modified assessment, hands-on projects, cooperative work, repetition of key vocabulary, use of visuals, graphic organizers, etc. SDAIE is not intended to replace primary language content instruction; in fact, primary language literacy is a prerequisite for effective SDAIE.

ELD Standards Support Activities – MATH

Listening & Speaking	
Language Fluency Level	ELD Standards
Intermediate	<p>• The student will respond to messages by asking simple questions or a brief restatement of the message.</p> <p>• The student will listen attentively to stories/information and identify key details and concepts using both verbal and non-verbal responses.</p> <p>• The student will actively participate in social conversation with peers and adults on familiar topics by asking and answering questions and soliciting information.</p> <p>• The student will identify the main idea and some supporting details of oral presentations, familiar literature pieces, and key concepts of subject matter content.</p> <p>• The student will identify a variety of media messages and give some supporting details (e.g. radio, television, movies).</p> <p>• The student will prepare and deliver short presentations on ideas, premises, or images obtained from a variety of common sources.</p> <p>• The student will prepare, ask, and respond to basic interview questions.</p>
Early Advanced	<p>• Oral written presentation on major mathematical concepts (Ex. Pythagorean, Families of Graph, etc)</p> <p>• Power point presentation, write paragraph using concept Vocab.</p> <p>• Conducting surveys</p> <p>• The student will summarize literary pieces in greater detail, including character, setting, plot, and analysis.</p> <p>• The student will actively participate and initiate more extended social conversations with peers and adults on unfamiliar topics by asking and answering questions, restating, and soliciting information.</p> <p>• The student will recognize appropriate ways of speaking that vary based on purpose, audience, and subject matter.</p> <p>• The student will respond to messages by asking questions, challenging statements, or offering examples that affirm the message.</p> <p>• The student will use simple figurative language and idiomatic expressions to communicate ideas to a variety of audiences (e.g. "sunshine girl," "heavy as a ton of bricks").</p> <p>• The student will prepare and deliver presentations that follow a process of organization and use a variety of sources.</p> <p>• The student will prepare and deliver brief oral presentations/reports on historical investigations, problem/solution or a cause/effect.</p>
	<p>Activities to Support the Standard</p> <ul style="list-style-type: none"> • Ask questions orally in complete sentence. • Oral presentations where they repeat what they have learned. • Questioning students during and after instruction. • Create activities in which the students ask questions. • Discuss word problems • Students work in cooperative groups. • Re-explain process and concept to partners in cooperative pairs
	<ul style="list-style-type: none"> • Projects completed by collaborative groups. • Statistical surveys where they interact with adults. • Reading comprehension and theme problems. • Create activities/surveys in which the students need to present their findings. • In solving systems of equation, student s are required to solve a word problem and present their situation • IMP presentation • Math A-Probability/stat survey presentation

ELD Standards Support Activities – MATH		
Listening & Speaking		
Language Fluency Level	ELD Standards	Activities to Support the Standard
Advanced	<ul style="list-style-type: none"> The student will demonstrate understanding of figurative language and idiomatic expressions by responding to and using such expressions appropriately. 	
	<ul style="list-style-type: none"> The student will identify strategies used by the media to present information for a variety of purposes (e.g. to inform, entertain, or persuade). 	
	<ul style="list-style-type: none"> The student will negotiate and initiate social conversations by questioning, restating, soliciting information, and paraphrasing. 	

Reading: Word analysis – Phonemic Awareness

Language Fluency Level	ELD Standards	Activities to Support the Standard
Intermediate	<ul style="list-style-type: none"> The student will apply knowledge of common English morphemes in oral and silent reading to derive meaning from literature and texts in content areas. 	<ul style="list-style-type: none"> Review root meaning (e.g. “mono, “bi,” and “poly”).
	<ul style="list-style-type: none"> The student will identify and distinguish between cognates and false cognates in literature and texts in content areas (e.g. cognate – agonia, agony; false cognate – éxito, exit). 	<ul style="list-style-type: none"> I.D. false & true statements in geometry.
	<ul style="list-style-type: none"> The student will apply knowledge of word relationships such as roots and affixes to derive meaning from literature and texts in content areas (e.g. remove, extend). 	<ul style="list-style-type: none"> Understanding new vocab, using new concepts. Taking notes.
Advanced	<ul style="list-style-type: none"> All of the above. 	<ul style="list-style-type: none"> Projects completed by collaborative groups. Statistical surveys where they interact with adults.

ELD Standards Support Activities – MATH

Reading: Fluency and Vocab. development	
Language Fluency Level	Activities to Support the Standard
Intermediate	<p style="text-align: center;">ELD Standards</p> <ul style="list-style-type: none"> • The student will use a standard dictionary to derive meanings of unknown vocabulary. • The student will identify variations of the same word that are found in a text. • The student will interpret meaning of idioms, analogies, and metaphors. • The student will demonstrate internalization of English grammar, usage, and word choice, by recognizing and correcting some errors when speaking or reading aloud. • The student will use decoding skills and knowledge of vocabulary, both academic and social, to read independently. • The student will use knowledge of English morphemes, phonics, and syntax to decode and interpret the meaning of unfamiliar words.
Early Advanced	<ul style="list-style-type: none"> • Solving word problems • Making notes independently • College Prep Math tools kits <ul style="list-style-type: none"> • Translating English sentences to Math equations • Solving word problems with equations • In geometry particularly, students develop the vocabulary of mathematics. Often words have specialized math meanings. (e.g. Learn when “less than/ore than” mean “+/- or </>”). <ul style="list-style-type: none"> • Provide background in basic geometry, vocabulary in notes.
Advanced	<ul style="list-style-type: none"> • The student will use knowledge of affixes, roots, and increased vocabulary to interpret meaning of words in literature and texts in content areas. • The student will use standard dictionary to determine meanings of unknown words (e.g. idioms and words with multiple meanings). • The student will use decoding skills and knowledge of academic and social vocabulary to achieve independent reading. • The student will use idioms, analogies, and metaphors in literature and texts in content areas. • The student will read increasingly complex narrative and expository texts aloud with appropriate pacing, intonation, and expression. • The student will use words appropriately that sometimes have multiple meanings and apply this knowledge consistently to literature and texts in content areas. • The student will apply knowledge of academic and social vocabulary to achieve independent reading. • The student will use common idioms and some analogies and metaphors (e.g. “shine like a star,” “let the cat out of the bag”).

ELD Standards Support Activities – MATH

Reading: Comprehension, Analysis & Expository Critique

Language Fluency Level	ELD Standards	Activities to Support the Standard
Intermediate	<ul style="list-style-type: none"> • The student will present a brief report which verifies and clarifies facts presented in two to three forms of expository text. • The student will read and use detailed sentences to orally identify the main ideas and use them to make predictions about informational materials, literary text, and text in content areas. • The student will understand and orally explain most multi-step directions for simple mechanical devices and for simple applications. • The student will listen to an expert from a brief political speech and give an oral critique of the author's evidence using simple sentences. • The student will read and orally identify the structure and format of workplace documents (e.g. graphics and headers) and give one brief example of how authors use the feature to achieve their purpose. • The student will read and use simple sentences to orally identify the features of rhetorical devices of simple excerpts of public and workplace documents and content text. 	<ul style="list-style-type: none"> • Math word problems, multi-step problems; e.g. surface area of solids.
Early Advanced	<ul style="list-style-type: none"> • The student will apply knowledge of language to achieve meaning/comprehension from informational materials, literary texts, and text in content areas. • The student will analyze the structure and format of workplace documents, and how the authors use the features to achieve their purpose. • The student will prepare and oral and written report which evaluates the credibility of an author's argument or defense of a claim (include a bibliography). • The student will read and analyze how clarity is affected by patterns of organization, repetition of key ideas, syntax, and word choice. • The student will analyze the features and rhetorical devices of at least two types of public documents (e.g. warranties, contracts, manuals, magazines, and textbooks). 	<ul style="list-style-type: none"> • Group Tests.
Advanced	<ul style="list-style-type: none"> • The student will apply knowledge of language to achieve meaning/comprehension from informational materials, literary text, and text in content areas. • The student will analyze the features and rhetorical devices of different types of public documents and how the authors use these features and devices. • The student will analyze how clarity is affected by patterns of organization, hierarchical structures, repetition of key ideas, syntax, and word choice in text across content areas. • The student will prepare an oral and written report which evaluates the credibility of an author's argument or defense of a claim by critiquing the relationship between generalizations and evidence. Prepare a bibliography for the report. • The student will prepare a brief research or synthesizing paper in which content areas and ideas are analyzed from several sources to present a coherent argument or conclusion, including proper format and bibliography 	

ELD Standards Support Activities – MATH

Writing: Penmanship, Organization & Focus, research, Revision & Evaluation			
ELD Standards	Activities to Support the Standard		
Language Fluency Level Intermediate	<ul style="list-style-type: none"> The student will narrate a sequence of events and communicate their significance to the audience. The student will write brief expository compositions and reports of information that: a) include a thesis and some supporting details; b) provide information from primary sources; and c) organize and record information on charts and graphs. The student will recognize elements of characterization in a piece of writing and apply them when writing. The student will write responses to selected literature that exhibit understanding of the text using detailed sentences and transitions. The student will recognize structured ideas and arguments and their supporting examples in persuasive writing. The student will use complex sentences to write brief fictional biographies and short stories that include a sequence of events and provide supporting details. The student will use basic strategies of note taking, outlining, and the writing process to structure drafts of simple essays, with consistent use of standard grammatical form (some rules may not be evident). 	<ul style="list-style-type: none"> Create activities in which students need to explain the order/sequence of their findings. 	
	<ul style="list-style-type: none"> The student will investigate and research a topic in a content area and develop a brief essay or report that includes source citations. 	<ul style="list-style-type: none"> Create activities in which the students need to investigate and then present or inform the class. Research a mathematician and write a report about them. Research on-line a topic for power point presentations. 	
	<ul style="list-style-type: none"> The student will identify various elements of discourse in writing (e.g. purpose, speaker, audience, form). 	<ul style="list-style-type: none"> Portfolio cover letters. Presentation of POW (problem of the week). 	
	<ul style="list-style-type: none"> The student will develop a clear thesis and support it using the rhetorical devices of analogies, quotations, and facts. 		
	<ul style="list-style-type: none"> The student will write persuasive compositions that structure ideas and arguments in a logical way with consistent use of standard grammatical forms. 		
	<ul style="list-style-type: none"> The student will use appropriate language variations and genres in writing for language and other content areas. 		
	<ul style="list-style-type: none"> The student will write reflective compositions that explore the significance of events. 		
	<ul style="list-style-type: none"> The student will write detailed fictional biographies or autobiographies. 		
	<ul style="list-style-type: none"> The student will use strategies of note taking, outlining, and summarizing to structure drafts of clear, coherent, and focused essays with consistent use of standard grammatical forms. 		
	<ul style="list-style-type: none"> The student will write expository compositions and reports of information that convey information from primary and secondary sources and some technical terms. Use appropriate tone and voice based on purpose, audience, and subject matter. 		
Early Advanced			

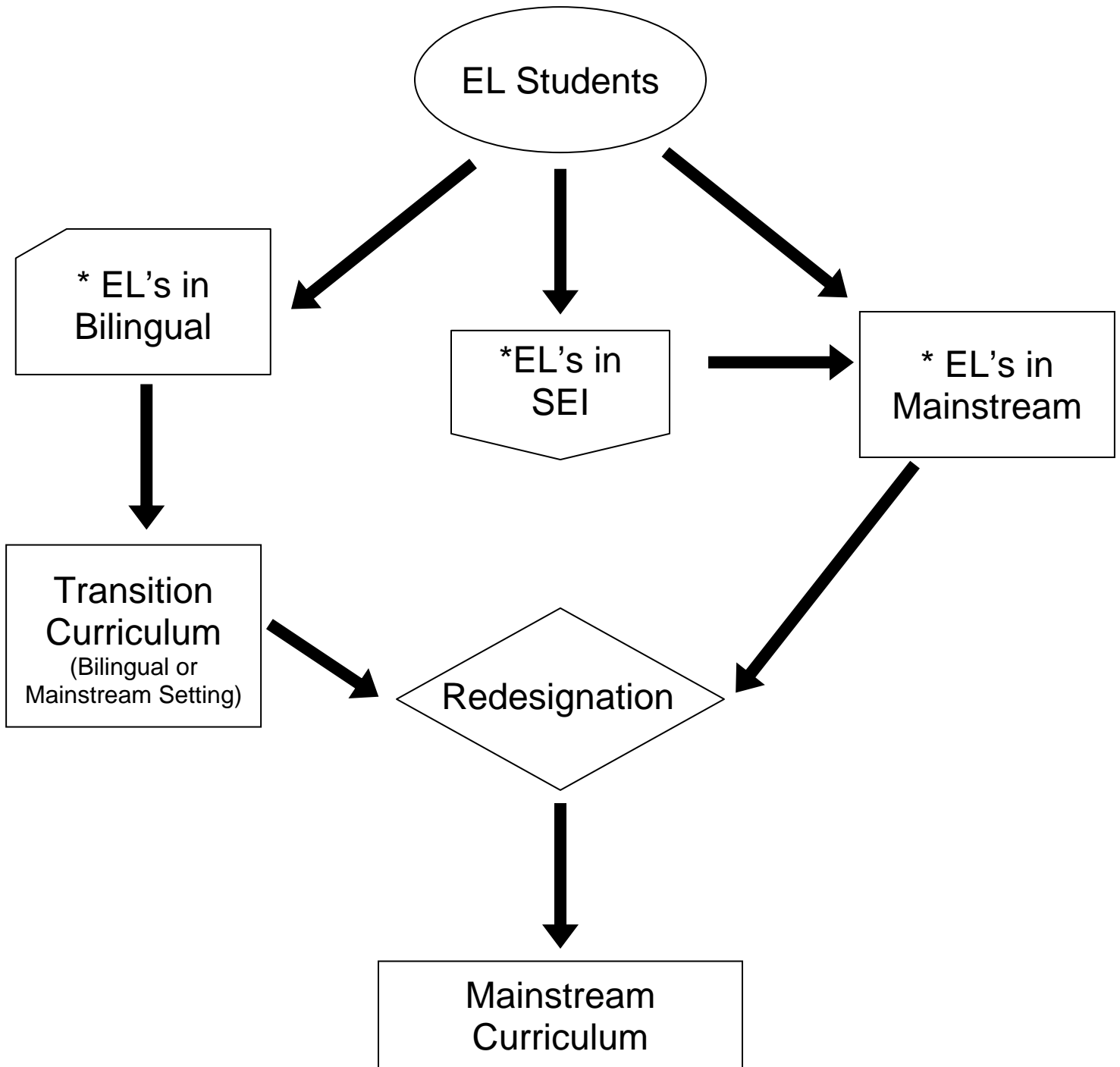
ELD Standards Support Activities – MATH		
Language Fluency Level	ELD Standards	Activities to Support the Standard
Advanced	<ul style="list-style-type: none"> The student will write persuasive and expository compositions that include a clear thesis, describe points of support, and address counter arguments. 	
	<ul style="list-style-type: none"> The student will produce writing that establishes a controlling impression or thesis. 	
	<ul style="list-style-type: none"> The student will structure ideas and arguments within a given context giving supporting and relevant examples. 	<ul style="list-style-type: none"> Geometric Proofs. POW's write report – describe answer, solution, how they got it, <u>convince</u> others their solution is correct.
	<ul style="list-style-type: none"> The student will produce writing using various elements of discourse (e.g. purpose, speaker, audience, form), in narrative, expository, persuasive, informational, and/or descriptive writing. 	
	<ul style="list-style-type: none"> The student will use a variety of rhetorical devices to support assertions (e.g. appeal to logic through reasoning, personal anecdote, case study, and analogy). 	
	<ul style="list-style-type: none"> The student will use strategies of note taking, outlining, and summarizing to structure drafts of clear, coherent, and focused essays using standard grammatical forms. 	<ul style="list-style-type: none"> Tool kits, note taking from a lesson given by the teacher and-or the book.
	<ul style="list-style-type: none"> The student will write expository compositions, including analytical essays and research reports, for language arts and other content areas that provide evidence in support of a thesis and related claims. 	
	<ul style="list-style-type: none"> The student will clarify and defend positions with relevant evidence, including facts, expert opinion, quotations and/or expression of commonly expressed beliefs and logical reasoning. 	<ul style="list-style-type: none"> Defend solution to POW and give examples as to why it is true.

ELD Standards Support Activities – MATH		
Grades 9-12	Writing: <u>Conventions</u> – <u>Capitalization</u>, <u>Punctuation</u>, <u>Sentence Structure</u>, <u>Grammar</u>, <u>Spelling</u>	Activities to Support the Standard
Language Fluency Level	ELD Standards	
Intermediate	<ul style="list-style-type: none"> The student will revise writing for appropriate word choice and organization with variation in grammatical form and spelling. 	
	<ul style="list-style-type: none"> The student will use, edit, and correct basic grammatical structures and conventions of writing. 	
	<ul style="list-style-type: none"> The student will create coherent paragraphs through effective transitions. 	
Early Advanced	<ul style="list-style-type: none"> The student will revise writing for appropriate word choice, organization, consistent point of view, and transitions, with some variation in grammatical forms and spelling. 	
	<ul style="list-style-type: none"> The student will edit writing for grammatical structure and conventions of writing. 	
	<ul style="list-style-type: none"> The student will revise writing for appropriate word choice and organization, consistent point of view, and transitions which approximate standard grammatical forms and spelling. 	
Advanced	<ul style="list-style-type: none"> The student will create coherent paragraphs through effective transitions and parallel constructions. 	
	<ul style="list-style-type: none"> The student will edit writing for conventions of writing to approximate standard grammatical forms. 	

ELD Standards Support Activities – MATH

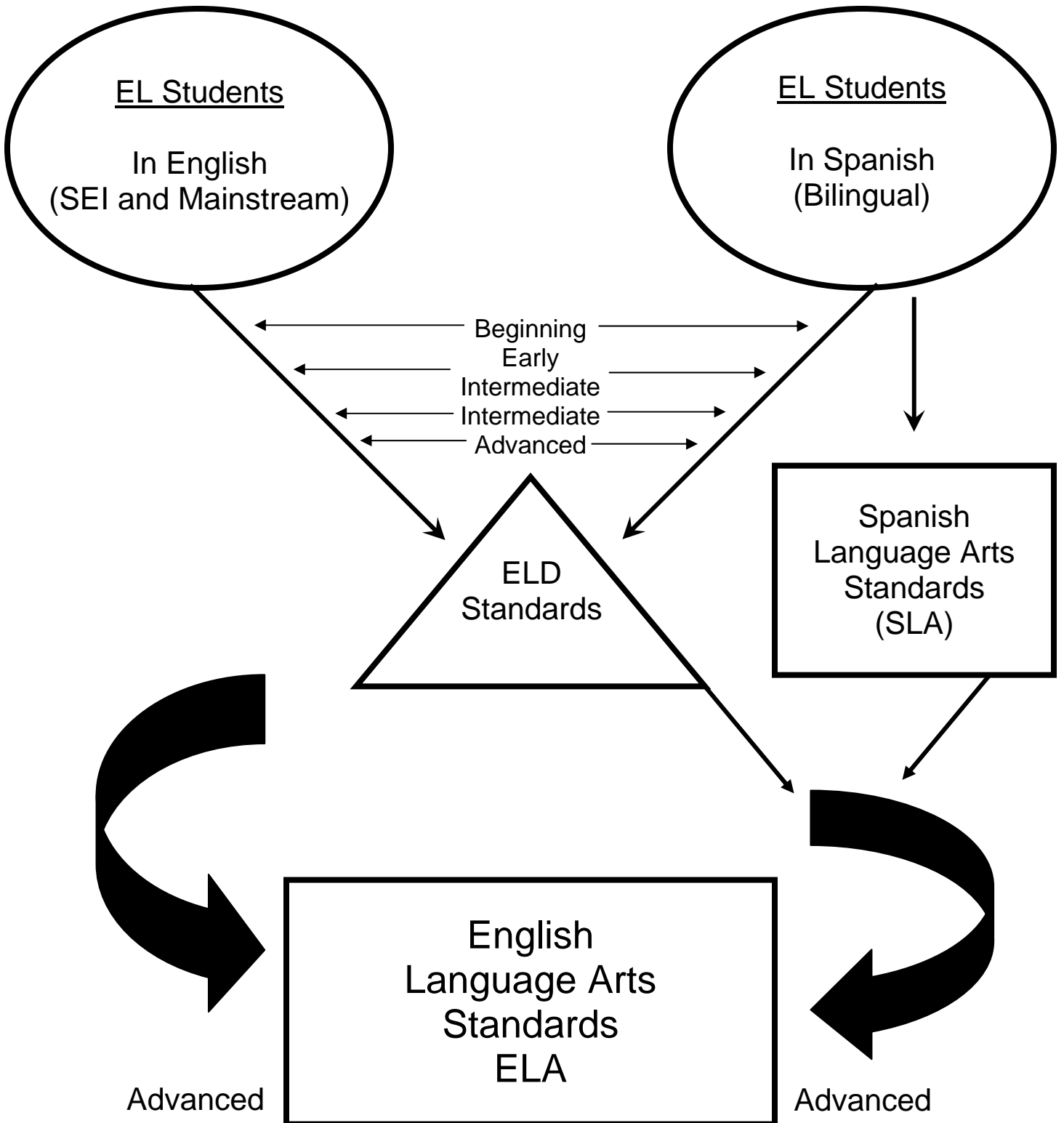
Grades 9-12	READING: Narrative Analysis of Grade Level Appropriate Texts, and Literary Criticism, Structural Features of Literature
Language Fluency Level	Activities to Support the Standard
Intermediate	<p style="text-align: center;">ELD Standards</p> <ul style="list-style-type: none"> • The student will use expanded vocabulary, descriptive words, and paraphrasing for oral and written responses to texts. • The student will read and use detailed sentences to orally respond to factual comprehension questions taken from three forms of literature. • The student will read and use detailed sentences to orally describe the sequence of events in literary texts. • The student will apply knowledge of language to analyze and derive meaning/comprehension from literary texts. • The student will use detailed sentences to orally compare and contrast a similar theme or topic across three genres. • The student will read and use detailed sentences to orally explain the literary elements of theme, plot, setting, and characters. • The student will read and use detailed sentences to orally describe what a character is like by what he/she does in a narration, dialogue, or drama. • The student will use detailed sentences to orally identify at least two ways in which poets use personification, figures of speech, and sounds.
Early Advanced	<ul style="list-style-type: none"> • The student will identify several literary elements and techniques (e.g. figurative language, figures of speech, and symbolism). • The student will read and identify ways in which poets use personification, figures of speech, imagery, and sounds. • The student will identify the function of dialogue, scene design, and sides in dramatic literature. • The student will orally and in writing compare and contrast a similar theme or topic across several genres using more detailed sentences. • The student will identify recognized works of American literature and their genres in order to contrast major periods, themes, and trends. • The student will identify works of world literature and contrast the major literary forms and techniques. • The student will identify characteristics of sub-genre (e.g. satire, pastoral, allegory) that are used in various genres. • The student will identify techniques which have specific rhetorical or aesthetic purposes in literary texts (e.g. irony, tone, mood, "sound" of language). • The student will describe the function of dialogue, scene design, asides, and soliloquies in dramatic literature. • The student will explain the significance of several literary elements and techniques (e.g. figurative language, imagery, allegory, and symbolism). • The student will compare and contrast a similar theme or topic across genre and explain how the genre shapes the themes or topics. • The student will analyze the interaction between character and subordinate characters in literary texts (e.g. motivations and reactions). • The student will analyze recognized works of American literature and their genre in order to contrast major periods and trends.

ENGLISH LEARNER PROGRAM SERVICES



* All English Learners receive a program of English Language Development and grade level core curriculum.

GOAL FOR EL MASTERY OF STANDARDS



STAGES OF LANGUAGE ACQUISITION

BEGINNING (6-12 months)

STUDENT CHARACTERISTICS	TEACHING STRATEGIES
<ul style="list-style-type: none"> • Experience a silent period • Associate sound and meaning • Develop listening strategies and comprehension skills • Communicate nonverbally and with L₁ • Recognize and focus on key words • Rely on contextual cues • Show comprehension by following directions, pointing, drawing, role play • Reproduce what they “hear” • Mispronounce words • Make errors of omission • Respond with one or two words to simple questions • Can name objects and produce isolated words • Can label parts of drawings, diagrams 	<ul style="list-style-type: none"> • Use motherese or caretaker speech • Introduce key vocabulary for recognition • Use a variety of realia visuals, gestures to make speech and shared reading comprehensible • Repeat vocabulary in a systematic fashion • Do not force children to speak • Allow for non-verbal responses and/or one or two word responses and L₁ responses • Make sure that the children are listening and that they understand key vocabulary • Focus the attention on the activity so that the students forget that you are speaking English to them • Encourage all attempts to communicate • Continue to expand passive vocabulary • Provide comprehensible input for the introduction of new vocabulary • Continue to extend listening skills • Continue to focus on comprehension • Ask questions which encourage single-word responses <ol style="list-style-type: none"> 1. Yes/No: Is this a man? 2. Choice: Is this a dog or a cat? 3. Completion: this is a big, brown _____ 4. Single Word questions: What is this? • Praise and expand students’ single-word responses <p>TOTAL PHYSICAL RESPONSE (TPR)</p> <ul style="list-style-type: none"> • Associations are made between language and body movement • Use to teach comprehension strategies in the BEGINNING stage • Use to teach new vocabulary in any stage • The teacher gives a command and the students follow the instructions <p>NAMES OF STUDENTS</p> <ul style="list-style-type: none"> • The teacher talks about a person, thing, or picture using gestures and context • Test comprehension by asking, “who has...?” • Combine with total physical response • Associate words with students • Use with visuals and pictures

STAGES OF LANGUAGE ACQUISITION

EARLY INTERMEDIATE (12-18 months)

STUDENT CHARACTERISTICS	TEACHING STRATEGIES
<ul style="list-style-type: none"> • Reproduce familiar phrases • Begin to generate and speak in simple sentences • Make frequent errors in speech • Begin to acquire grammatical elements • Retell main events in stories • Can read basic vocabulary and write simple sentences 	<ul style="list-style-type: none"> • Give more comprehensible input • Continue to develop and extend recognition vocabulary • Give students a chance to produce language in situations where they are comfortable • Expand students' responses • Ask who, what, where questions (literal) • Ask questions requiring simple comparisons, descriptions, and sequencing of events • Ask questions requiring responses of lists of words • Provide activities designed to encourage students to produce simple sentences • Use the language experience approach to introduce reading and writing • Use predictable and patterned books • Develop story frames • Context-based ELD

STAGES OF LANGUAGE ACQUISITION

INTERMEDIATE (2-3 years)

STUDENT CHARACTERISTICS	TEACHING STRATEGIES
<ul style="list-style-type: none"> • Engage in conversation and produce connected narrative • Interact with native speakers • Make fewer errors in speech • Read from a variety of texts with scaffolding from teacher • Identify main ideas and details • Can summarize, draw comparisons, define new vocabulary 	<ul style="list-style-type: none"> • Encourage students to describe personal experiences • Focus on idiomatic expressions • Concentrate on activities which teach content areas, by teaching content-based ELD • Develop study skills: making predictions, inferences • Explain text features (headings, charts, maps, etc.) • Continue to develop vocabulary skills by providing comprehensible input • Develop the cognitive skills, especially reading and writing • Ask how and why questions, open-ended, higher level thinking questions • Provide activities to develop higher levels of thinking <p style="text-align: center;">ACTIVITIES TO DEVELOP HIGHER LEVELS OF THINKING</p> <ul style="list-style-type: none"> • Content activities • Humanistic-affective activities • Problem-solving activities • Games <ol style="list-style-type: none"> 1. Dialogues 2. Interviews 3. Newspaper ads 4. Preference ranking 5. Role playing 6. Charts, tables and graphs

STAGES OF LANGUAGE ACQUISITION EARLY ADVANCED (2-4 years)

STUDENT CHARACTERISTICS	TEACHING STRATEGIES
<ul style="list-style-type: none"> • Appear to be orally fluent (high level BICS) • Continue to develop the academic vocabulary which most EO¹ students already possess • Continue to develop grade level literacy skills 	<ul style="list-style-type: none"> • ELD focus shifts to academic language and literacy • Continue teaching and expanding the study/learning of the students • Ask questions to help students synthesize, analyze, and evaluate in oral and written communication • SDAIE strategies for core content instruction • Formal grammar instruction

1. EO = English Only

STAGES OF LANGUAGE ACQUISITION ADVANCED (4-7 years)

STUDENT CHARACTERISTICS	TEACHING STRATEGIES
<ul style="list-style-type: none"> • Comprehend and generate discussion in social setting and in content related topics • Read grade level texts • Organize and generate written compositions 	<ul style="list-style-type: none"> • Expand academic vocabulary • Expand reading and writing skills • Expand study/learning skills

ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 3

T-TABLES AND NTH TERMS

READER

CAIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants will build on what they know about simple repeating patterns to finding the n th term and generalizing.

Focus Question

What implications do Garrison and Mora's research on the language-concept connection have on the instructional decisions that you make when teaching math to EL students?

Mathematics

- Connect t-tables to functions
- Explore finite differences
- Extend and recognize a linear pattern by its rules (n th term)

Language

- Examine the language-concept connection (Garrison article)
- Explore various SDAIE strategies
- Discuss academic language in mathematics

Problem of the Day

Aliaba

Homework/ Article

With Different Eyes – Insights Into Teaching Language Minority Students Across the Disciplines
Linda Sasser
Beth Winningham

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

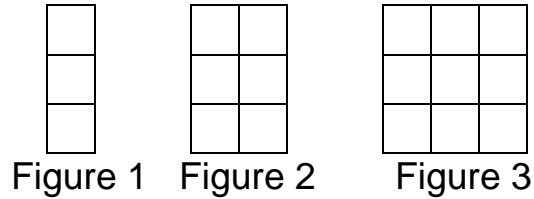
Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

IN SEARCH OF THE UNKNOWN

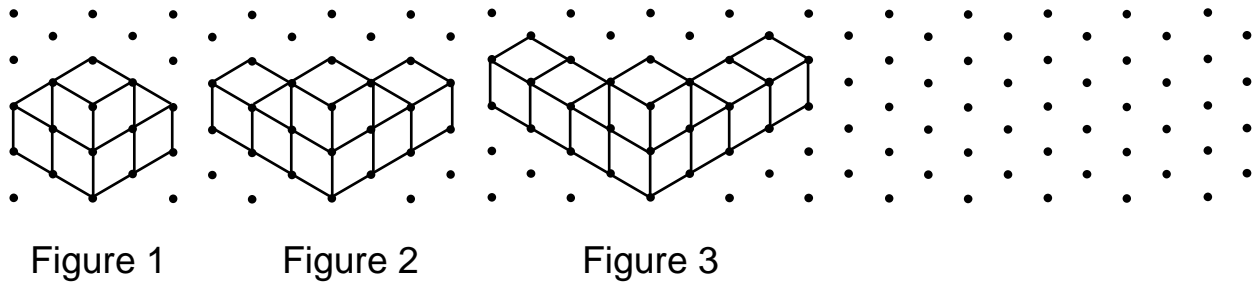
Build and draw the next figure below.



List these terms and the next four terms in the chart. Extend the chart to include the n th term. Then describe the patterns that you notice.

Term Number	Number of Squares
1	3
2	6
3	9

Build and draw the next figure below.



List these terms and the next four terms in the chart. Extend the chart to include the n th term. Then describe the patterns that you notice.

Term Number	Number of Squares
1	4
2	6
3	8

Build and draw the next figure below.



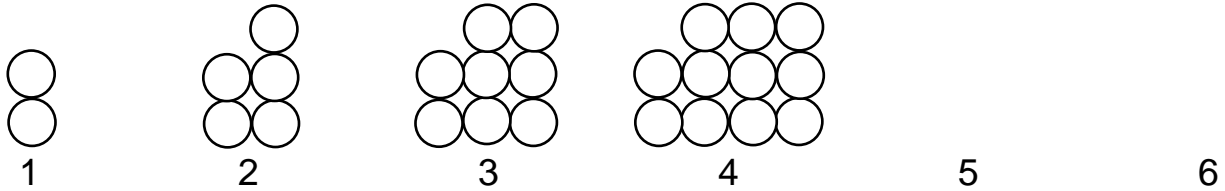
Figure 1 Figure 2 Figure 3

List these terms and the next four terms in the chart. Extend the chart to include the n th term. Then describe the patterns that you notice.

Term Number	Number of Squares
1	1
2	7
3	13

FINITE DIFFERENCES: A METHOD USED TO FIND THE NTH TERM

1) Look at this pattern. Build the next two terms using manipulatives.



2) Make a table:

Term #	number of circles	DIFFERENCE
1		
2		
3		
4		
5		
6		
·		
·		
·		
n		

3) Nth Term:

4) Reflection:

What does the difference mean? What part of the term is it?

How did you figure out the second part of the nth term?

THE METHOD OF FINITE DIFFERENCES

For some of the extra challenges in *What's Next?* The horizontal solutions are fairly complex. An effective approach to these problems is the method of finite differences. This method may be applied to find a horizontal solution (general formula) whenever a *constant* difference occurs between numbers in a sequence.

After data are collected in a table, determine how many columns of differences are required to obtain a column of constant differences.

		1 st diff.	2 nd diff.
0	1		
1	4	> 3	
2	11	> 7	> 4
3	22	> 11	> 4
4	37	> 15	> 4
5	56	> 19	> 4
n	?		

In the example, note that it takes two columns of differences to obtain constants.

The numbers in the first column of differences are 3, 7, 11, 15, and 19. Since these are not constant, create a second column of differences. The differences between these numbers are constant, since each difference is 4.

It may be necessary to create several columns of differences to find a constant difference. Once the constant difference has been found, use the formulas on the Finite Difference Chart. Note that there are four tables of formulas on this chart. The chart shows that every first degree expression has only one column of differences; every second degree expression has two columns of differences, etc. The choice of table is determined by how many columns of differences are required to generate a constant difference. For example, if only one column is required, the solution may be found through the first degree table. If three columns are required, the third degree table would be used.

In the earlier example, two columns of differences are required to reach a constant difference, so the solution is available through the second degree table. To solve this problem, assign the values in the problem's table to the corresponding expressions in the Finite Difference Chart for second degree expressions.

	1 st diff.	2 nd diff.	n	an^2+bn+c
0	(1)		0	(c)
1	4	> (3)	1	$a+b+c$ → (a+b)
2	11	> 7	2	$4a+2b+c$ → $3a+b$ → $2a$
3	22	> 11	3	$9a+3b+c$ → $5a+b$ → $2a$
4	37	> 15	4	$16a+4b+c$ → $7a+b$ → $2a$
5	56	> 19	5	$25a+5b+c$ → $7a+b$

Assigning these values creates the following three equations:

$$\begin{aligned} c &= 1 \\ a + b &= 3 \\ 2a &= 4 \end{aligned}$$

Solving these three equations, beginning with $2a = 4$, produces the following values for a, b, and c.

$$\begin{aligned} a &= 2 \\ b &= 1 \\ c &= 1 \end{aligned}$$

When these values are substituted in the general second degree expression, an^2+bn+c , the result is $2n^2+n+1$, the general formula for the horizontal solution.

While the method of finite differences is frequently a very convenient problem solving approach, it will not always lead to a solution (constant differences may not occur), nor is it necessarily the best way to approach a problem.

The Finite Differences Chart may be especially useful if students are challenged to discover how the chart is constructed and to experiment with the technique on problems which may have been solved through other processes.

FINITE DIFFERENCE CHART

First Degree

n	$an+b$
0	b
1	a+b
2	2a+b
3	3a+b
4	4a+b
5	5a+b

$\begin{matrix} & \searrow & & \searrow & & \searrow & & \searrow & & \searrow \\ & & a & & a & & a & & a & & a \end{matrix}$

Second Degree

n	an^2+bn+c
0	c
1	a+b+c
2	4a+2b+c
3	9a+3b+c
4	16a+4b+c
5	25a+5b+c

$\begin{matrix} & \searrow & & \searrow & & \searrow & & \searrow & & \searrow \\ & & a+b & & 3a+b & & 5a+b & & 7a+b & & 9a+b \\ & & & \searrow & & \searrow & & \searrow & & \searrow \\ & & & & 2a & & 2a & & 2a & & 2a \end{matrix}$

Third degree

n	an^3+bn^2+cn+d
0	d
1	a+b+c+d
2	8a+4b+2c+d
3	27a+9b+3c+d
4	64a+16b+4c+d
5	125a+25b+5c+d

$\begin{matrix} & \searrow & & \searrow & & \searrow & & \searrow & & \searrow \\ & & a+b+c & & 6a+2b & & 12a+2b & & 18a+2b & & 24a+2b \\ & & & \searrow & & \searrow & & \searrow & & \searrow \\ & & & & 6a & & 6a & & 6a & & \end{matrix}$

Fourth Degree

n	$an^4+bn^3+cn^2+dn+e$
0	e
1	a+b+c+d+e
2	16a+8b+4c+2d+e
3	81a+27b+9c+3d+e
4	256a+64b+16b+4d+e
5	625a+125b+25c+5d+e
6	1296a+216b+36c+6d+e

$\begin{matrix} & \searrow & & \searrow & & \searrow & & \searrow & & \searrow \\ & & a+b+c+d & & 14a+6b+2c & & 50a+12b+2c & & 110a+18b+2c & & 194a+24b+2c \\ & & & \searrow & & \searrow & & \searrow & & \searrow \\ & & & & 36a+6b & & 60a+6b & & 84a+6b & & 108a+6b \\ & & & & & \searrow & & \searrow & & \searrow \\ & & & & & & 24a & & 24a & & 24a \end{matrix}$

PROBLEM SET: GARRISON & MORA ARTICLE

1. Spider Problem

An eensy weensy spider was at the bottom of a 15-meter waterspout. Each day when the sun came out the spider crawled upward 5 meters. But each evening the rain came down and washed the spider back down 4 meters. At this rate, how many days will it take the spider to climb out of the waterspout?

2. Hens and Hogs Problem

When she was visiting her Grandpa's farm, Trisha saw that he raised only hens and hogs. She counted 39 heads and 100 feet in the barnyard. How many hens and hogs did her grandpa have in the barnyard?

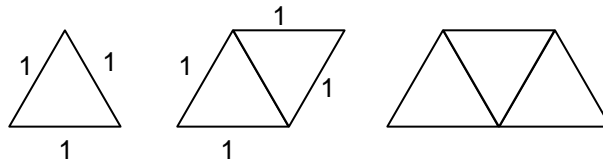
3. Problem of the Day 99

In the restored colonial village of Millerville, a path goes from the visitor center to the mill as follows: visitor center to blacksmith $\frac{3}{4}$ km; blacksmith to cobbler $\frac{1}{3}$ km; cobbler to general store $\frac{1}{2}$ km; general store to mill $\frac{3}{8}$ km. Jill started back from the mill at the same time Kyle started from the visitor center. Each walked 1 km. Who was closer to the cobbler's shop at that point?

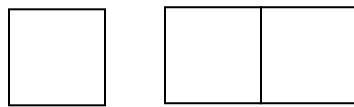
HINGED

Use the space below to draw additional hinged shapes and record their perimeters. For example, one triangle has a perimeter of three units. When an identical triangle is “hinged” onto the first, the perimeter becomes four units.

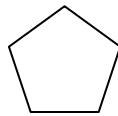
Triangles:



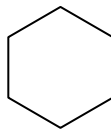
Squares:



Pentagons:



Hexagons:



Use the patterns you discover to complete this table.

Number of Polygons	Perimeter of Triangles	Perimeter of Squares	Perimeter of Pentagons	Perimeter of Hexagons
1	3	4	5	6
2	4			
3				
4				
5				
10				
n				

EXTRA CHALLENGE:

What rule could be used to find the perimeter of n hinged polygons when each polygon has s sides?

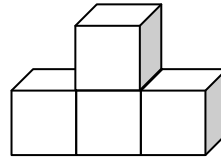
BUILDING BLOCKS

Block upon block, layer upon layer, patterns are developing. Complete the tables to discover the “blueprint” for each building. Use what you have discovered to predict the number of blocks needed for the 50th and nth building.

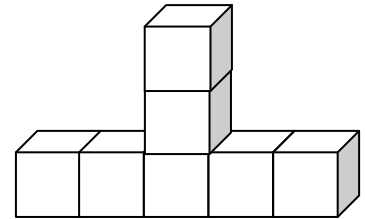
Building Number	Number of Blocks Needed
1	1
2	
3	
4	
5	
6	
50	
n	



#1



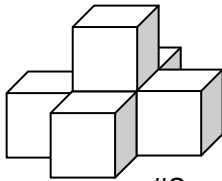
#2



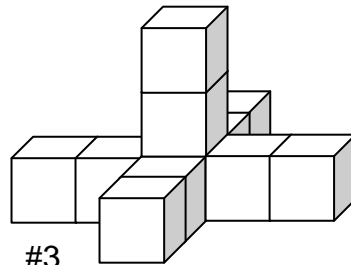
#3



#1



#2



#3

Building Number	Number of Blocks Needed
1	1
2	
3	
4	
5	
6	
50	
n	

SILENCIO BOARD GAME GRID

$\frac{1}{2}$	1	5	2	7	-3	9	0	-6	x	

6	3	2	$-\frac{1}{2}$	-5	-1	10	4	0	x	

10	4	-2	7	1	-3	6	$\frac{1}{2}$	2	x	

$\frac{1}{2}$	3	9	1	0	-1	-2	4	-4	x	

1	6	11	$\frac{1}{4}$	-5	2	4	-3	0	x	

NAME THAT NUMBER

Complete the following tables.

1	5
2	7
3	9
4	11
5	
6	
50	
n	

1	3
2	6
3	11
4	18
5	
6	
50	
n	

1	7
2	10
3	13
4	16
5	
6	
50	
n	

1	8
2	13
3	18
4	23
5	
6	
50	
n	

1	1
2	5
3	9
4	13
5	
6	
50	
n	

1	0
2	3
3	8
4	15
5	
6	
50	
n	

COOPERATIVE LEARNING

Maximize Language Acquisition:

Provides secondary EL students with a low risk environment where they can comprehend and use English for the maximum amount of time possible so they can approach the language proficiency levels of their peers.

Students with lower proficiency levels can interact with students with higher proficiency levels in order to negotiate the meaning of the content.

Maximize Content Learning:

Stimulates all students to higher levels of thinking that will prepare them for academic learning.

Provides all students the opportunity to access the same content.

Maximize Social Development

Provides EL students the chance to develop positive and productive relationships with ALL types of students.

Gives EL students the opportunity to serve as teachers of other students or as experts on specified topics.

DEFINITION of SPECIALLY DESIGNED ACADEMIC INSTRUCTION IN ENGLISH (SDAIE)

SDAIE is the teaching of grade-level subject matter in English specially designed for speakers of other language. It is most appropriate for students who have reached an appropriate level of proficiency in English (speaking, comprehension, reading and writing) and who possess basic literacy skills in their own language.

WHAT IT IS:

It is an approach used by teachers who possess the competency to make content comprehensible to LEP students with intermediate fluency. This approach emphasizes the development of grade-level to advanced academic competencies and should be viewed as one component within a comprehensive program and as a bridge between primary language instruction and placement in mainstream English.

This instructional component within a full bilingual program incorporates a variety of instructional strategies and methods such as whole language, cooperative learning, and comprehensible input to help make core academic instruction in English understandable for LEP students. It is most appropriate for LEP students who have primary language literacy skills, and have reached a level of proficiency in English that allows them to benefit from such instruction. The goal of SDAIE is to make the grade level core content accessible to students whose English proficiency is at the intermediate level.

Learners of English derive equal educational access and opportunity in a full comprehensive program of instruction when English language development is accompanied by access to the core curriculum through primary language instruction.

SDAIE works when students have enough English that they can deal with rigorous, serious content that is not weakened or watered down. It is delivered in a manner that is sensitive to the linguistic needs and learning styles of the students. Therefore, the term "sheltered" has been eliminated from this report and replaced with SDAIE in order to preserve the intent of rigorous core curriculum instruction.

WHAT IT IS NOT:

It is not submersion into English, nor a substitute for primary language instruction, nor the most appropriate program option for all LEP students. It is not a stand alone program, a replacement for primary language and literacy development, nor the same as curriculum and is not a substitute for English language development (content-based ESL) and content instruction.

SDAIE vs. MAINSTREAM INSTRUCTION:

SDAIE needs to be distinguished from mainstream instruction. It is only one component of a full bilingual program that includes primary language, English language development, and mainstream instruction for LEP students. The needs of LEP students and the needs of mainstream students are quite different. One of the main differences is that the teacher of SDAIE requires training in language development as well as knowledge of the content area curriculum. Providing the same rigorous curriculum and using the appropriate strategies and materials means adaptations must be made to meet those needs. Good teaching alone is not sufficient for LEP students because it does not necessarily adapt the strategies nor the materials to meet their linguistic needs. There is a continuing concern that adaptation too often is interpreted to mean simplification of texts and concepts: this must be avoided. Maintaining the rigor of the curriculum, SDAIE provides elaboration and enrichment.

THE ROLE OF PRIMARY LANGUAGE:

The role of primary language is paramount and strategic in the concept of SDAIE classes. Primary language literacy is considered to be the link to content area access and core curriculum. The more highly developed literacy skills students have in their primary language, the more they will benefit from SDAIE classes.

When access to the core is not possible through direct primary language instruction, other resources should be used in order to provide as much core access as possible. These include both human and material resources such as:

Human resources:

- Bilingual instructional staff,
- Community language schools and other community agencies,
- Volunteer speakers of target languages
- peer and cross-age tutors,

- teacher teams in other grades/schools,
- college student tutors

Material resources may include:

- primary language texts, trade books, and reference books
- audio and video tapes,
- primary language computer programs,
- distance learning,
- CD-ROM with various language tracks, and
- interactive video

Definite characteristics exist that describe both the SDAIE approach and the students that are served by its implementation. They are included in the following:

CHARACTERISTICS OF THE SDAIE APPROACH:

- Cooperative and thematic learning environments;
- Teacher delivery that contextualizes content using comprehensible input and uses techniques such as rephrasing and paraphrasing;
- A variety of interactive strategies including student to student, student - to teacher, student-to-text, and student-to-self (reflection, self-evaluation);
- Careful planning of the environment, instruction, and materials;
- Identification and selection of focus concepts that integrate student learning;
- Facilitating a connection of focus concepts to students' experiences, knowledge, and needs to know;
- Selection of scaffolds to assist students' engagement and performance (social-affective, linguistic, cognitive-academic, metacognitive-metalinguistic);
- Continuous observation, monitoring, and assessment leading to teachers' modifications of instructional procedures and to students' increasing autonomy;
- Multicultural development and awareness and the validation of diversity.

STUDENT CHARACTERISTICS AND PLACEMENT CRITERIA:

SDAIE is appropriate for students who have met the following criteria:

- A threshold English language proficiency (including mastery at specified levels of reading and writing skills as well as oral skills) - intermediate and above,
- Primary language literacy, and
- Appropriate academic content background – different subjects by age/grade.

A CONTEXTUAL FRAMEWORK FOR SDAIE:

Based on the above ideas, the work group provided the following contextual framework for SDAIE:

"Programs that provide learners of English with equal education and access to the core curriculum of the school are those that contain the following key instructional approaches."

- Primary language instruction for primary language literacy purposes and academic development.
- English language development for literacy in English and cognitive academic development.
- SDAIE for the gradual progression of academic competencies in the content areas as the students acquire English. Under certain conditions it may be used, in conjunction with primary language support to provide access to the core curriculum.

Under specific circumstances, including multiple language settings or situations in which primary language instruction is not possible, a variety of instructional strategies will be necessary to meet student language and academic needs.

English Language Development - ELD

English Language Development (ELD), a curricular subject, is the teaching of English. It is sometimes called "English as a Second Language" or "ESL". English Language Development is a broader term in that it refers to all of the aspects of literacy in English and not just oral language fluency. Included in ELD are Listening, Speaking, Reading and Writing. The measurement tool that is used in California to determine the level of development in English is called the California English Language Development Test or the CELDT. The levels determined by the CELDT are Beginning, Early Intermediate, Intermediate, Early Advanced and Advanced. The state ELD standards are used as a guide to bring the student from beginning levels to advanced levels of fluency and literacy in English, eventually enabling the student to participate in mainstream English Language Arts.

Content Based English Language Development (ELD)

Current research shows that the most effective English Language Development programs are those that use content rich materials during ELD instruction. The reason for this is that not only is the instruction developing basic interpersonal communication skills or what Dr. Jim Cummins calls BICS, but it is also developing academic language and vocabulary, leading to Cognitive Academic Language Proficiency.

Specially Designed Academic Instruction in English - SDAIE

SDAIE is a methodology used for **grade level appropriate content instruction** in English. It is used to enable Limited English Proficient students to access the core curriculum that is defined by the grade level standards for each curricular area. *(As you know, during ELD time the content is lowered to levels below the grade level of the student to make the English being taught more comprehensible, but during math, science, history, geography, and other content area instruction we never lower the level of the content being taught, rather, we use special strategies to make the grade level content accessible to the English Learner.)* SDAIE includes such strategies as modified teacher speech, frequent comprehension checks, modified assessment, hands-on projects, cooperative group work, repetition of key vocabulary, use of visuals, graphic organizers, etc. SDAIE is not intended to replace primary language content instruction; in fact, primary language literacy is a prerequisite for effective SDAIE.

GLOSSARY FOR SDAIE REPORT

COMPREHENSIBLE INPUT - Describes understandable and meaningful language directed at people acquiring a second language. Characteristics include focus on communicating a meaningful message rather than on language forms; frequent use of concrete contextual referents such as visuals, props, graphics, and realia; acceptance of the primary language use by the learner; minimal overt correction by instructor; and the establishment of positive and motivating learning environment.

CONTENT BASED ESL - An approach used to develop English language proficiencies through the use of concepts and themes from various subject areas. This approach emphasizes English language development.

CONTEXTUALIZATION - Embedding language in a context by using manipulatives, pictures, gestures, and other types of realia to make it more meaningful for students.

CORE CURRICULUM - Those subjects which a student must master in order to be promoted to the next grade (k-8) or to graduate (9-12). The implication is that the curriculum for these subject regardless of language proficiency, must master.

CULTURAL BROKER - Someone who mediates between two or more cultures.

INTERACTIVE ENVIRONMENT - A classroom environment that is designed instructionally to utilize strategies such as cooperative and collaborative learning, to ensure interaction between students and students, students and text, students and educational staff, and students and self.

LANGUAGE PROFICIENCY - Includes mastery at specified levels of reading and writing skills as well as oral skills in a language.

LIMITED ENGLISH PROFICIENCY (LEP) - A student whose proficiency in English has been determined to be limited according to state approved tests.

MODELING - Giving students clear examples of what is requested of them for imitation. Learners need to see or hear what a developing product looks like.

NEGOTIATION OF MEANING - Communicative interaction using comprehensible input and output that facilitates language acquisition and/or cognitive development. It occurs when participants find themselves in situations where they have a vested interest in understanding messages and having their own messages understood.

PRIMARY LANGUAGE - The heritage language of the student as documented by the home Language Survey.

PRIMARY LANGUAGE INSTRUCTION - The use of the student's primary language for direct grade level instruction.

PRIMARY LANGUAGE LITERACY - The ability in the primary language to speak, read, write, and understand at the appropriate age/grade level of the student.

PRIMARY LANGUAGE SUPPORT - Any (limited) use of the primary language that enables student to understand terms and content and supports directly the content instruction that is to be delivered in the second language.

REALIA - Authentic objects and sources of information used as a resource for students to develop meaning from language.

SCAFFOLDING - Instruction or support mechanisms given in such a way that enable students to safely take risks, handle tasks involving complex language, and reach for higher goals with the help of teachers or more capable peers. Scaffolds are temporary because as the teacher observes that students are capable of handling more on their own, she/he gradually hands mechanisms that teachers build in order to enable their student to perform at higher levels than they are right now. Built into the concept of scaffolding is the idea of handing responsibility over to the learners for the kinds of actions they engage in. types of instructional scaffolds include modeling, bridging, contextualization, schema building, metacognitive development and text representations.

SCHEMAS - Clusters of meanings that are interconnected. Schema building is when new information is woven into pre-existing structures of meaning so that students see the connection through a variety of activities.

SDAIE - The teaching of grade-level subject matter in English specifically designed for speakers of other languages. It is most appropriate for students who have reached an appropriate level of proficiency in English (speaking, comprehension, reading and writing) and who possess basic literacy skills in their own language.

THRESHOLD LEVEL OF PROFICIENCY - The minimum level of language Proficiency that allows a student to access a curriculum that is rich and rigorous and engages and fosters critical thinking and critical interaction.

LEARN CONTENT

How? Through comprehensible lessons called SDAIE.

SDAIE (Specially designed Academic Instruction in English) strategies are instructional techniques for the EL student to “get” the content of what is being taught. Having limited English skills should not be an obstacle for the child to learn new concepts. This does not mean dummy down the content; it just means to deliver the content so the child doesn't have to *rely* on English skills to learn the content

Components of a SDAIE Lesson

1. Contextual Clue
 - Gestures
 - Realia
 - Graphic Organizers
 - Visual
 - Overheads
 - Manipulatives
 - Maps
 - Experiments
2. Lesson is Content Centered
 - Identifiable Objects
 - Content is grade-level
 - Hands-on activities
 - Key vocabulary is identified
 - Tap students' prior knowledge
 - “Talk time built into the activities
 - “Think time” built into activities
3. Teacher Behavior Modifications
 - Clear enunciation
 - Avoid use of slang/idioms
 - Don't correct language errors
 - Create low affective filter
4. Grouping Strategies
 - Pairs
 - Cooperative groups
 - Heterogeneous groups
5. Assessment of Content Instruction
 - Ongoing checks for understanding
 - Questioning
 - Portfolio
 - Observation
 - Group presentation

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12 KEY COMPONENTS OF SDAIE LESSONS

(Includes selected examples)

INTO	THROUGH	BEYOND
<ol style="list-style-type: none"> Connect to Prior Knowledge and Experience <ul style="list-style-type: none"> K-W-L Chart Brainstorm Quickwrite or Journal Entry Create Emotionally Safe Learning Environment <ul style="list-style-type: none"> Establish Procedures Acceptance of error Student praise Preview New English Vocabulary <ul style="list-style-type: none"> Use visuals and realia Connect to cognates 	<ol style="list-style-type: none"> Hands-on Learning <ul style="list-style-type: none"> Use of manipulatives Experiment Role Play Contextualize Language <ul style="list-style-type: none"> Use visuals and realia Slower rate of speech Emphasis of key words Use of Scaffolding to Make Meaning of Narrative (Modeled with teacher) <ul style="list-style-type: none"> Graphic Organizers Question-Answer Relationship Student Interaction/Cooperative Learning <ul style="list-style-type: none"> Numbered Heads, Round table, Think-Pair-Share, etc. Use of Multiple Intelligences <ul style="list-style-type: none"> Spatial: Collage, posters, dioramas Musical: Songs, choral reading Bodily Kinesthetic: Pantomime Check for Understanding <ul style="list-style-type: none"> Thumbs-up/Thumbs-down Mini boards Think-Pair-Share 	<ol style="list-style-type: none"> Use of all communication Skills (<i>listening, speaking, reading, and writing</i>) <ul style="list-style-type: none"> Reader Response Journals Reciprocal Teaching Use of Scaffolding to Demonstrate Understanding of Narrative (<i>For Review/Assessment</i>) <ul style="list-style-type: none"> Graphic Organizers (Venn Diagrams, T-charts, story maps) Question-Answer Relationship Summarize Lesson and Review Vocabulary <ul style="list-style-type: none"> Vocabulary Games Variety of assessment tools (test, observation, portfolio) Extend Learning to New Concepts <ul style="list-style-type: none"> Group Projects: plays, murals, connect to other curricular areas

12 KEY COMPONENTS OF SDAIE LESSONS

INTO	THROUGH	BEYOND

ELD AND SDAIE

The Distinction

ELD English Language Development

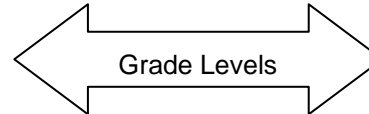
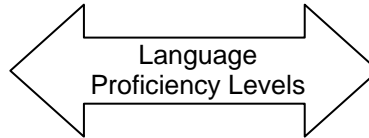
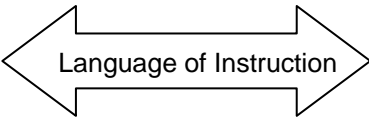
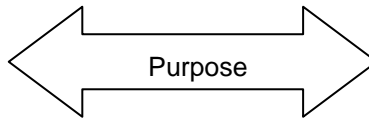
- Develop proficiency in English
- Learning content knowledge may be a by-product

- Instructional content is based on students' English proficiency levels
- Following the sequential approach, students may learn English first, then content knowledge later

- All English
- Students are expected to use English to communicate in student-to-teacher and/or student-to-student interactions

- Beginning, Intermediate, and Advanced levels of English Language Development (ELD)

- K-12



SDAIE Specially Designed Academic Instruction in English

- Develop knowledge in content areas
- Learning English language is a by-product

- Grade-level content is presented

- English; L1 may be used for clarification when necessary
- Students may use L1, particularly in student-to-student interactions

- Most appropriate for Intermediate and Advanced levels of English Language Development (ELD)

- 4-12 (currently being adapted for K-3)

ELD AND SDAIE

The Community

- Link new learning to prior knowledge.
- Nurture a supportive classroom environment that encourages students to participate and respect diverse cultures.
- Maintain a low anxiety level.
- Use frequent checks for understanding.
- Use modified speech, body language, and facial expressions.
- Use pictures, visuals, realia, manipulatives, graphic organizers, and technology.
- Promote interactions in a variety of grouping configurations.
- Incorporate ample opportunities to practice, demonstrate, apply, and reflect on new learning.
- Make connections between learning and real life experiences to stimulate students' interest.

ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 4

MORE NTH TERMS & GRAPHING

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants physically experience graphing. They will then focus on deconstructing a lesson in order to make it more accessible to EL students.

Focus Question

How does the Algebra Walk (human graph) activity help you understand or expand your knowledge about various features of equations?

Mathematics

- Represent data in tables, rules, and expressions
- Construct two-dimensional patterns for three-dimensional models
- Identify and graph ordered pairs in the four quadrants of the coordinate plane

Language

- Discuss and explore “Into-Through-Beyond” in mathematics
- Lesson Deconstructions

Problem of the Day

Ratio

Homework/ Article

School Mathematics for Language Enriched Pupils
Walter Secada

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

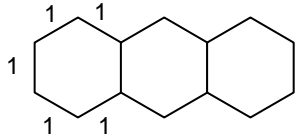
Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

POLYGONAL TRAIN PROBLEM

Extend the pattern below.

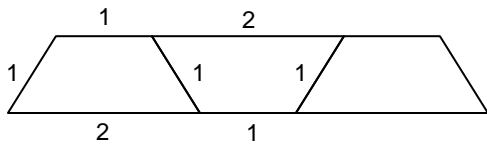


Complete the chart. Extend the chart to include the n th term.

Explain, in words, what happens to the perimeter as you add a new hexagon. Why?

Number of Hexagons	Perimeter
1	—
2	—
3	—
—	50
20	—
—	102
n	—

Extend the pattern below.



Complete the chart. Extend the chart to include the n th term.

Explain, in words, what happens to the perimeter as you add a new trapezoid. Why?

Number of Trapezoids	Perimeter
1	5
2	—
3	—
4	—
—	26
—	101
n	—

WHAT'S MY RULE?

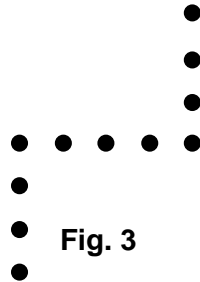
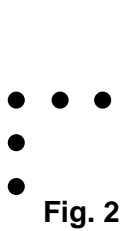
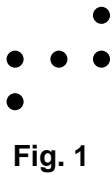
When solving problems, it is often helpful to know a general rule. Finding the n th term in a sequence is finding the general rule for all the terms in that sequence.

- Complete each sequence and find the n th term.
- | | | | | | | | | | | n th term |
|-----|------------------|-----|------------------|-----|-----------------|------|------|------|-----|-------------|
| 1. | 2, | 4, | 6, | 8, | 10, | ___, | ___, | ___, | ... | ___ . |
| 2. | 1, | 3, | 5, | 7, | 9, | ___, | ___, | ___, | ... | ___ . |
| 3. | 3, | 6, | 9, | 12, | 15, | ___, | ___, | ___, | ... | ___ . |
| 4. | 7, | 10, | 13, | 16, | 19, | ___, | ___, | ___, | ... | ___ . |
| 5. | 5, | 10, | 15, | 20, | 25, | ___, | ___, | ___, | ... | ___ . |
| 6. | 2, | 7, | 12, | 17, | 22, | ___, | ___, | ___, | ... | ___ . |
| 7. | $\frac{3}{2}$, | 2, | $\frac{5}{2}$, | 3, | $\frac{7}{2}$, | ___, | ___, | ___, | ... | ___ . |
| 8. | $-\frac{3}{2}$, | -1, | $-\frac{1}{2}$, | 0, | $\frac{1}{2}$, | ___, | ___, | ___, | ... | ___ . |
| 9. | 17, | 25, | 33, | 41, | 49, | ___, | ___, | ___, | ... | ___ . |
| 10. | 9, | 23, | 37, | 51, | 65, | ___, | ___, | ___, | ... | ___ . |

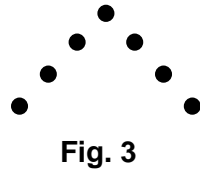
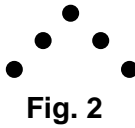
FIGURE IT OUT

If these patterns are continued, how many dots will be in the 100th figure of each sequence?

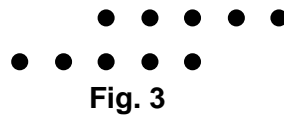
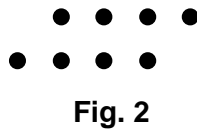
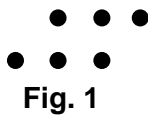
1.



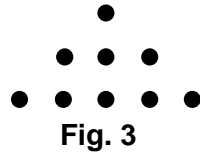
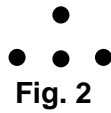
2.



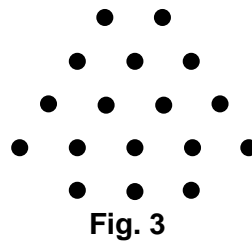
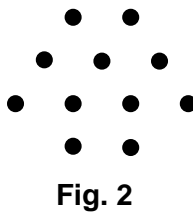
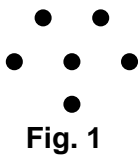
3.



4.



5.



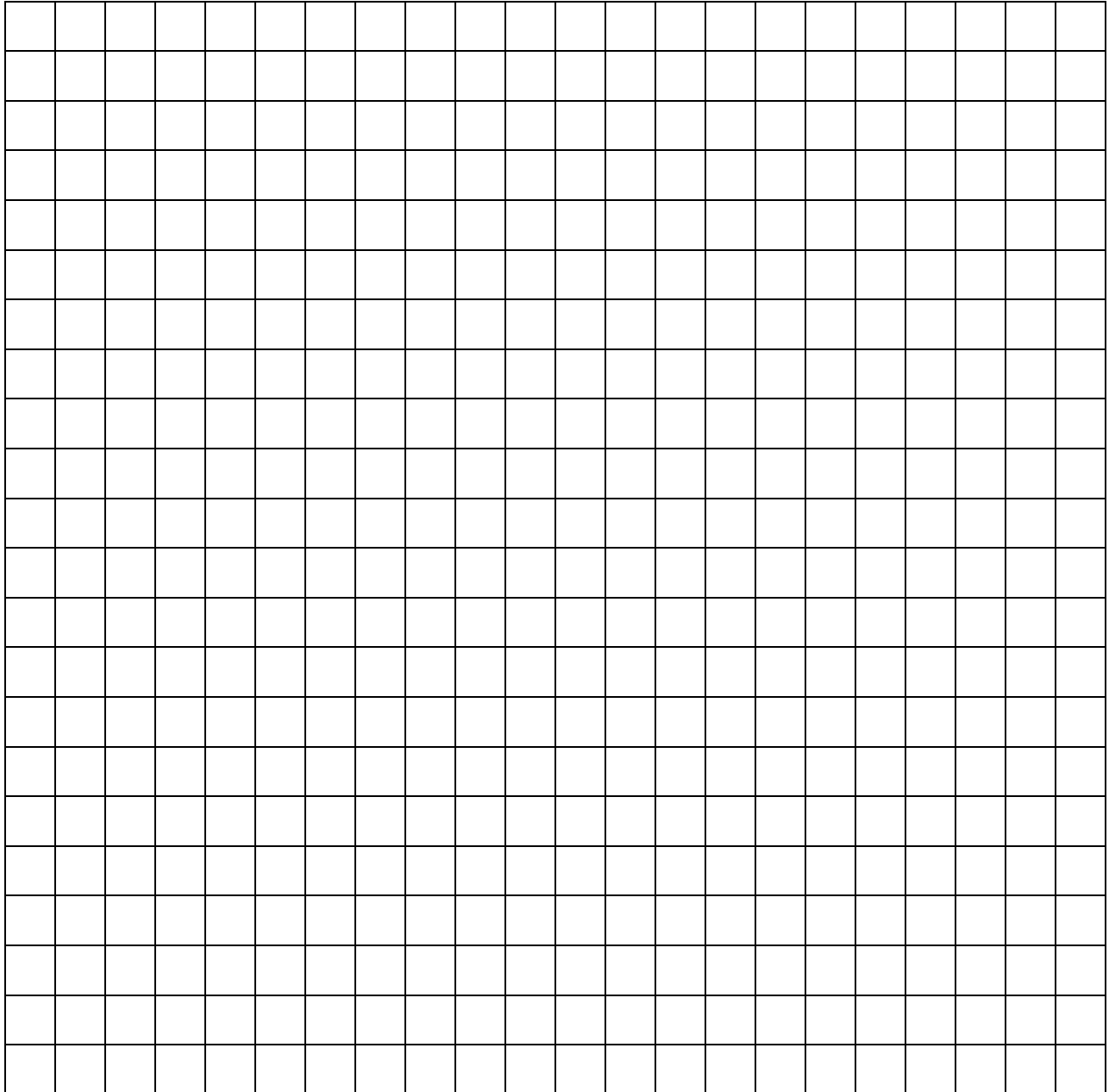
Make up some of your own figures!

WARMUP: GRAPHING

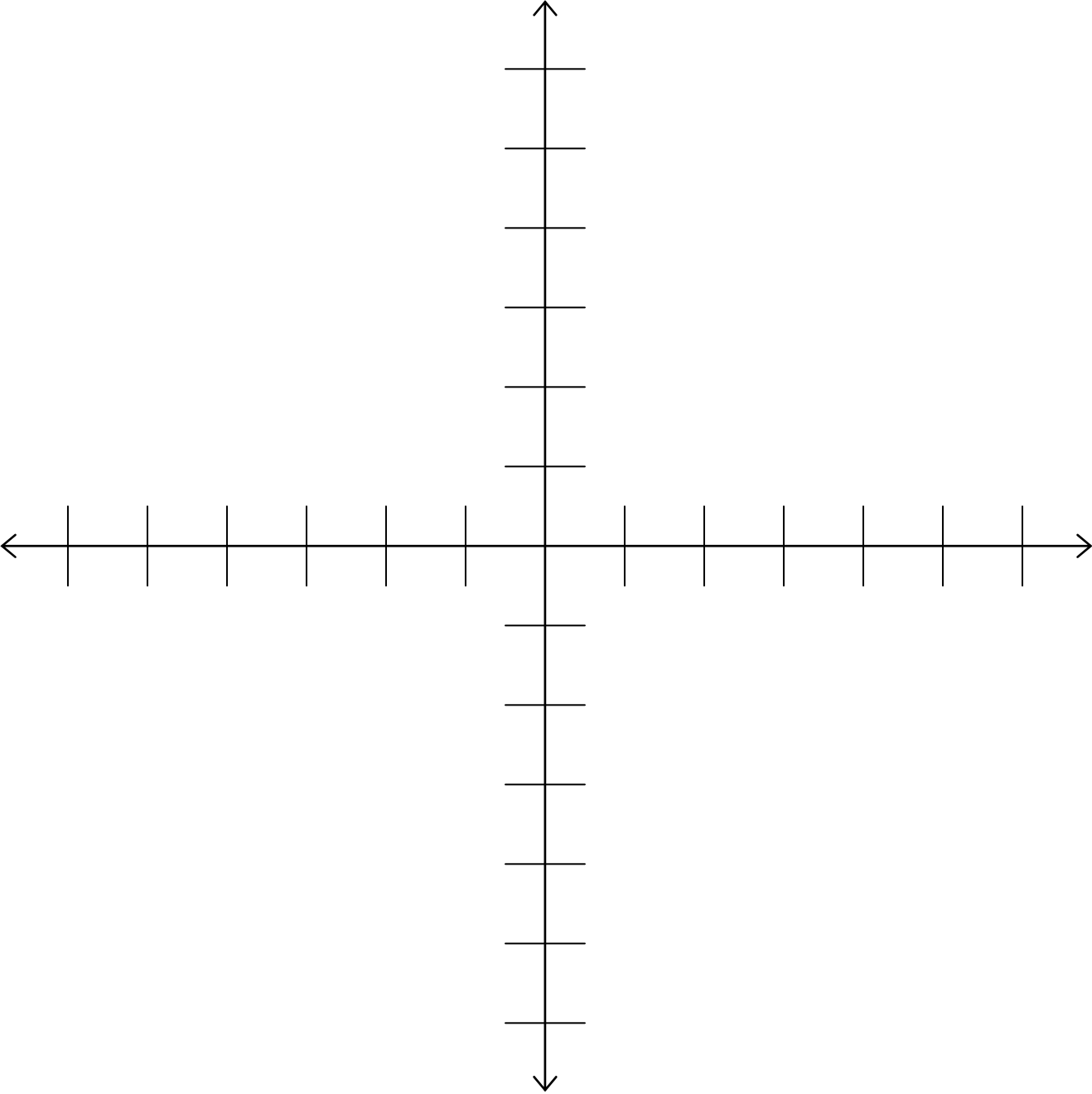
Graph the following points, then connect them in alphabetical order.

- A (0, 4)
- B (4, -5)
- C (-5, 1)

- D (5, 1)
- E (-4, -5)
- F (0, 4)



COORDINATE PLANE



ALGEBRA WALK RESOURCE PAGE

<p>RED</p> <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> IN # </div> <div style="font-size: 24px;">→</div> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> OUT # </div> </div>		<p>Describe what you see:</p>
<p>BLUE</p> <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> IN # </div> <div style="font-size: 24px;">→</div> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> OUT # </div> </div>		<p>Describe what you see:</p>
<p>YELLOW</p> <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> IN # </div> <div style="font-size: 24px;">→</div> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> OUT # </div> </div>		<p>Describe what you see:</p>
<p>GREEN</p> <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> IN # </div> <div style="font-size: 24px;">→</div> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> OUT # </div> </div>		<p>Describe what you see:</p>
<p>ORANGE</p> <div style="display: flex; align-items: center; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> IN # </div> <div style="font-size: 24px;">→</div> <div style="text-align: center;"> <input style="width: 40px; height: 30px; border: 1px solid black;" type="text"/> OUT # </div> </div>		<p>Describe what you see:</p>

$(-4, _)$

$(-2, _)$

$(-5, _)$

$(-3, _)$

$(0, \rightarrow)$

$(2, \rightarrow)$

$(-1, \rightarrow)$

$(1, \rightarrow)$

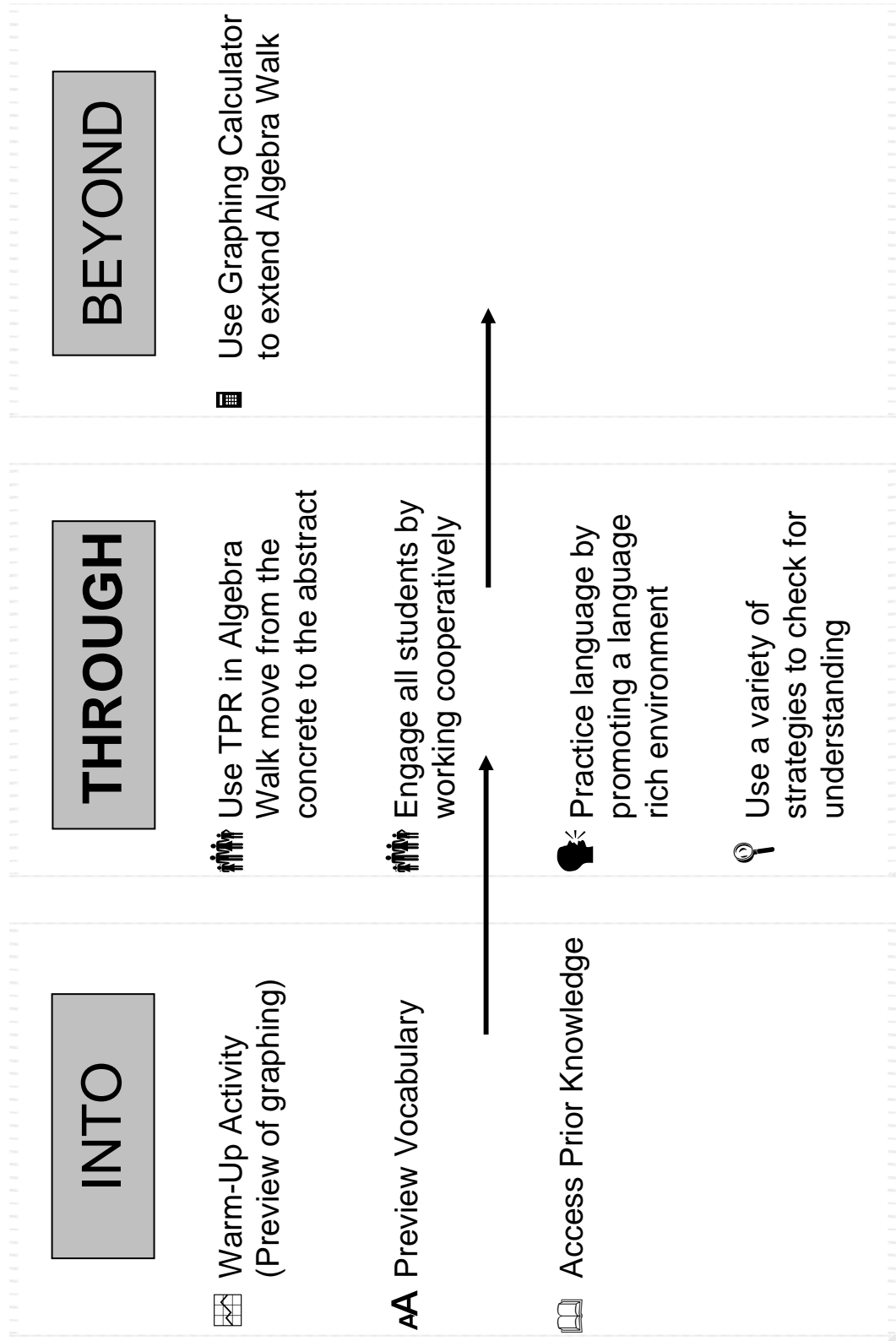
(4,)

(6,)

(3,)

(5,)

ALGEBRA WALK DECONSTRUCTION



ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 5

**GRAPHING APPLICATION
(MOTION DETECTOR)**

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants physically experience slope by using a motion detector. Participants also focus on re-writing word problems and preparing mini-lesson presentations.

Focus Question

At this point in time, what specific strategies/activities have you found the most useful and why? What specific strategies/activities can you take directly back into your classroom?

Mathematics

- Examine how a motion detector can be used to demonstrate rate as a measure of one quantity per unit value of another quantity.

Language

- Work cooperatively in groups to prepare mini-lesson presentation
- Re-write POD's to reflect accessibility to EL students
- Use TPR (Total Physical Response) for conceptual understanding of $d=rt$

Problem of the Day	Homework/ Article
Ditch Diggers	None

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

SCAFFOLDING INSTRUCTION FOR SECOND LANGUAGE LEARNERS

Scaffold	How does it support students' building of their understanding?	Classroom Strategies, Activities, and Tasks
I Modeling	<ul style="list-style-type: none"> ◆ Clarifies procedures through direct experience ◆ Provides concrete examples of what a student's finished product may look like 	<ul style="list-style-type: none"> ◆ Any procedure, task, product, or skill introduced for the first time should be modeled
II Bridging	<ul style="list-style-type: none"> ◆ Provides a personal connection between the learner and the theme of the class ◆ Taps into students' prior knowledge relevant to the class theme 	<ul style="list-style-type: none"> ◆ Think and write ◆ Family Interactive Homework Assignment ◆ Think/ Pair/ Share ◆ 3 Step Interview
III Contextualization	<ul style="list-style-type: none"> ◆ Creates a clear experiential environment that familiarizes new, unknown concepts and throws light on them 	<ul style="list-style-type: none"> ◆ Video with Focused Question ◆ Manipulatives ◆ Realia
IV Schema Building	<ul style="list-style-type: none"> ◆ Helps students establish the connections that exist between and across concepts that may otherwise appear unrelated ◆ Helps students gain perspective with regards to where ideas fit in the larger scheme of things 	<ul style="list-style-type: none"> ◆ Compare and Contrast Matrix ◆ Venn Diagrams ◆ Word Webs
V Test Representation	<ul style="list-style-type: none"> ◆ Invites students to extend their understandings and apply them in a novel format 	<ul style="list-style-type: none"> ◆ Drama or Role Play ◆ Cartoon ◆ Share Reading with a Predictable text (which leads to student innovation of the text)
VI Metacognitive Development	<ul style="list-style-type: none"> ◆ Supports students' internalization of strategies through a conscious focus on the implementation of plans of attack ◆ Fosters student autonomy through self-monitoring and self-assessment 	<ul style="list-style-type: none"> ◆ Learning Logs ◆ K-W-L ◆ Guided reading and Reciprocal Learning

REFERENCE SHEET 1: Scaffolding Instruc. For Sec. Lang. Learners Lang, Cul. Ident. & Achieve.: Activity 5 Towards Equity: a Guide for Teaching and Learning in a Multicultural Society McGinty / Mendoza-Reis Adapted from the work of Aida Walqui 1998

Lesson Plan Checklist for The Sheltered Instruction Observation Protocol (SIOP)

I. PREPARATION

1. Write content objectives clearly for students.
2. Write language objectives clearly for students.
3. Choose content concepts appropriate for age and educational background level of students.
List them:
4. Identify supplementary materials to use (graphs, models, visuals).
List materials:
5. Adapt content (e.g. text, assignment) to all levels of student proficiency.
List ideas for adaptation:
6. Plan meaningful activities that integrate lesson concepts (e.g. surveys, letter writing, simulations, constructing models) with language practice opportunities for reading, writing, listening, and/or speaking. *List them:*

II. INSTRUCTION

Building a background

7. Explicitly link concepts to students' backgrounds and experiences.
Examples:
8. Explicitly link past learning and new concepts.
Examples:
9. Emphasize key vocabulary (e.g. introduce, write, repeat, and highlight) for students.
List key vocabulary:

Comprehensible Input

10. Use speech appropriate for students' proficiency level (e.g. slower rate, enunciation, and simple sentence structure for beginners).
11. Explain academic tasks clearly.
12. Use a variety of techniques to make content concepts clear (e.g. modeling, visuals, hands-on activities, demonstrations, gestures, body language).
List them:

Strategies

13. Provide ample opportunities for students to use strategies (e.g. problem solving, predicting, organizing, categorizing, evaluating, self-monitoring).
List them:

14. Use scaffolding techniques consistently (providing the right amount of support to move students from one level of understanding to a higher level) throughout lesson.
List them:
15. Use a variety of question types including those that promote higher-order thinking skills throughout the lesson (e.g., literal, analytical, and interpretive questions).
List them:

Interaction

16. Provide frequent opportunities for interaction and discussion between teacher/student and among students about lessons concepts, and encourage elaborated responses.
17. Use group configurations that support language and content objectives of the lesson.
List the grouping types:
18. Provide sufficient wait time for student responses consistently.
19. Give ample opportunities for students to clarify key concepts in L1 as needed with aide, peer, or L1 text.

Practice/Application

20. Provide hands-on materials and/or manipulatives for students to practice using new content knowledge.
List materials:
21. Provide activities for students to apply content and language knowledge in the classroom.
List them:
22. Provide activities that integrate all language skills (i.e., reading, writing, listening, and speaking).
List them:

Lesson Delivery

23. Support content objectives clearly.
24. Support language objectives clearly.
25. Engage students approximately 90-100% of the period (most students taking part and on task throughout the lesson).
26. Pace the lesson appropriately to the students' ability level.

III. REVIEW/EVALUATION

27. Give a comprehensive review of key vocabulary.
28. Give a comprehensive review of key content concepts.
29. Provide feedback to students regularly on their output (e.g., language, content, work).
30. Conduct assessments of student comprehension and learning throughout lesson on all lesson objectives (e.g., spot checking, group response).

EFFECTIVE SDAIE LESSON GUIDELINES

Rationale:

- Why are you teaching this particular lesson?
- Who are the students you will be teaching and how does this lesson fit into their experiences and knowledge?
- What are their special needs
- How does this lesson fit within the larger unit or curriculum?
- Upon what previous learning is it dependent?
- What learning follows this concept?
- How does this lesson fit within the previous and future lessons in a sequence?

Standards Addressed:

Math Standards:

- What California Math Content Standards are you taking into account?
- What should they know and be able to do as a result of this learning experience?

ELD Standards:

- What California ELD Standards are you taking into account?
- How will you promote growth in Listening and Speaking, Reading, and Writing?
- What grade span are you working in?
- What skill level will you address?

Assessment:

- What evidence will you use to find out whether or not the students have met your target Standards (journals, questioning, authentic assessment, performance-based assessment, writing activities, solving problems, restating ideas, applying skills to life situations, etc.)?
- If you are using a traditional form of assessment, how will you modify it to allow for EL needs? (extra time, alternate answer forms, etc.)

Materials:

- What materials will you need in order to teach this lesson?
- What realia and manipulatives will students use?
- What handouts, readings, overheads, audiovisual materials, graphs, charts, etc. will you need to prepare?

Instructional Strategies: “Into”

- What activity or activities will lead students into the lesson?
- How will you “open the door” to the new concept being introduced?

Language Considerations:

- What can the students do in English?
- How would you characterize their English proficiency?
- What linguistic and cultural idioms might be unclear to students?
- **Have you identified key vocabulary terms that are necessary for understanding the concept being addressed?**
- How will you introduce the vocabulary?

Tapping Prior Knowledge:

- What prior knowledge are you assuming from the students?
- Are there any culturally-based assumptions that your EL students may not have experienced that are important to the understanding of the concept to be taught?
- **What strategies will you use to activate (or create) that knowledge? (KWL, journal entries, cooperative interviews, graphic organizers, warm-ups, homework check, review, etc.)**

Instructional Strategies: “Through”

- What specific strategies and techniques will form the core of your lesson?
- How have you contextualized your instructions?
- What modeling will you provide?
- If you are teaching in expository mode, what contextual clues will you provide? (Graphic organizers, modeling, gesturing, props, etc.)
- If you are using discussion, how will you provide an environment to encourage this for EL students?
- What listening, speaking, reading and writing opportunities will you provide?
- **What scaffolding will you provide to assist students in negotiating their way through written text?**
- What strategies will you use to ensure students are actively learning?

Instructional Strategies: “Beyond”

Closure:

- What type of closure activities will you incorporate?
- How will you tie this lesson into future lessons?
- How will you encourage students to reflect on their learning (metacognition)?

SDAIE LESSON PLAN

Specially Designed Academic Instruction in English



Lesson Topic:

Learning Objective:

Key Concepts/Language/Vocabulary to Develop:	
Key Concepts	
Language Vocabulary Content Obligatory (relating directly to the content being learned)	
Language Vocabulary Content Supportive (used to support the content activity in terms of process and procedure)	

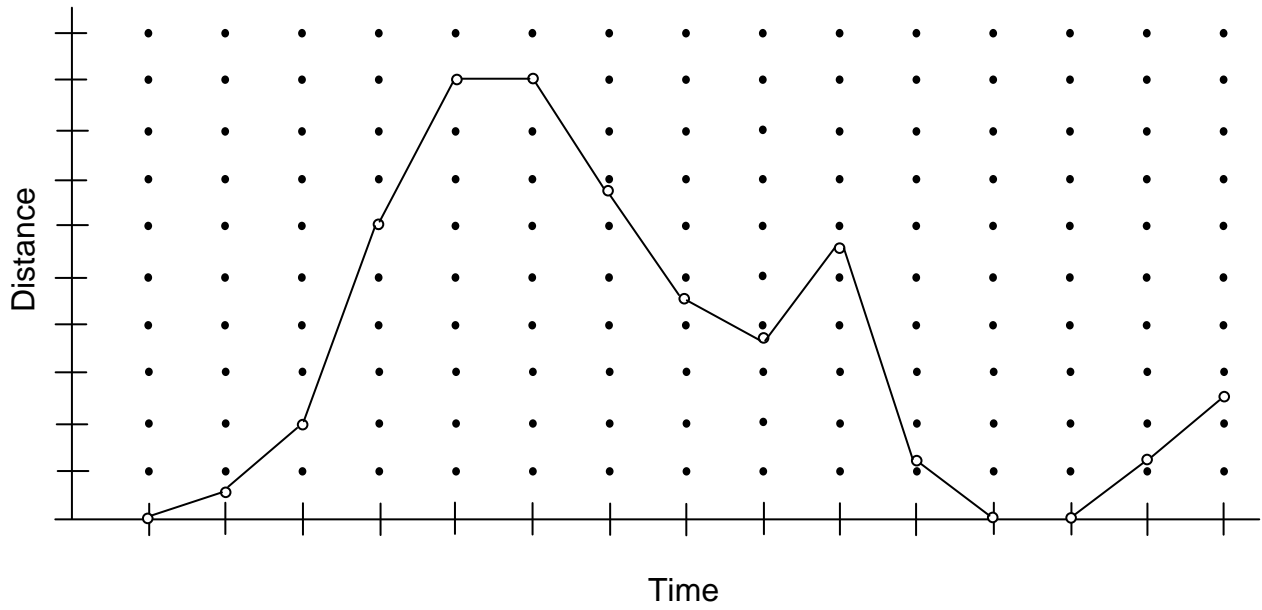
Strategies	Activities	Materials Needed
<p>Introduce Prepare students with:</p> <ul style="list-style-type: none"> • Experiences • Prior Knowledge 		
<p>Explore Provide relevant instruction and practice through:</p> <ul style="list-style-type: none"> • Presentation using SDAIE strategies. • Practice independently, with partners, and collaboratively • Use varied grouping configurations and activities for various learning styles. • Monitor students and provide feedback. • Modify materials and presentation to enhance learning. 		
<p>Extend</p> <ul style="list-style-type: none"> • Extend, enrich, and integrate learning across the curriculum. • Help students make conceptual and linguistic connections across the curriculum. 		
<p>Assess</p> <ul style="list-style-type: none"> • Check for clarification • Observe and assess concept and skill development • Ongoing assessment and modification of instruction 		

Template from Amazing English by Teresa Walter (Addison Wesley - 1996)

THINGS TO LOOK FOR IN A QUALITY SDAIE LESSON

1. There is abundant use of visuals, graphic organizers, models, games, and manipulatives.
2. Teacher continually checks for comprehension.
3. The teacher focuses on meaning rather than form. Structural error correction is kept to a minimum.
4. Students are allowed sufficient think time to respond to questions.
5. Teacher provides comprehensible input by modifying his/her language. Teacher uses simplified speech, clear enunciation, controlled vocabulary and keeps idiom usage to a minimum. The teacher highlights the concept being taught through repetition, rephrasing, and the use of many examples.
6. Teacher lectures are kept to a minimum and are supported through the use of visuals.
7. Lessons integrate the four modes of language: listening, speaking, reading, and writing.
8. Students are provided with opportunities to learn from each other through cooperative learning groups, peer tutoring, and cross-age tutoring.
9. Students have access to primary language materials that relate to the concept being taught.
10. Teacher designs activities that build on students' prior knowledge of the concept or topic being taught.

CAR RIDE GRAPH



Welcome Agents:

You have entered a secure zone.

**Your ultimate mission...SHOULD you decide to accept it...
is to determine how to get a graphing calculator to
draw the graph at the bottom of the graph activity sheet.**
The most “acceptable” answer may require some critical thinking.

BEFORE you can complete the ultimate mission, you must determine how you should walk so as to make a motion detector detect your movement and show graphs like the first eight graphs shown in the **graph activity sheet**.

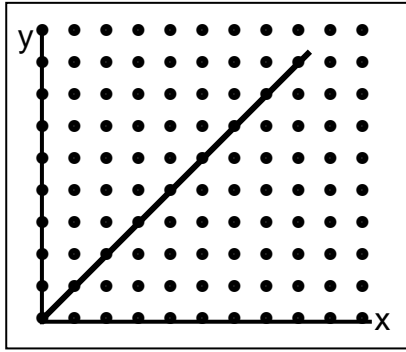
[Hint: Determine WHEN you should stand still,
WHEN you should walk,
HOW FAST, HOW SLOW, WHICH DIRECTION –
- TOWARD the detector or AWAY FROM the detector.]

You see, the motion detector sends out an electronic beam that you can't see. (Don't worry; you can't feel it either!) When the beam “runs into” your body, a dot will show up on the graph. The dot will help track the time that passed by before the beam reached AND how far away (distance) from the motion detector you were at the time.

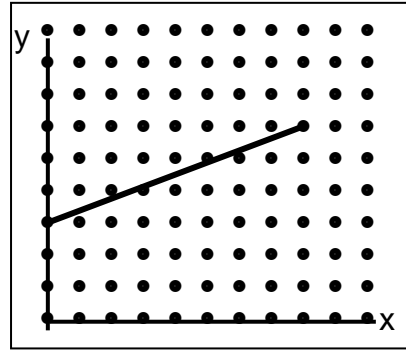
This is NOT an impossible mission. I expect you will enjoy it. You may collaborate with fellow agents on your team to determine your next move.

I look forward to seeing you WALK YOUR TALK when next we meet! Good luck on your mission.

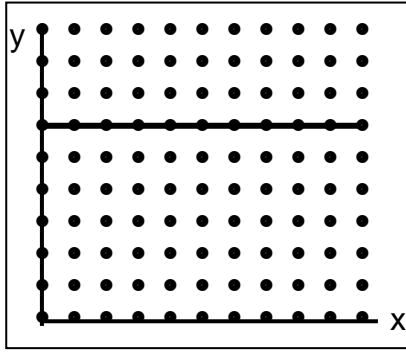
A.



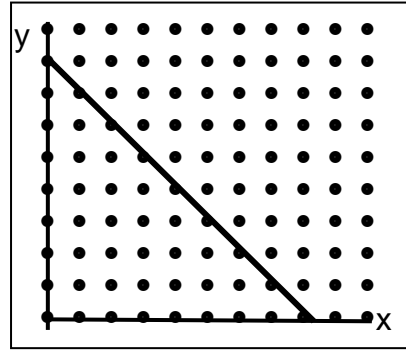
B.



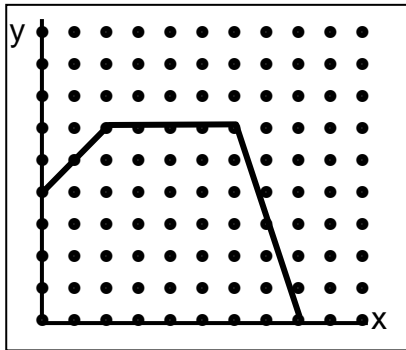
C.



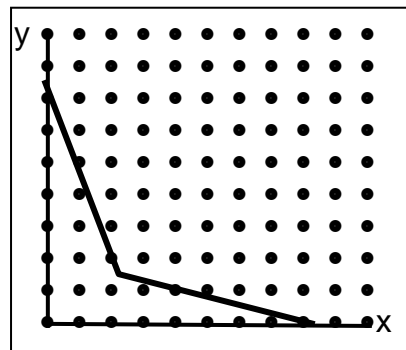
D.



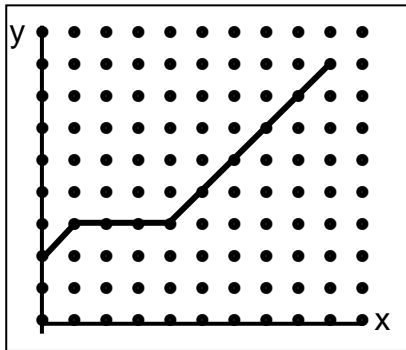
E.



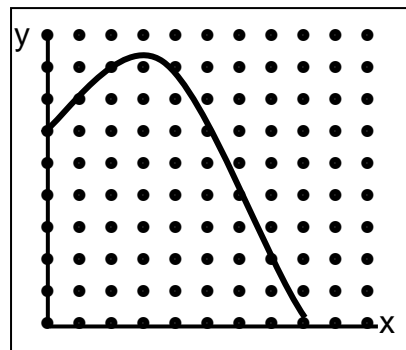
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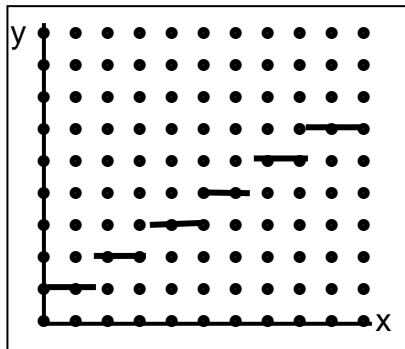
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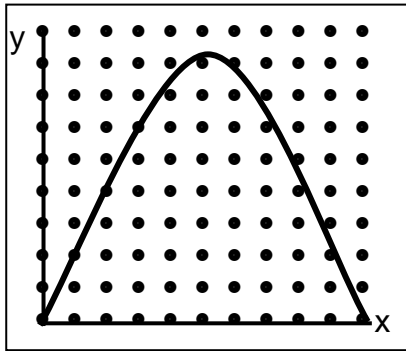


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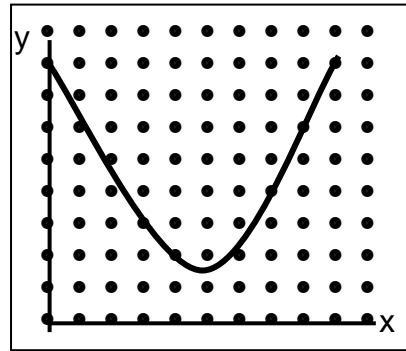


BONUS!

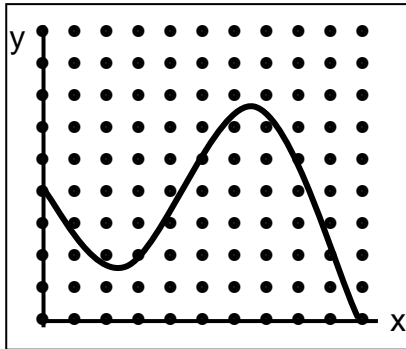
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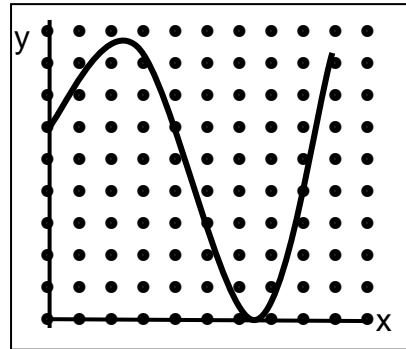
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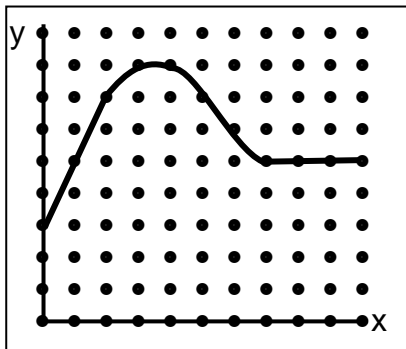
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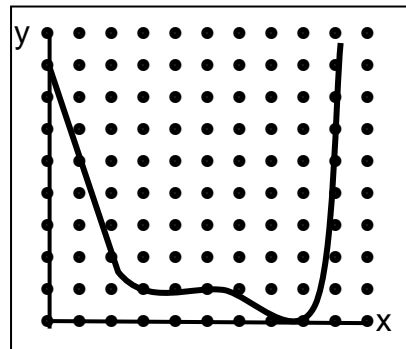
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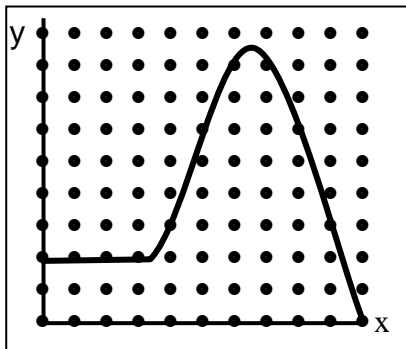
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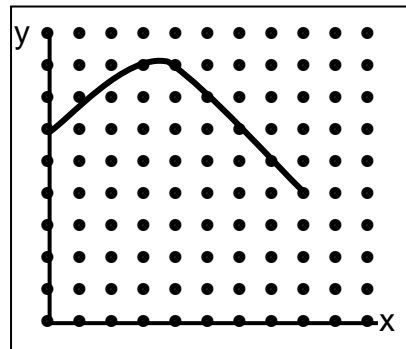
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Q.





Teacher to Teacher

Mission Possible!



Can You Walk Your Talk?

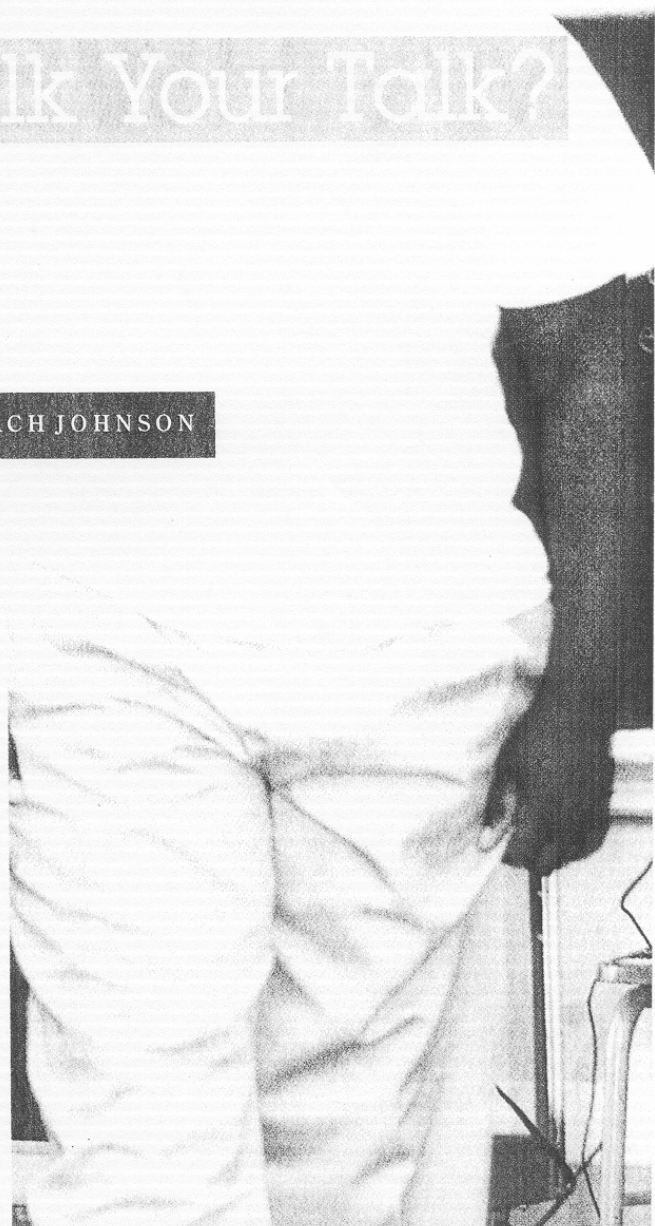
THE *MISSION IMPOSSIBLE* TELEVISION series is a thing of the past, yet *Mission Impossible* movies keep the mystery and intrigue alive. I take advantage of this intrigue to make one particular mathematics lesson more interesting for my students. This lesson uses a problem-solving approach to introduce an exploration of graphing-related concepts, such as intercepts, slope, and rates of change.

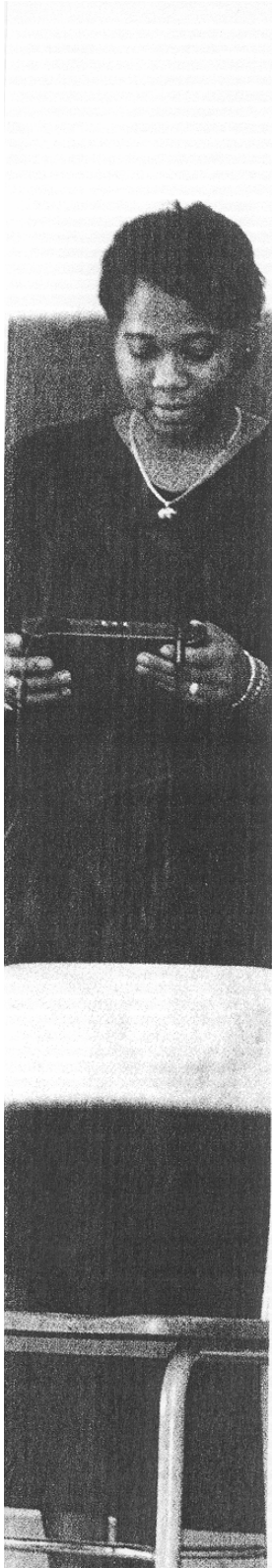
For this activity, students are assigned to cooperative groups in advance or quickly form groups with the two or three people seated closest to them. In the famous *Mission Impossible* episodes, a distinctive voice announces the mission to Agent Phelps through a tape recording that soon self-destructs. The audience never sees the person who speaks on the recording, nor do we know his name. We assume that he is a headquarters official, which is the teacher's role in this exploration. We know that the agent will not be able to ask any questions or engage in dialogue with headquarters before starting his mission. The agent may choose to accept or reject the mission; as we know, he always accepts and immediately sets off to meet the challenges that lie ahead before he is able to complete the mission.

Before we begin, I hand out the activity sheets shown in **figures 1** and **2**. I also introduce the Calculator-Based Ranger (CBR) and the graphing calculator. The students draw a connection to graphs that they have seen previously as we discuss the axes of

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PHOTOGRAPH BY JEFFREY SABO. ALL RIGHTS RESERVED

the graphs that we will use in our mission. The x -axis is the time in seconds, and the y -axis is the distance away from the motion detector in feet or meters. Students are encouraged to plan their strategies before the day of the mission. They may also consult with available “experts,” such as parents, older siblings, and older students, but not the headquarters official.

The mission begins as I ad-lib the information on the activity sheet:

Good morning, Agents! You have entered a secure zone. You must search for clues—sometimes referred to as “patterns”—to help you determine how to walk in front of the motion detector in a way that will cause the graphing calculator attached to it to plot the graphs shown on the back of the page. Your ultimate mission is to determine what to do to achieve the final graph at the bottom of the page. Before you can walk for that graph, you must determine how you should walk to make the motion detector detect your movement and show graphs like the first eight on the back of this page. You must determine when you should stand still; when you should walk; how fast or how slow you should go; and in which direction you should walk, that is, toward the detector or away from the detector.

I am always excited by the critical thinking of the students as someone first attempts to walk for the ninth graph. Eventually, someone suggests that more than one agent might be required to walk for the graph. After much consideration, a team of volunteers gathers to arrive at a consensus on their approach to the graph (see fig. 3). They stand in line approximately two feet apart in front of the motion detector. The person in front of the motion detector counts off, “One, . . . two, . . . three, . . .,” then takes a big step to the right or left, out of

Fig. 1 Mission Possible activity sheet

Welcome, Agents:

You have entered a secure zone.

Your ultimate mission . . . If you decide to accept it . . .
is to determine how to get a graphing calculator to
draw the graph at the bottom of the graph activity sheet.
 The most “acceptable” answer may require
 some critical thinking.

BEFORE you can complete the ultimate mission, you must determine how you should walk so as to make a motion detector detect your movement and show graphs like the first eight graphs shown in the **graph activity sheet**.

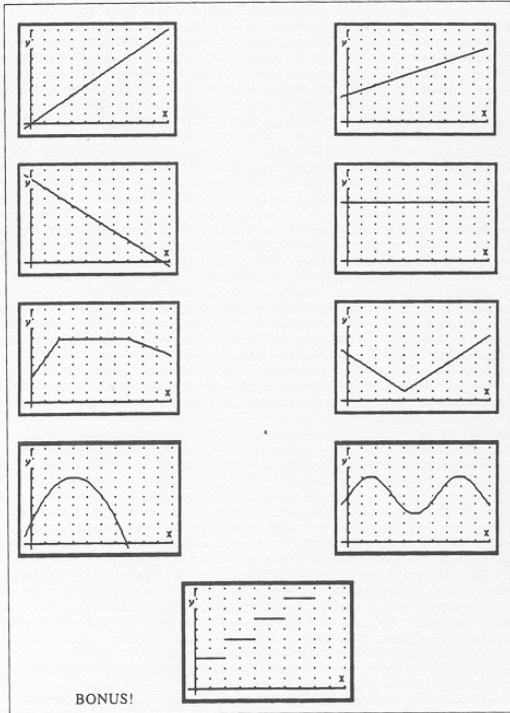
[Hint: Determine WHEN you should stand still,
 WHEN you should walk,
 HOW FAST, HOW SLOW, WHICH DIRECTION—
 —TOWARD the detector or AWAY FROM the detector.]

You see, the motion detector sends out an electronic beam that you can’t see. (Don’t worry; you can’t feel it either!) When the beam “runs into” your body, a dot will show up on the graph. The dot will help track the **time** that passed by before the beam reached you AND how far away (**distance**) from the motion detector you were at the time.

This is NOT an impossible mission. I expect you will enjoy it. You may collaborate with fellow agents on your team to determine your next move.

I look forward to seeing you WALK YOUR TALK when next we meet!
 Good luck on your mission.

Fig. 2
Mission
Possible
graph
activity
sheet



the range of the motion detector. The next person in line begins to count, “One, . . . two, . . . three,” then steps out of range. The counting and stepping continues until the last person has had a turn. Voila! Mission possible? Mission completed!

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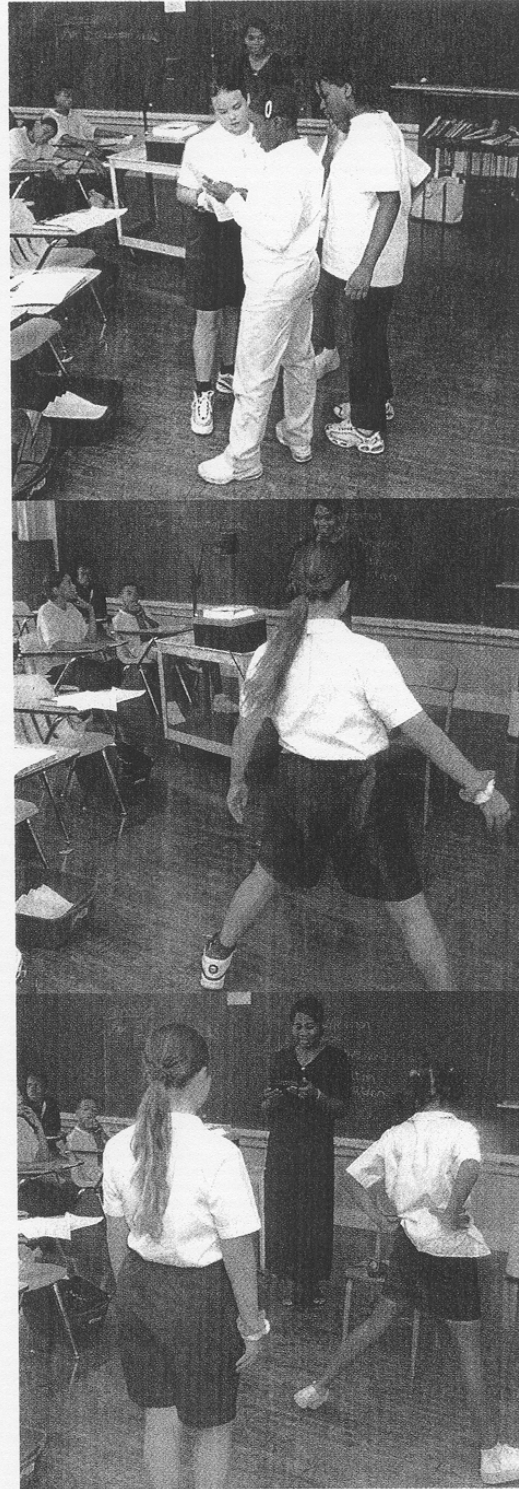


Fig. 3 Students activate the motion detector after a consultation

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THE CASE OF THE MISSING LAUNDRY...

MRS. MURPHY'S LAUNDRY

Mrs. Murphy was naturally very angry when she learned that her wash had been stolen from her clothesline while she was away. She asked Detective Curlock Foams to find out who was the thief. Upon investigating the movements of all who had been in the neighborhood about that time, Detective Foams discovered the following facts.

There was but one road between Waterloo and Daleville (24 miles due north). Mrs. Murphy lived on this road just 15 miles north of Waterloo. At 10:00 a.m., a bus left Waterloo and arrived at Daleville at 10:40 a.m., without making any other stops. The same bus made a return trip at the same speed, leaving Daleville at 10:50 a.m. Passengers on the northbound bus remembered seeing the laundry on the line as they passed. The driver and some passengers on the southbound bus were certain that there was no laundry on the line when they passed Mrs. Murphy's house.

At 9:30 a.m. Claude Bennington was known to have left his home 13 miles north of Waterloo. He walked north, past Mrs. Murphy's house, arriving at a service station, 18 miles from Waterloo, at 11:00 a.m. (Curlock Foams counted on a man walking at an average speed of 3 miles per hour.)

Ralph lives next door to Claude Bennington. He was walking to Daleville and left his home at 10:00 a.m. He was picked up by Mr. Pumpernickle at 11:30 a.m.

Mr. Pumpernickle had left his home (4 miles north of Waterloo) at 11:10 a.m. and had driven at an even speed of 40 miles per hour all the way, stopping only a moment to pick up Ralph. He was certain that Ralph was carrying no packages of any kind.

At 10:00 a.m. Alex Martin left his home (11 miles north of Waterloo) and walked to a garage (16 miles north of Waterloo), arriving there at the same time as did George Monroe.

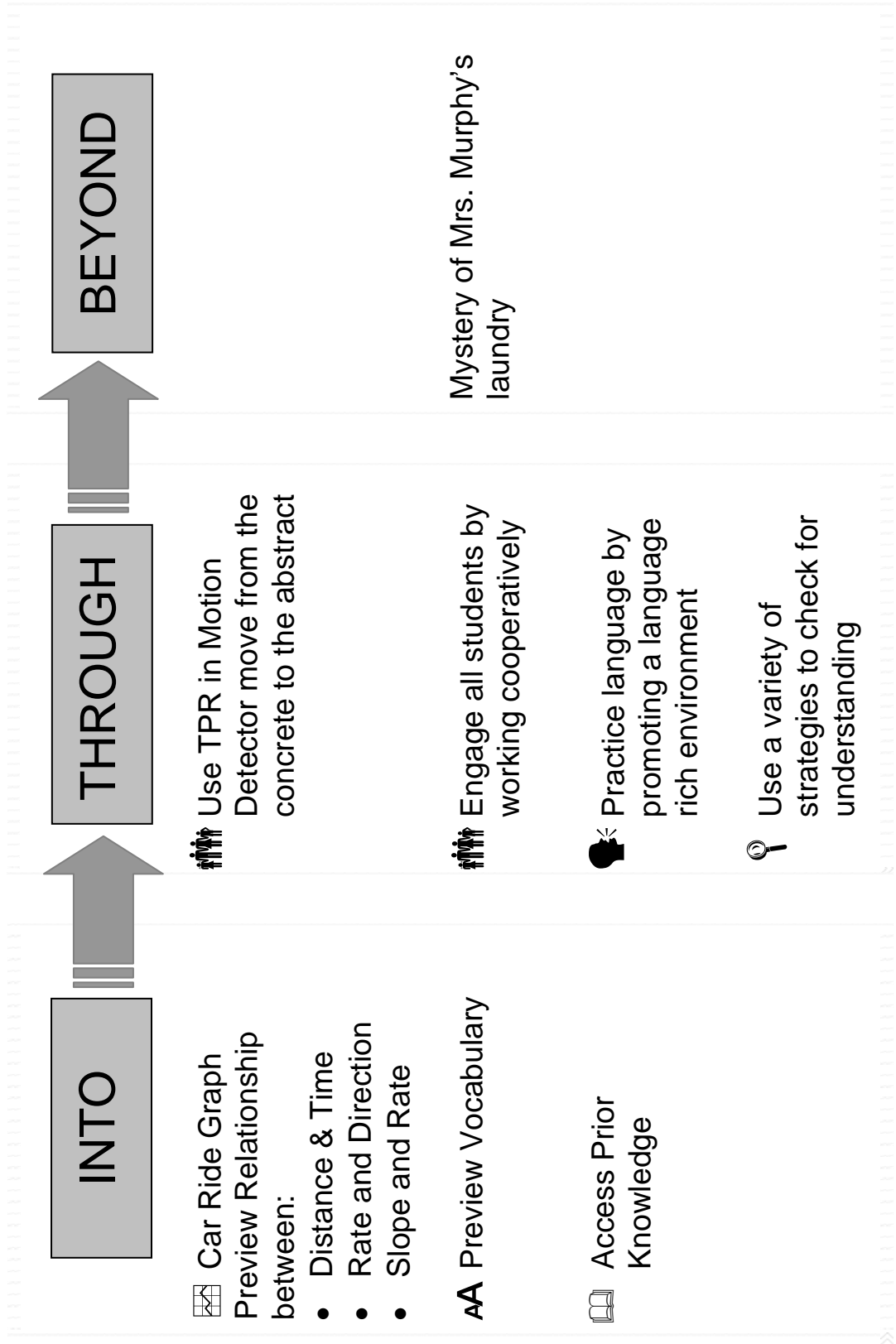
George Monroe had traveled on his bicycle at a rate of 6 miles per hour from his home (10 miles north of Waterloo), having left his home at 10:40 a.m.

Curlock Foams sat down at his desk, drew some lines on a piece of graph paper, picked up his hat, and went out to arrest the guilty person.

Who did he arrest?

Explain how you figured it out.

DISTANCE-TIME DECONSTRUCTION



ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 6

SLOPE IN THE REAL WORLD

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants will explore real world problems involving slope.

Focus Question

What does the slope ratio mean? What activities/strategies can you use to make the concept of slope more comprehensible to EL students?

Mathematics

- Explore patterns and extend the patterns to graphs
- Graph linear functions
- Explore the concept of slope and how it is used in the real world
- Explore the slope-intercept connection

Language

- Use visual organizers to teach academic language in mathematics
- Use real world examples (prior knowledge) to reinforce the concept of slope
- Discuss academic language

Problem of the Day	Homework/ Article
Stamps	<i>Making Mathematics Accessible to Latino Students – Rethinking Instructional Practice</i> Lena Lincoln Khisty

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

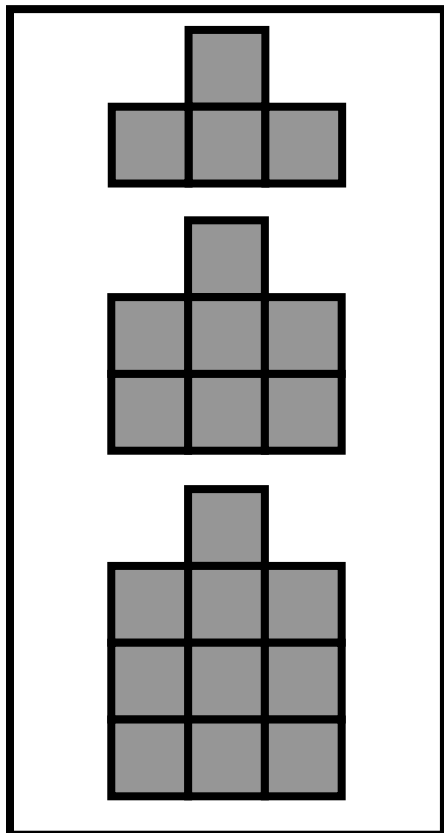
Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

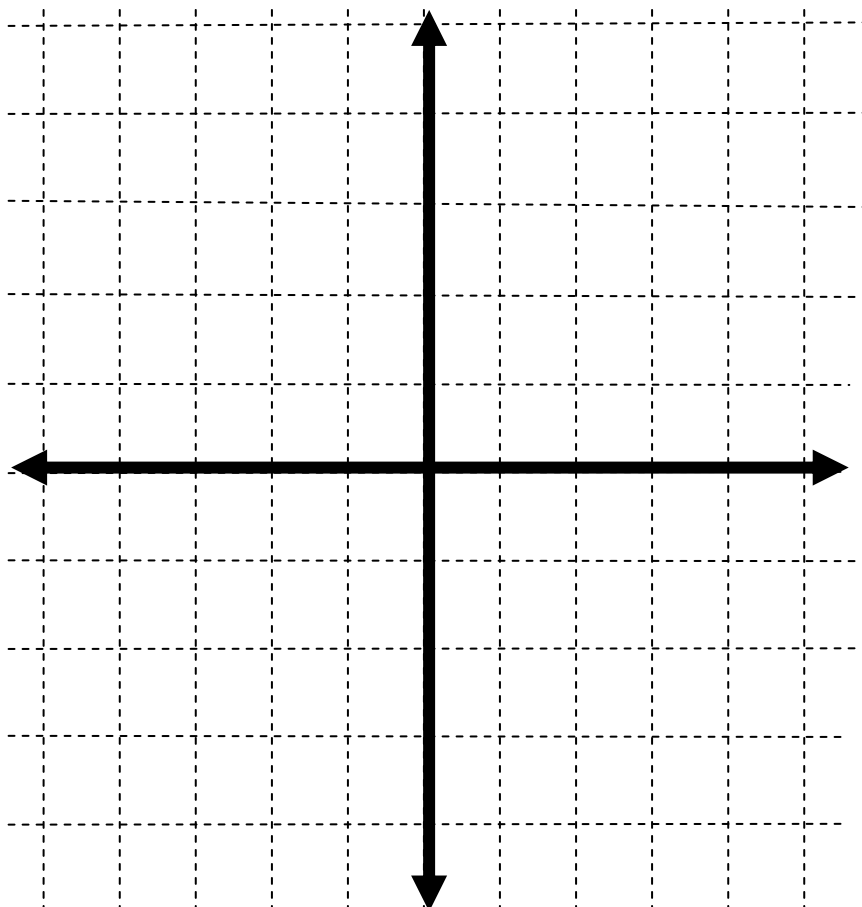
Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

Patterns, Table, Function & Graph Connection



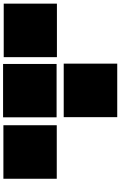
n	f(n)
1	
2	
3	
⋮	
17	
⋮	
51	
⋮	
n	

What is the relationship between n and $f(n)$?

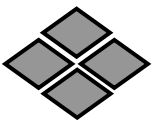


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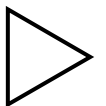


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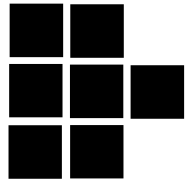


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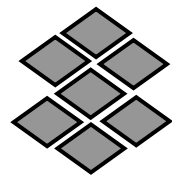
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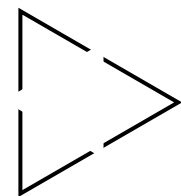
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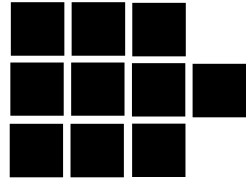
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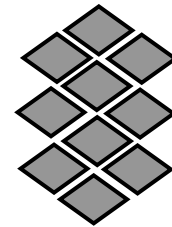
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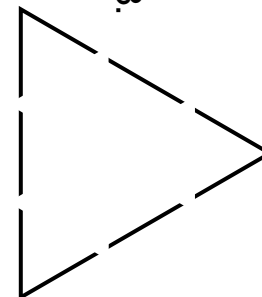
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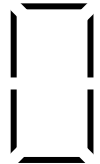
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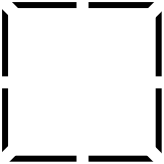
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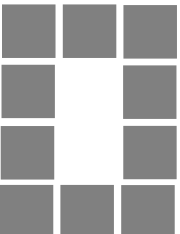
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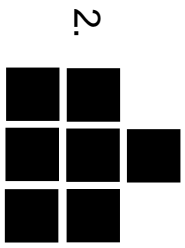
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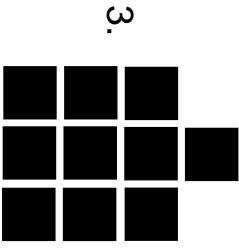
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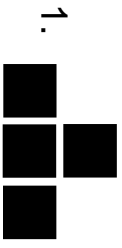


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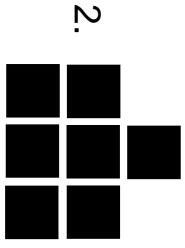


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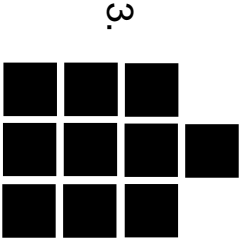
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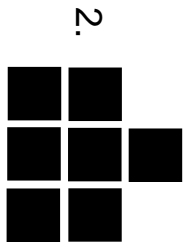


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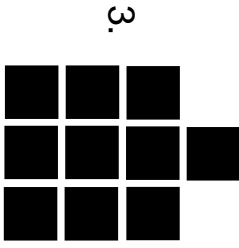
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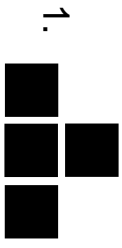


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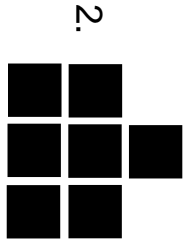


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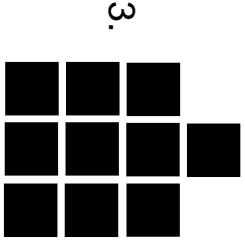
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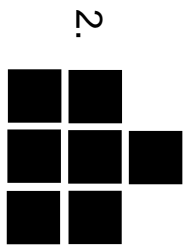


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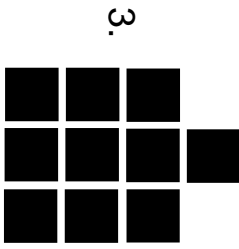
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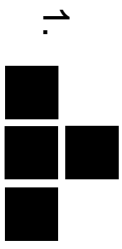


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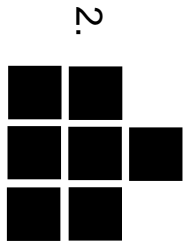


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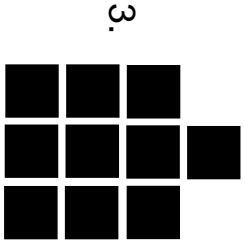
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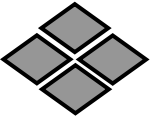
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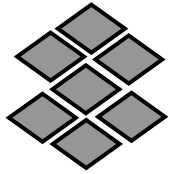
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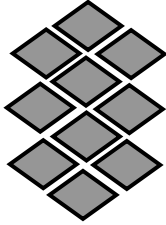
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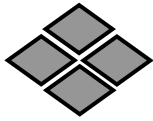


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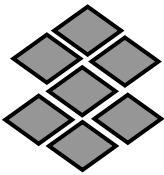


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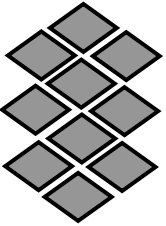
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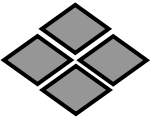


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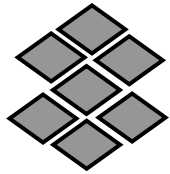


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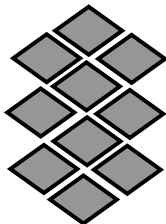
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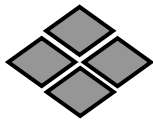


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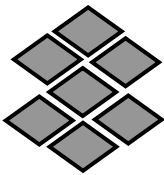


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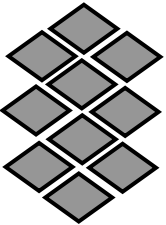
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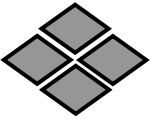


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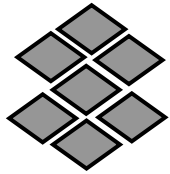


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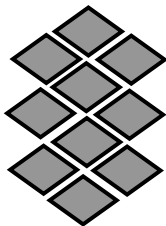
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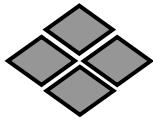


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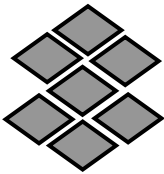


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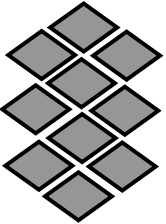
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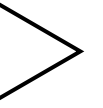
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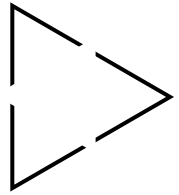
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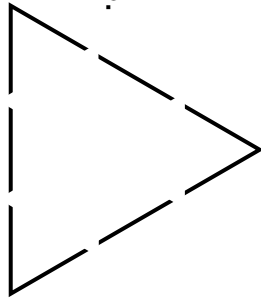
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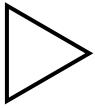
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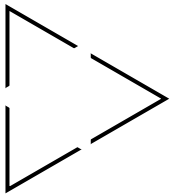
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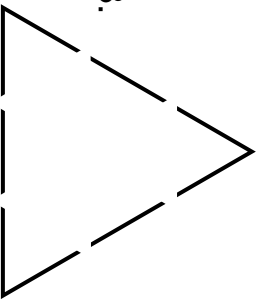
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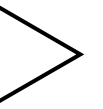
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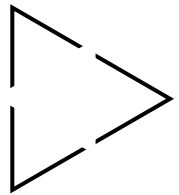
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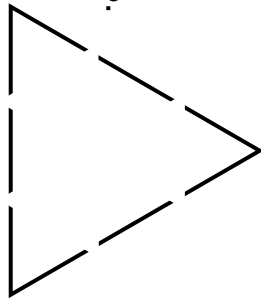
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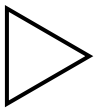
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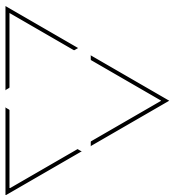
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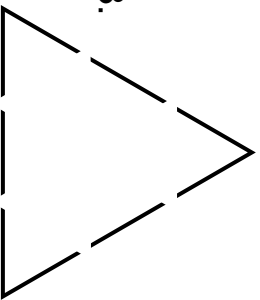
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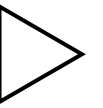
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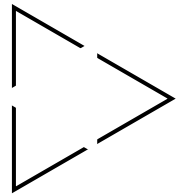
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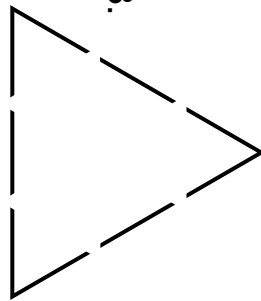
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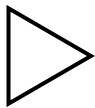
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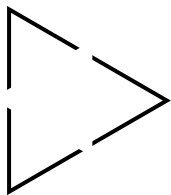
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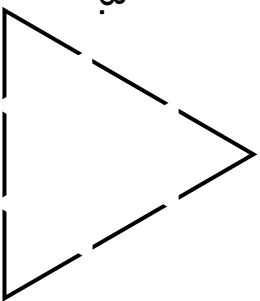
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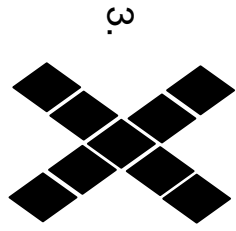
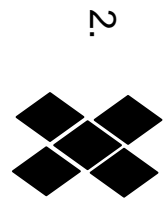
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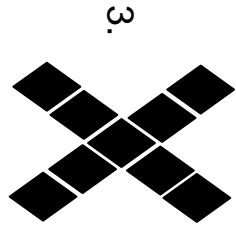
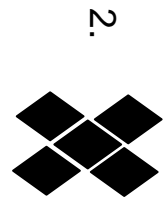
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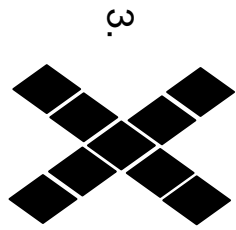
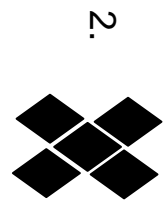
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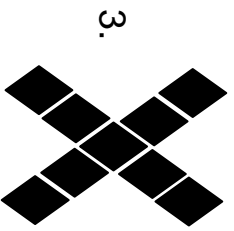
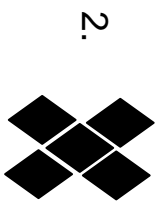
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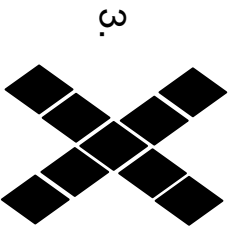
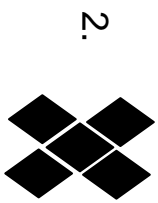
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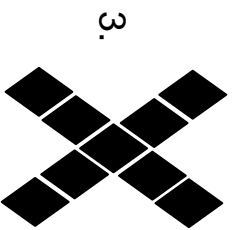
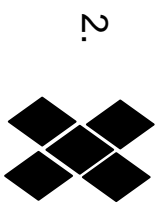
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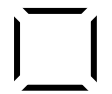


D.
1.

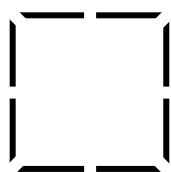



D.
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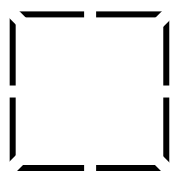
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1. 


2. 

3. 

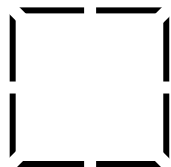
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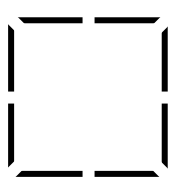
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1. 

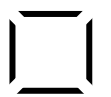
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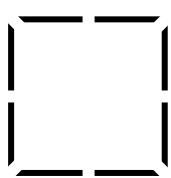
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2. 

3. 

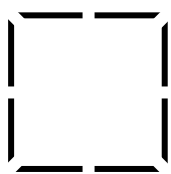
E.
1. 

2. 

3. 

E.
1. 

2. 

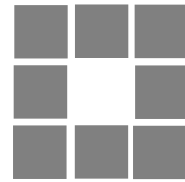
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F.

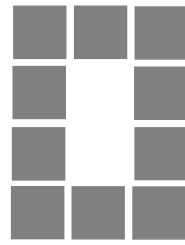
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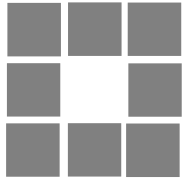


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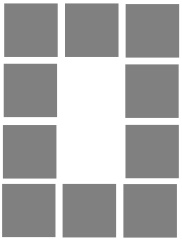
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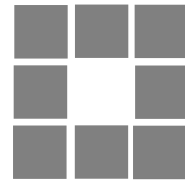


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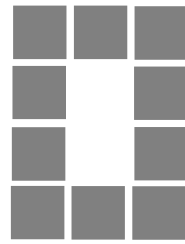
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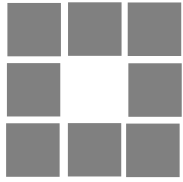


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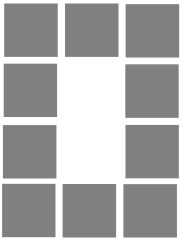
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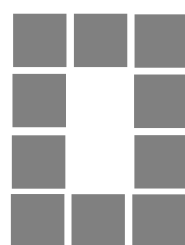
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2.



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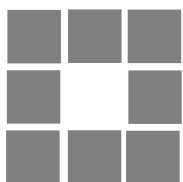


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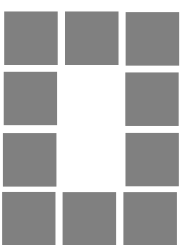
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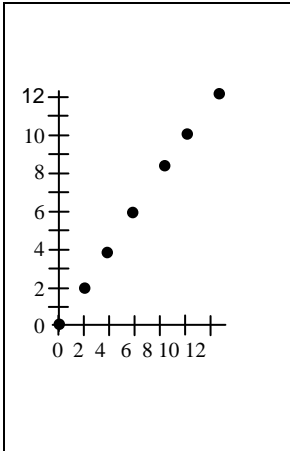
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3.



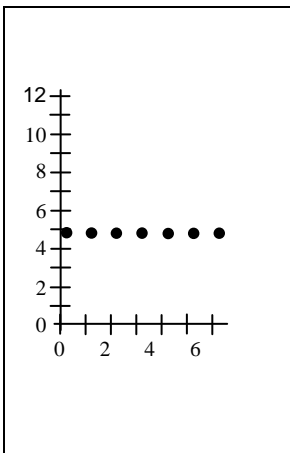
PATTERNS AND FUNCTIONS



In	Out
1	0
2	2
3	4
4	6
5	8
6	10
7	12

$$y = 2x - 2$$

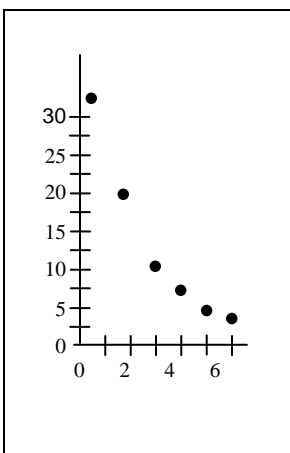
Double and subtract 2.



In	Out
0	5
1	5
2	5
3	5
4	5
5	5
6	5

$$y = 5$$

Multiply by 0 and add 5.

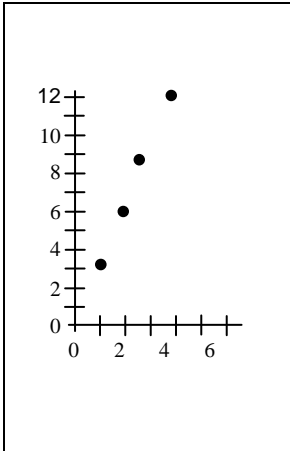


In	Out
1	36
2	18
3	12
4	9
5	7.2
6	6
7	5.1
8	4.5

$$xy = 36$$

Divide into 36.

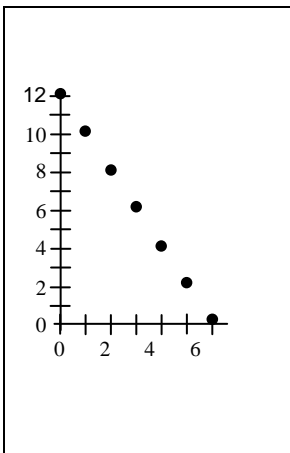
PATTERNS AND FUNCTIONS



In	Out
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24

$$y = 3x$$

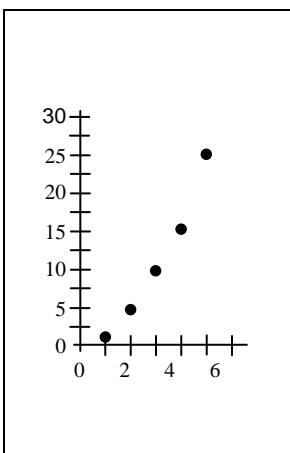
Triple.



In	Out
0	12
1	10
2	8
3	6
4	4
5	2
6	0

$$y = 12 - 2x$$

Double and subtract from 12.



In	Out
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64

$$y = x^2$$

Square.

MATH VOCABULARY 1

more than *increased by* *altogether* *how many more?* *exact*
less than *equal shares* *larger* *dividend* *smaller*
change *quotient* *multiplied by* *almost* *twice*
shorter *plus* *decreased by* *sum of* *divisible*
total *same number* *estimate* *divided by* *times* *longer*
subtracted from *difference* *multiply* *nearest* *equal parts* *fewer*
add *area* *in all* *added to* *divided into* *minus* *subtract*
total distance around *perimeter* *product of* *average*
which is less? *table* *if the pattern continues*

Write each word, or phrase, in the column that matches the operation:

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
OTHER:			

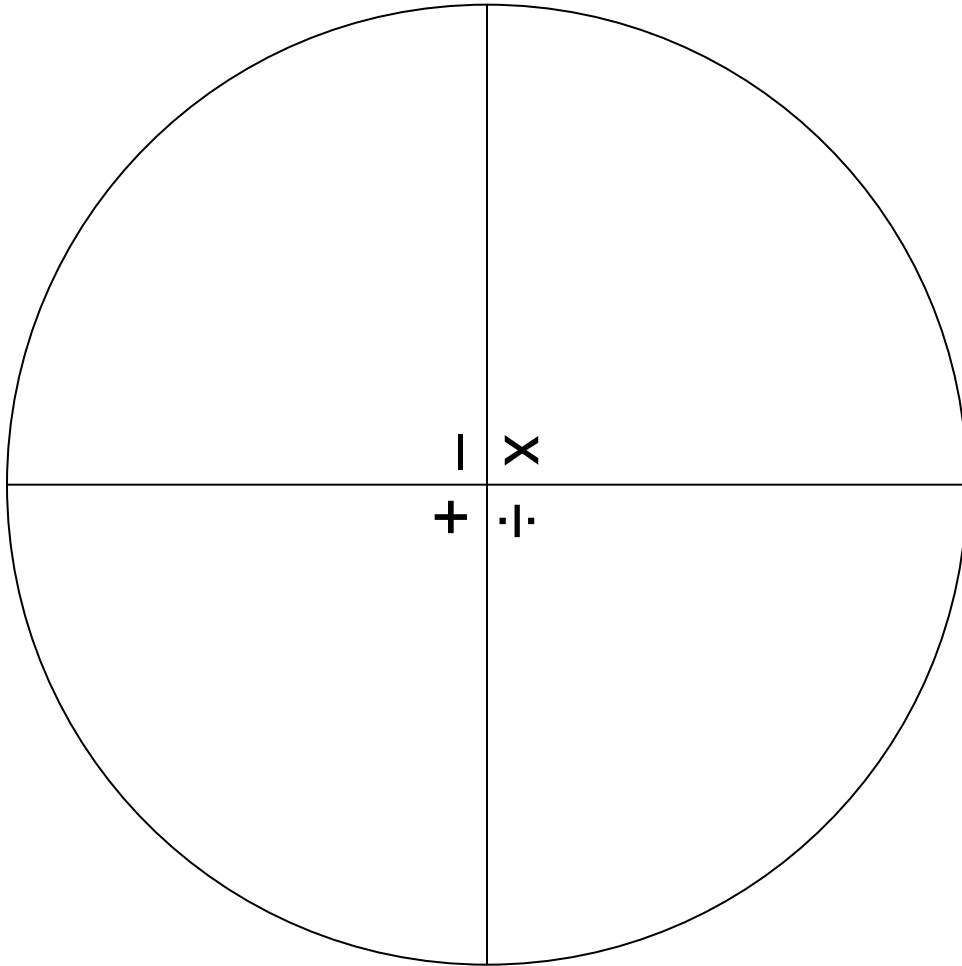
MATH VOCABULARY 2

equal to = sum ten less than less than < how many?
 one more than smallest circle smaller addition tens (longs)
 one less than number shorter/longer tally chart volume number sentence
 words/pictures/numbers ten more than most often
 o'clock picture graph triangle before/after
 rectangle + plus bar graph ones (units) hundreds (flats) pattern
 square estimate length larger most often weight difference
 digit largest least often how much? subtraction
 - minus

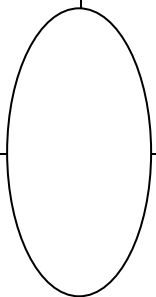
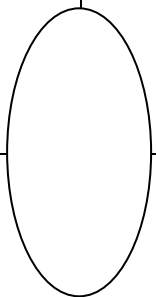
Write each word, or phrase, in the column that matches the operation:

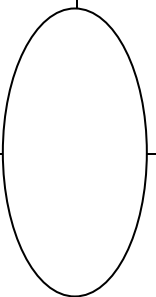
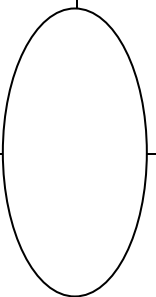
NUMBER SENSE	ALGEBRA AND FUNCTIONS	MATHEMATICAL REASONING	MEASUREMENT AND GEOMETRY
STATISTICS, DATA ANALYSIS, AND PROBABILITY:			

OPERATION BOARD



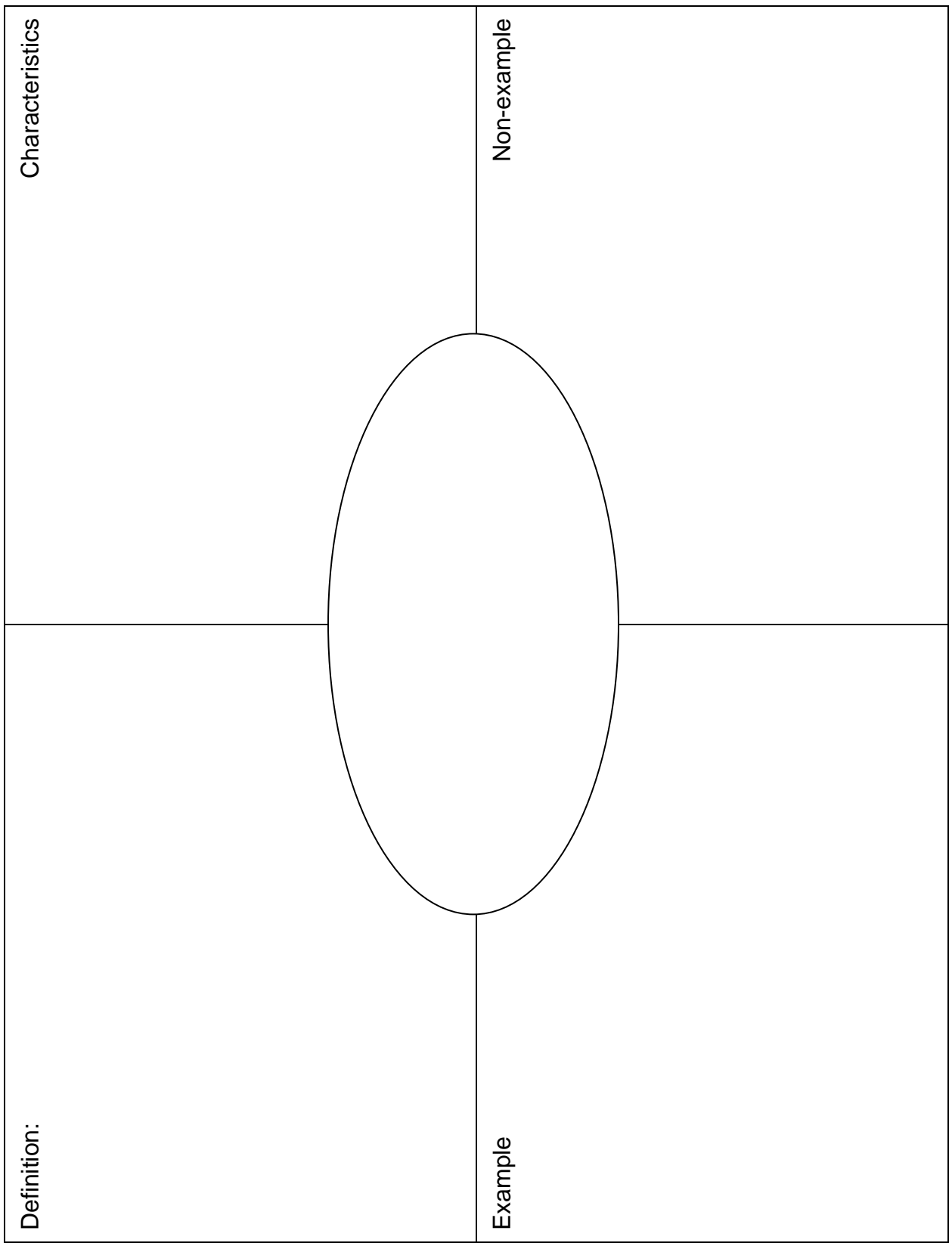
WORD ORGANIZERS

Definition:	Characteristics:
	
Example	Non-Example

Definition	Reminder
	
Diagram	Example

Word:	Picture:
Definition:	Reminder:

Word:	Definition:	Picture/Diagram that reminds you of the definition
Sentence:		



COMPARING GRAPHS OF LINES 4

Set 4

- $y = 2x + 1$
- $y = 2x + 2$
- $y = 2x + 3$
- $y = 2x + 4$
- $y = 2x + 5$

Tables

x	y	x	y	x	y	x	y	x	y

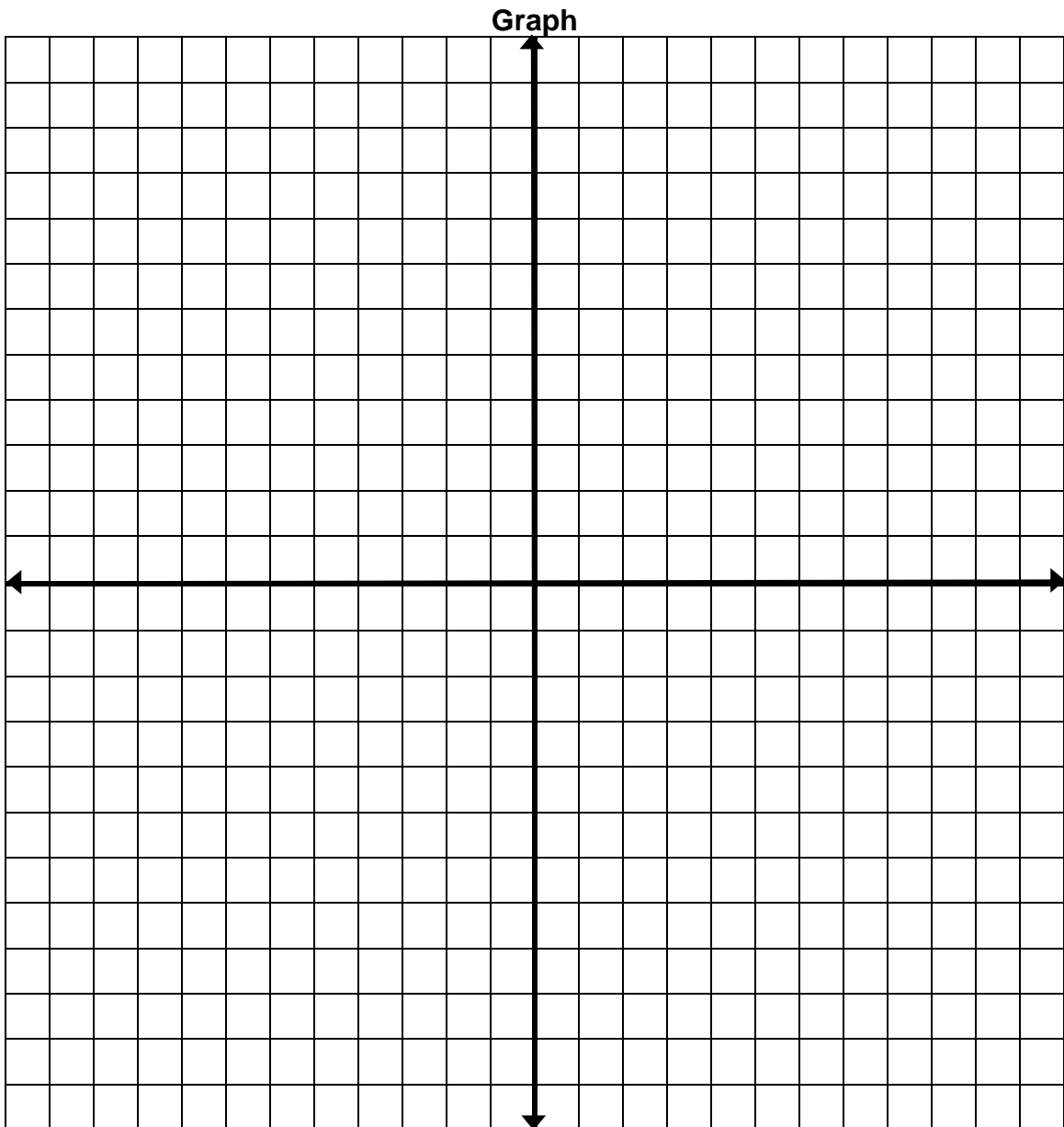
$y = 2x + 1$

$y = 2x + 2$

$y = 2x + 3$

$y = 2x + 4$

$y = 2x + 5$



COMPARING GRAPHS OF LINES 5

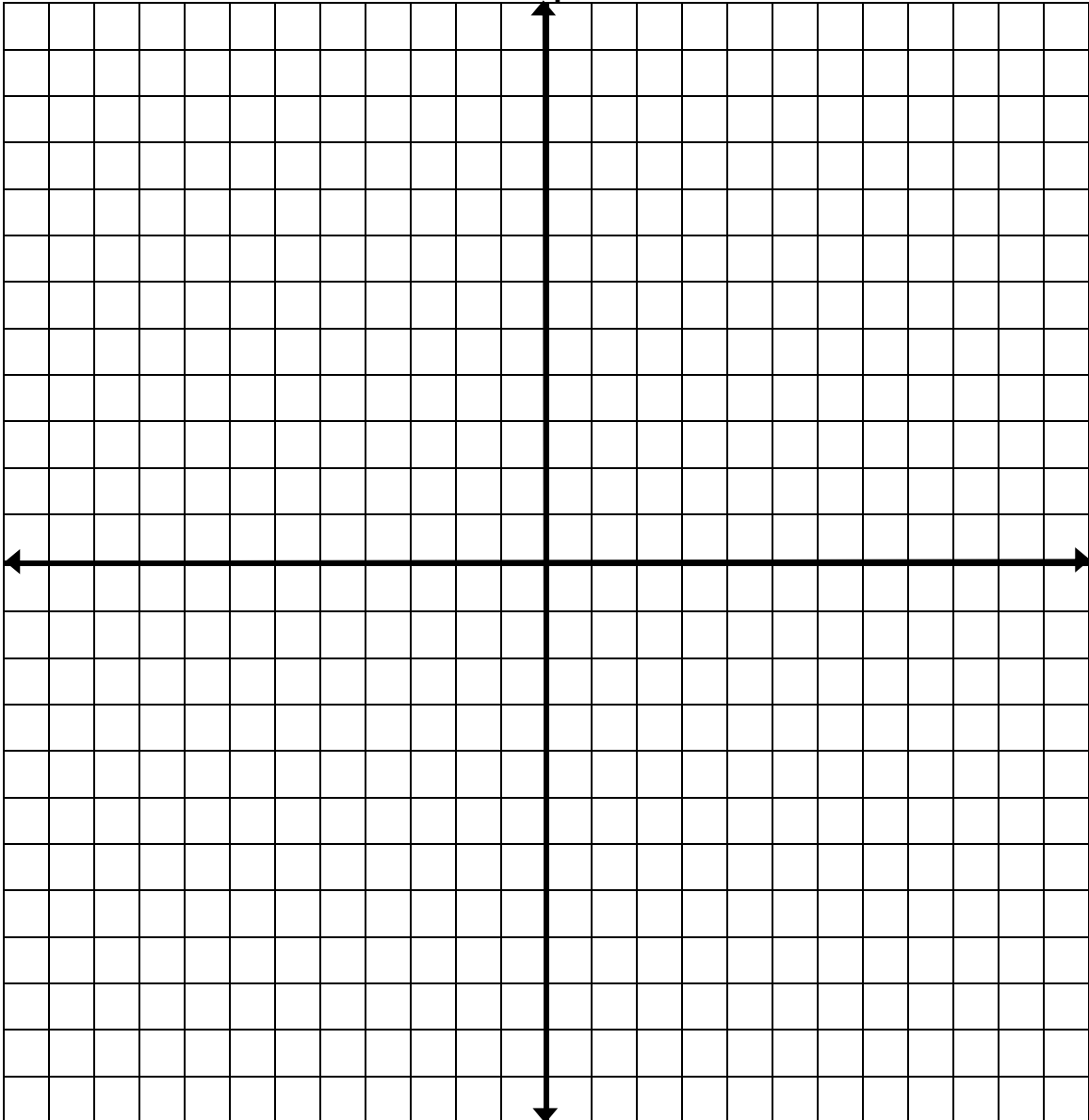
Set 5

- $y = 2x - 1$
- $y = 2x - 2$
- $y = 2x - 3$
- $y = 2x - 4$
- $y = 2x - 5$

Tables

x	y	x	y	x	y	x	y	x	y
$y = 2x - 1$		$y = 2x - 2$		$y = 2x - 3$		$y = 2x - 4$		$y = 2x - 5$	

Graph



COMPARING GRAPHS OF LINES 6

Set 6
 $y = -x$
 $y = -2x$
 $y = -3x$
 $y = -4x$
 $y = -5x$

Tables

x	y
---	---

$y = -x$

x	y
---	---

$y = -2x$

x	y
---	---

$y = -3x$

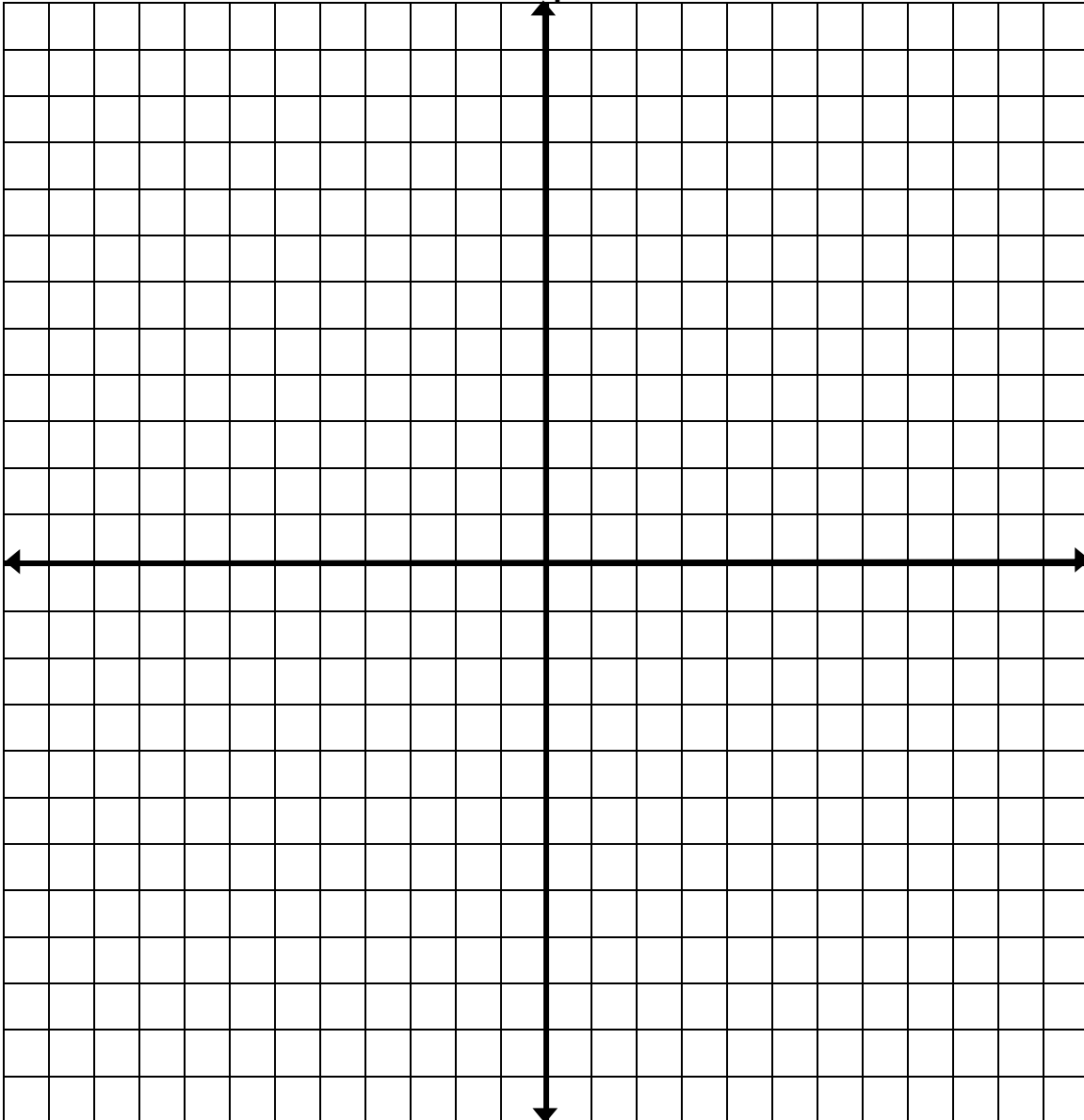
x	y
---	---

$y = -4x$

x	y
---	---

$y = -5x$

Graph



COMPARING GRAPHS OF LINES 7

Set 7

- $y = -x + 1$
- $y = -x + 2$
- $y = -x + 3$
- $y = -x + 4$
- $y = -x + 5$

Tables

x	y	x	y	x	y	x	y	x	y

$y = -x + 1$

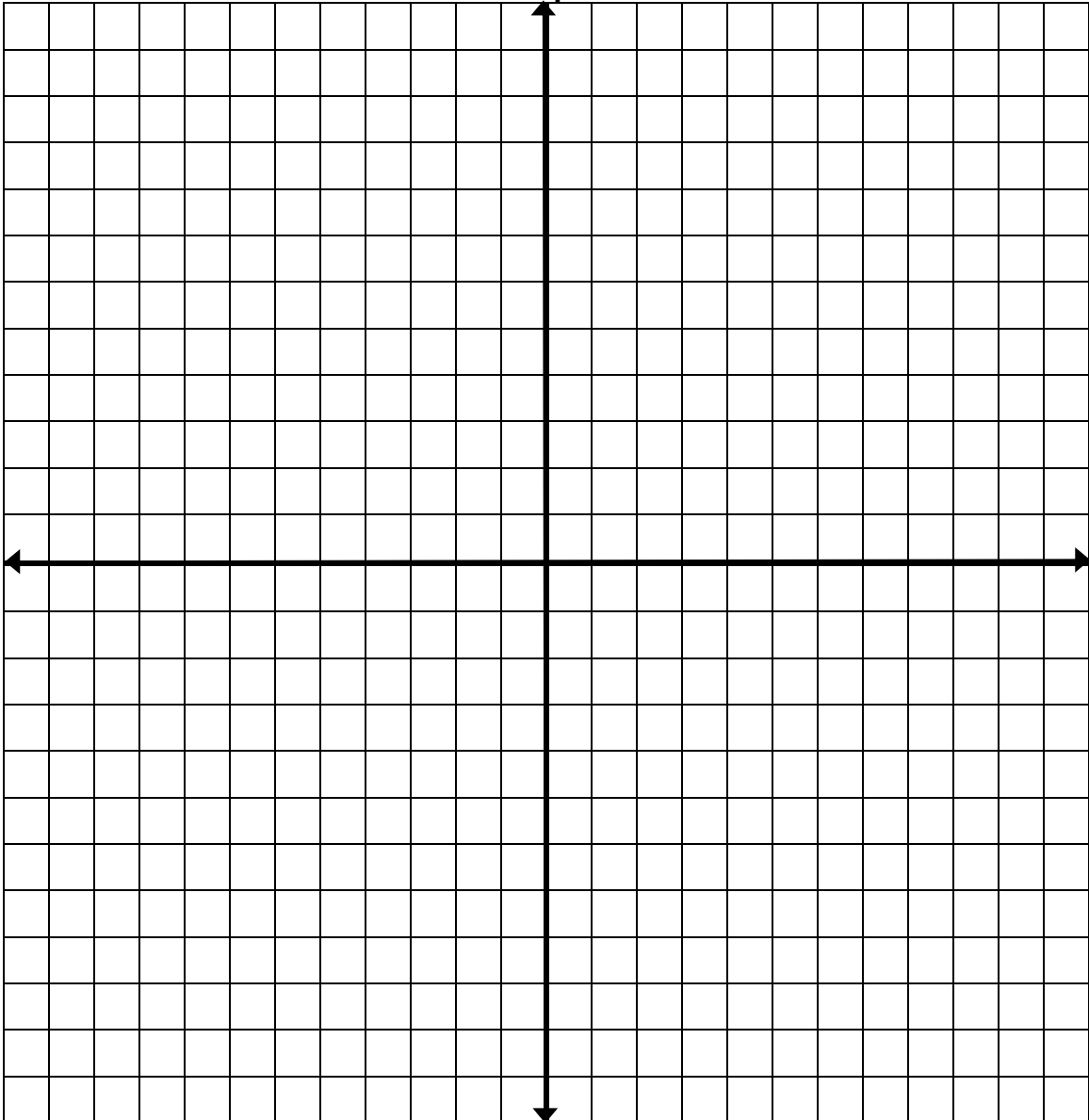
$y = -x + 2$

$y = -x + 3$

$y = -x + 4$

$y = -x + 5$

Graph



COMPARING GRAPHS OF LINES 8

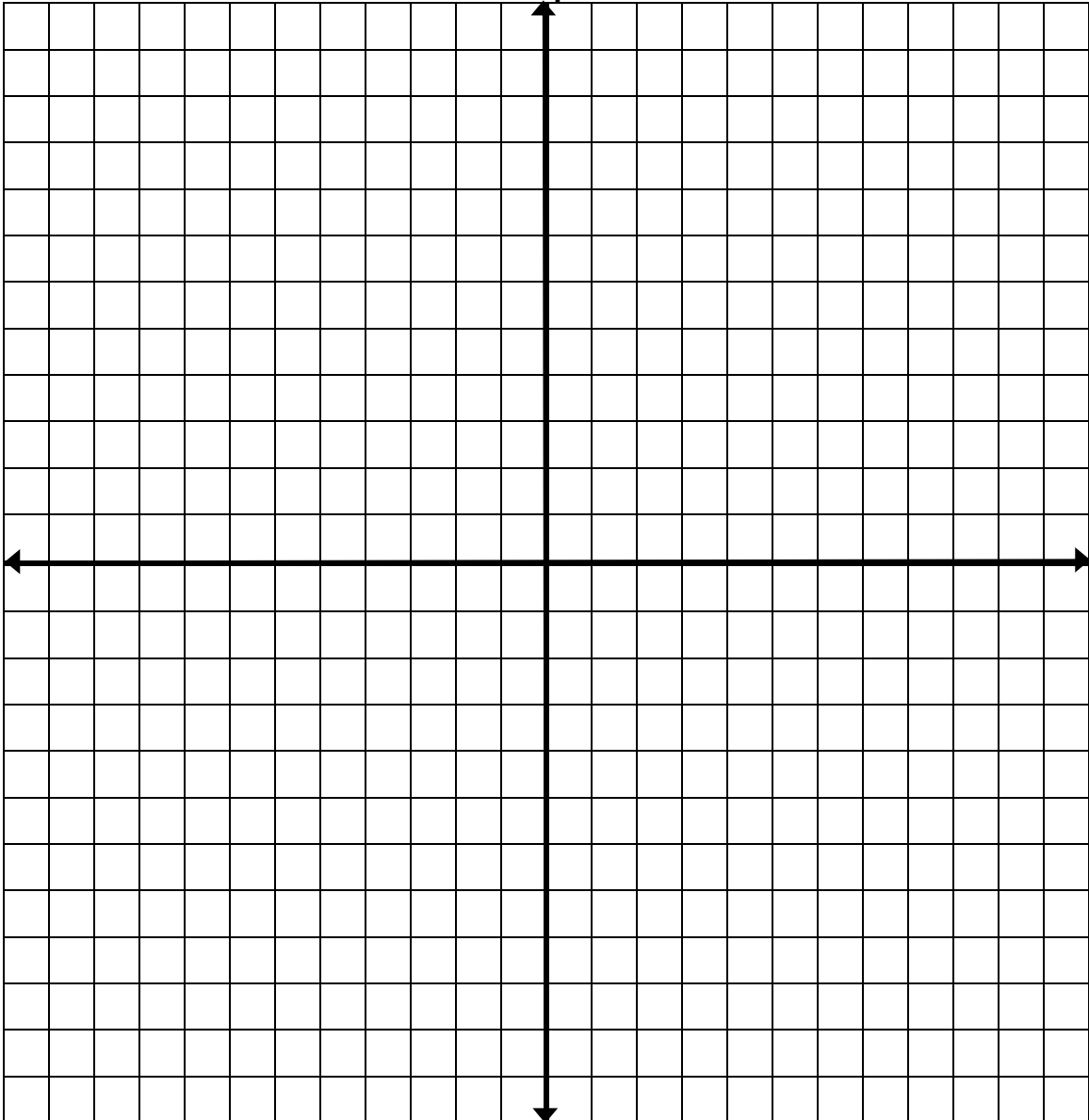
Set 8

- $y = -x - 1$
- $y = -x - 2$
- $y = -x - 3$
- $y = -x - 4$
- $y = -x - 5$

Tables

x	y	x	y	x	y	x	y	x	y
$y = -x - 1$		$y = -x - 2$		$y = -x - 3$		$y = -x - 4$		$y = -x - 5$	

Graph



JOURNAL

For the next 5 minutes, reflect on what you have learned so far (today or during the whole institute). It can be on ELD or mathematical concepts.

ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 7

SLOPE INTERCEPT CONNECTION

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants will be introduced to the formal definition of slope. Participants will then connect this to the slope-intercept connection.

Focus Question

How do we connect the basic concepts of linear functions to a more rigorous definition of slope? How do we give our EL students access to this rigorous mathematics?

Mathematics

- Examine the formal definition of slope
- Investigate slope and y-intercept of linear functions
- Use the graphs of linear functions to determine the equation of the line
- Address academic math vocabulary and the role it plays in conceptual understanding of mathematical concepts

Language

- Explore Into-Through-Beyond in mathematics
- Work cooperatively in preparation for sheltered lesson –address issues of assessment
- Discuss various activities that promote academic language in a mathematics classroom

Problem of the Day

Hoops

Homework/ Article

Assessment and Equity
By Terri Belcher, Grace Davila Coates, Jose Franco, and Karen Mayfield-Ingram

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

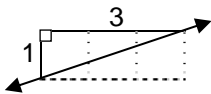
Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

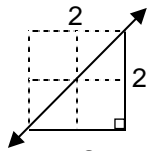
Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

PATTY PAPER SLOPE

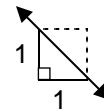
- Take a piece of patty paper; copy each line on top of the next line.
- Compare the slopes.
- What happens to the slope of the line when $v < h$, $v = h$, or $v > h$?
- Discuss and write your conclusions in your journal.



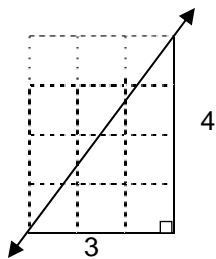
Slope is $\frac{1}{3}$



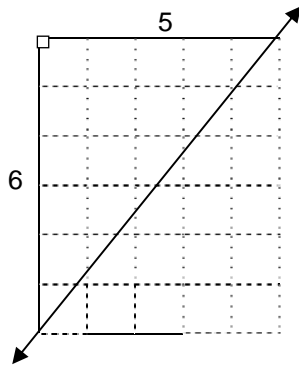
Slope is $\frac{2}{2}$ or 1



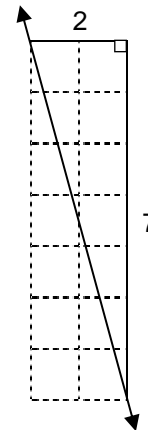
Slope is $-\frac{1}{1}$ or -1



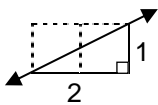
Slope is $\frac{4}{3}$



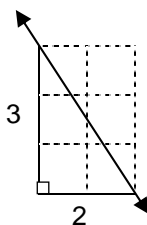
Slope is $\frac{6}{5}$



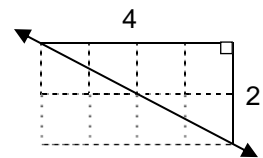
Slope is $-\frac{7}{2}$



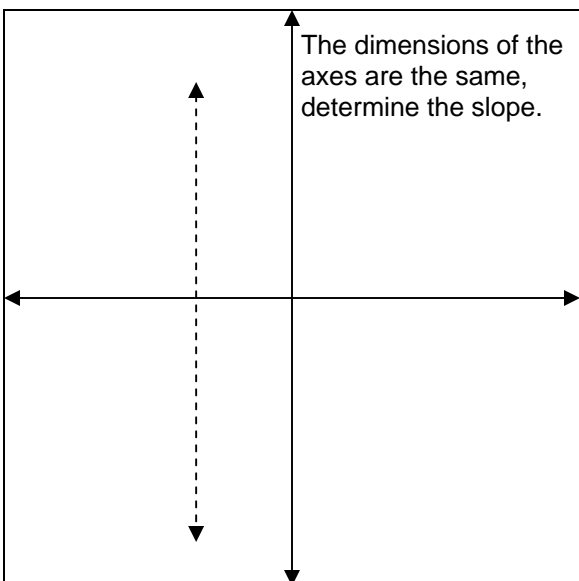
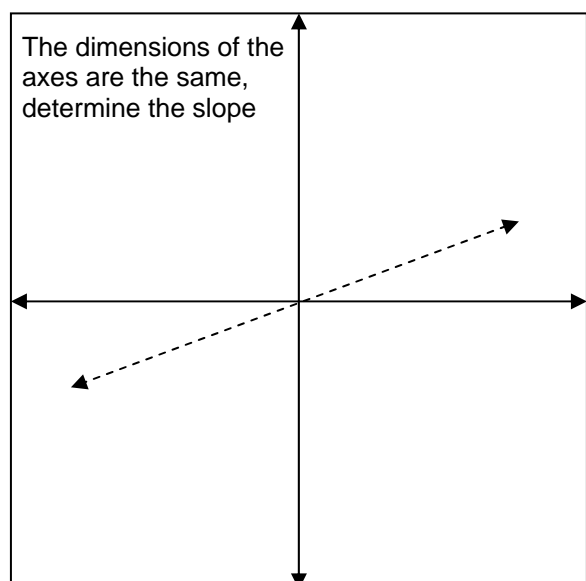
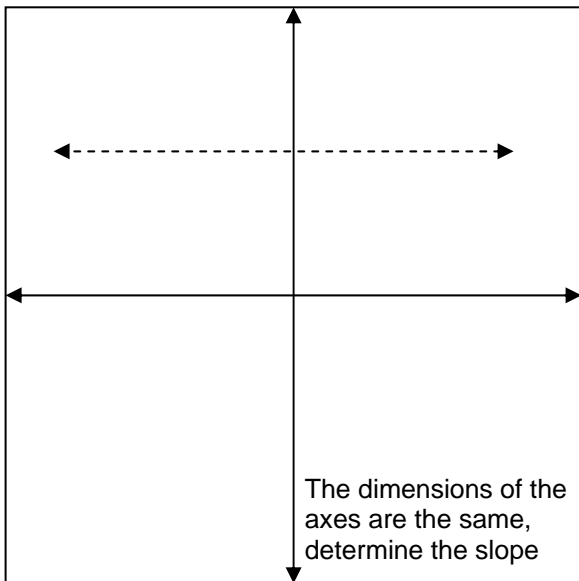
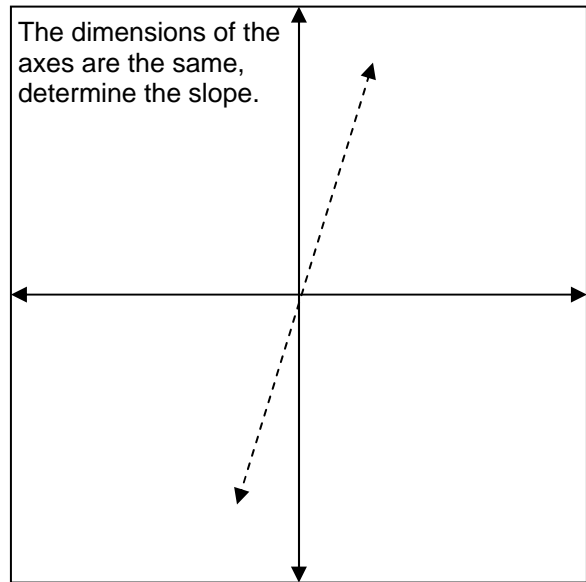
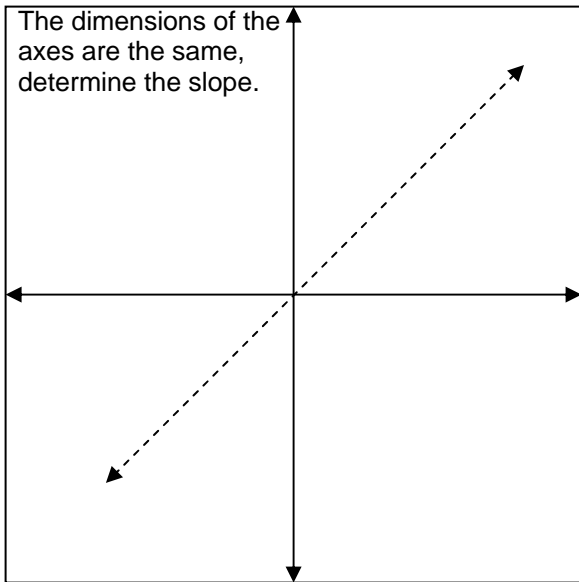
Slope is $\frac{1}{2}$



Slope is $-\frac{3}{2}$



Slope is $-\frac{2}{4}$ or $-\frac{1}{2}$



$$m = \left| \frac{v}{h} \right|, |v| > |h|$$

$$m = \left| \frac{v}{h} \right|, |v| = |h|$$

$$m = \left| \frac{v}{h} \right|, |v| = 0$$

$$m = \left| \frac{v}{h} \right|, |v| < |h|$$

$$m = \left| \frac{v}{h} \right|, |h| = 0$$

The slope cannot be determined.

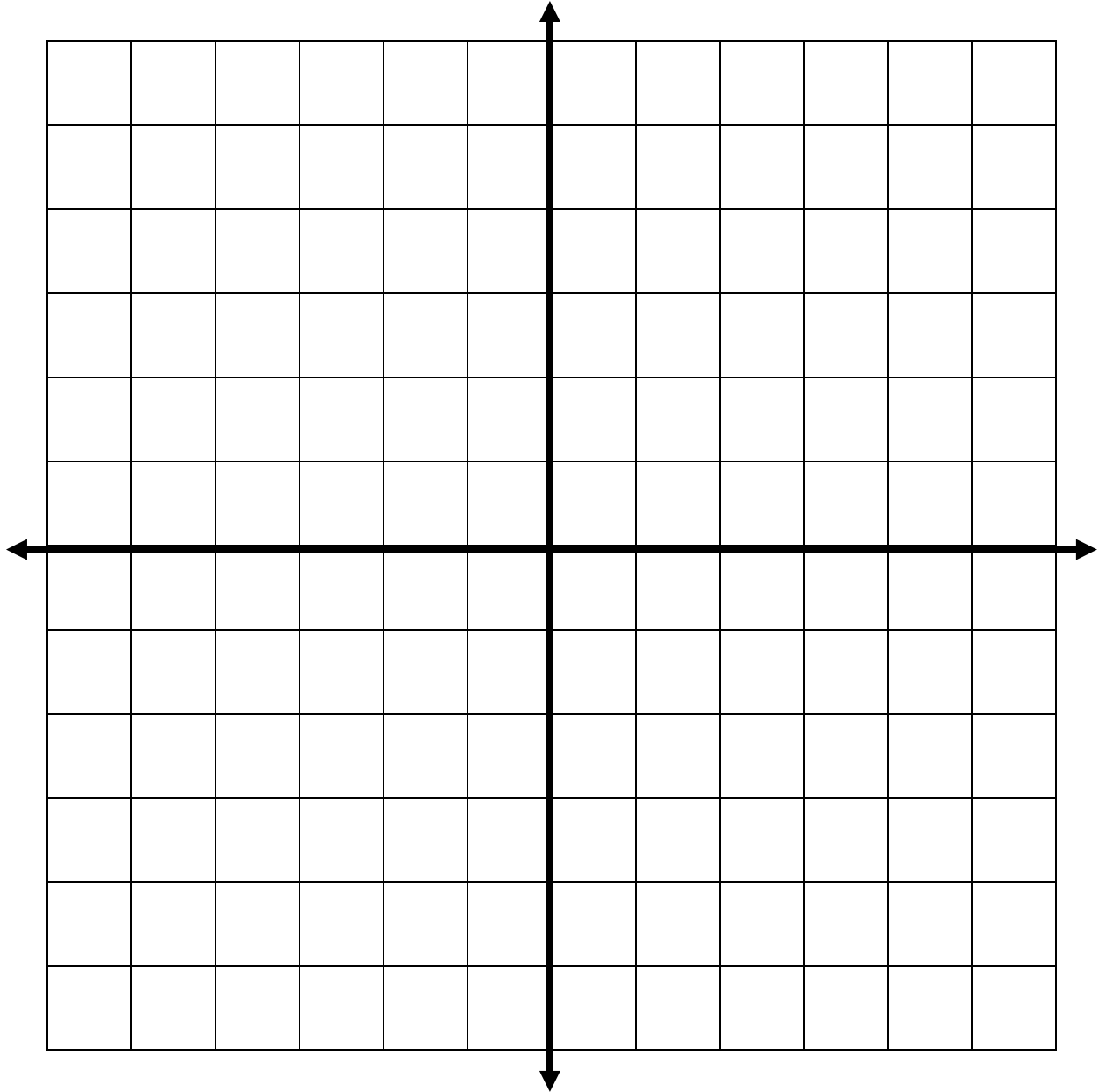
The slope cannot be determined.

The slope cannot be determined.

COORDINATE AXIS

a) $f(x) = 2x + 1$

b) $f(x) = -\frac{2}{3}x - 2$



WARMUP: SLOPE DANCE

Look at the functions assigned to your group.

Identify the slope and y-intercept.

Go outside and make a graph using the people in your group.

Do not make a table, use only what you know about slope and the y-intercept.

$$\text{SLOPE} = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{rise}}{\text{run}} = \frac{\text{vertical movement}}{\text{horizontal movement}} = \frac{\text{move up or down along the } y\text{-axis}}{\text{move left or right along } x\text{-axis}}$$

Y-INTERCEPT = point where the function crosses the y-axis

GROUP FUNCTIONS:

Group 1: a) $f(x) = 3x + 2$
b) $f(x) = -\frac{1}{3}x - 1$

Group 3: a) $f(x) = -2x + 1$
b) $f(x) = \frac{1}{2}x - 2$

Group 5: a) $f(x) = 3x - 3$
b) $f(x) = -\frac{2}{5}x + 2$

Group 7: a) $f(x) = x + 2$
b) $f(x) = -\frac{2}{3}x - 3$

Group 2: a) $f(x) = -x + 2$
b) $f(x) = \frac{2}{3}x - 4$

Group 4: a) $f(x) = 4x - 1$
b) $f(x) = \frac{3}{5}x + 1$

Group 6: a) $f(x) = 2x - 3$
b) $f(x) = \frac{-1}{2}x + 2$

EQUATIONS FOR SLOPE DANCE

Use the slope and y-intercept to graph each equation below.

1. $y = \frac{2}{3}x + 1$

2. $y = \frac{1}{2}x - 3$

3. $y = -\frac{3}{4}x + 2$

4. $y = -\frac{3}{2}x - 3$

5. $y = -\frac{3}{5}x + 3$

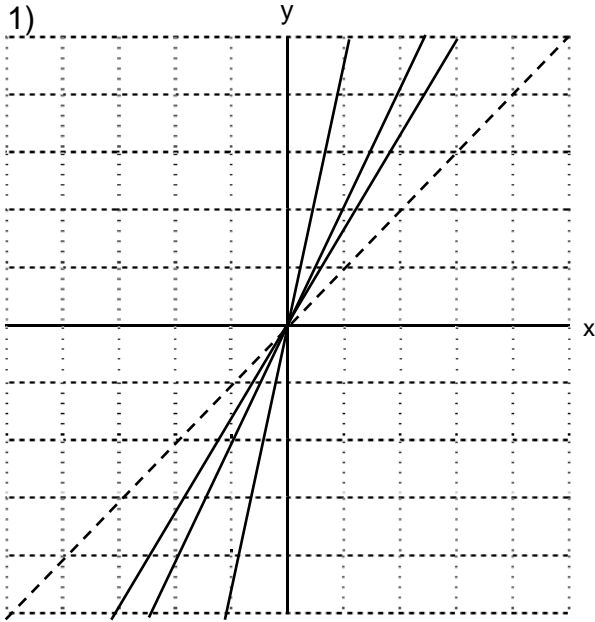
6. $y = -\frac{2}{7}x - 1$

7. $y = \frac{2}{3}x - 3$

8. $y = -\frac{5}{2}x + 1$

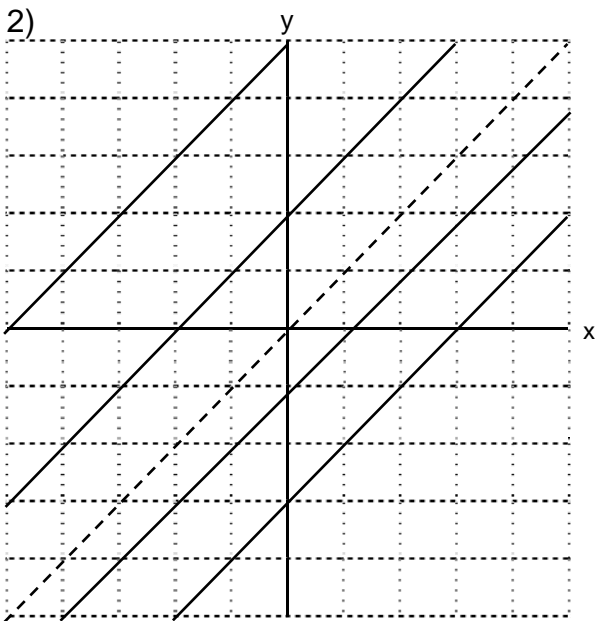
9. $y = -\frac{7}{8}x + 5$

RESOURCE PAGE 1



equation	(m) slope	(b) y-intercept

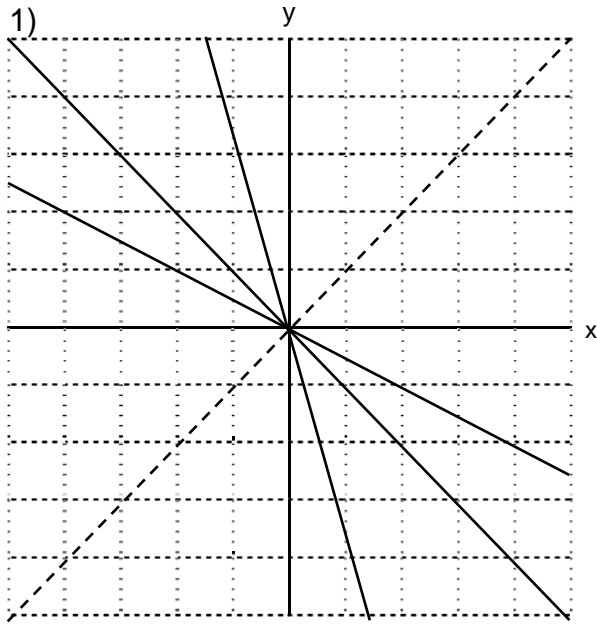
- Write your theory about how the value of m affects the graph.
- Write your theory about how the value of b affects the graph.



equation	(m) slope	(b) y-intercept

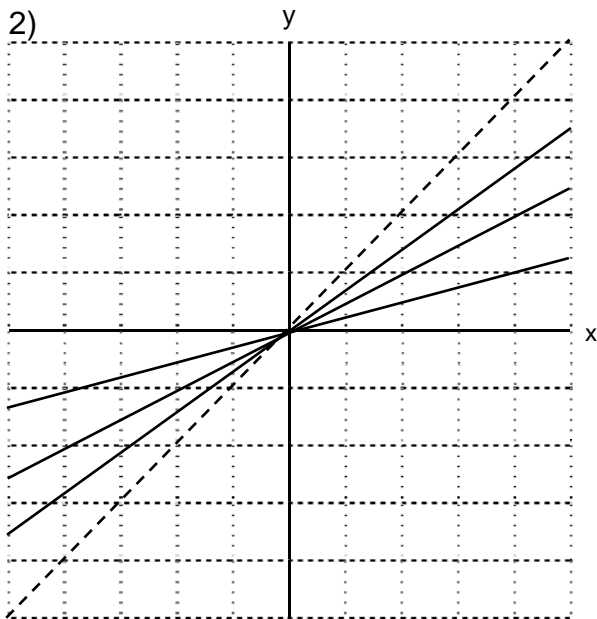
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RESOURCE PAGE 1



equation	(m) slope	(b) y-intercept

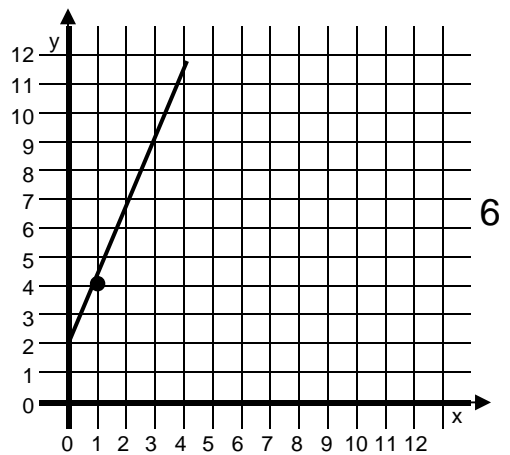
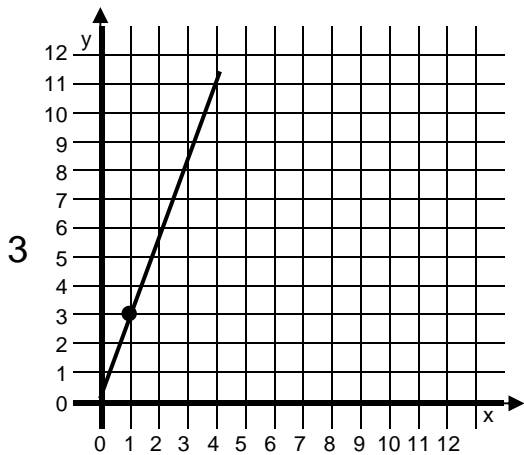
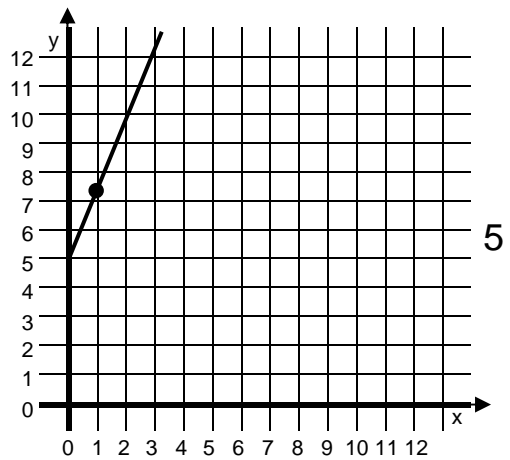
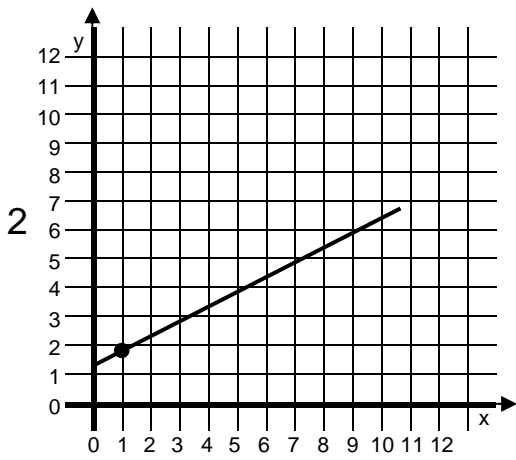
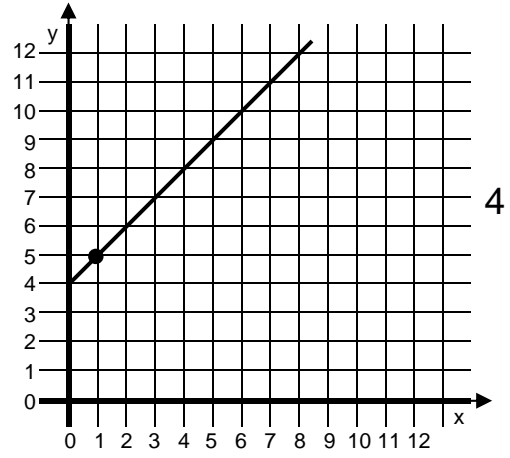
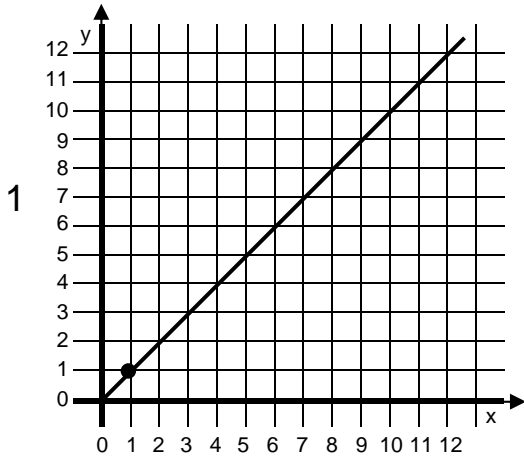
- Write your theory about how the value of m affects the graph.
- Write your theory about how the value of b affects the graph.



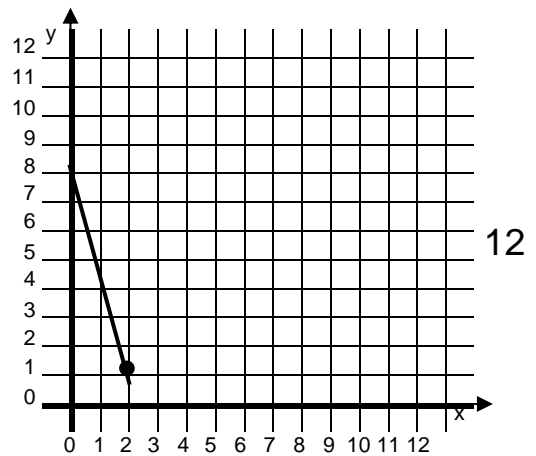
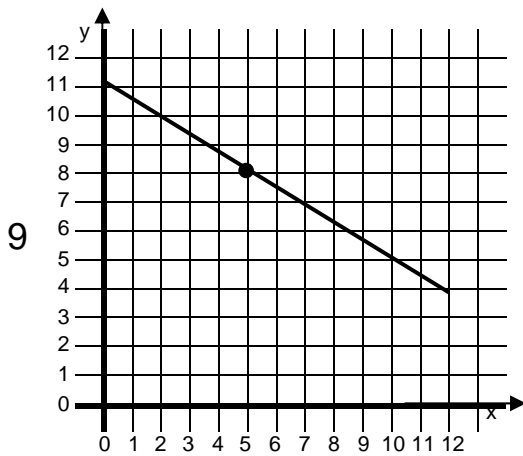
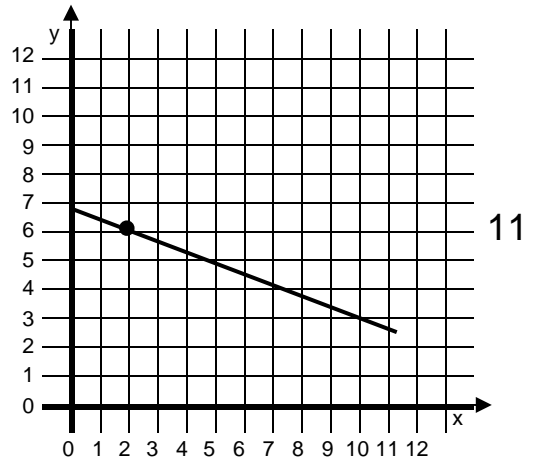
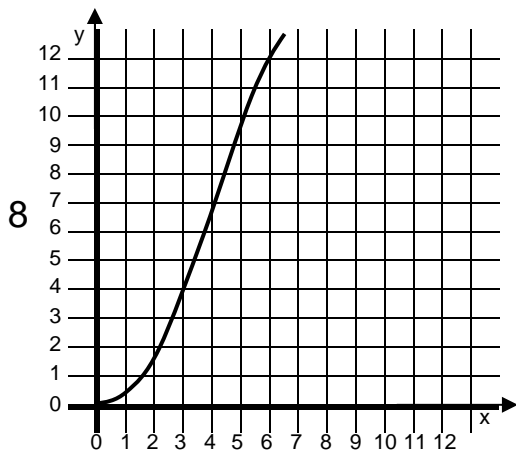
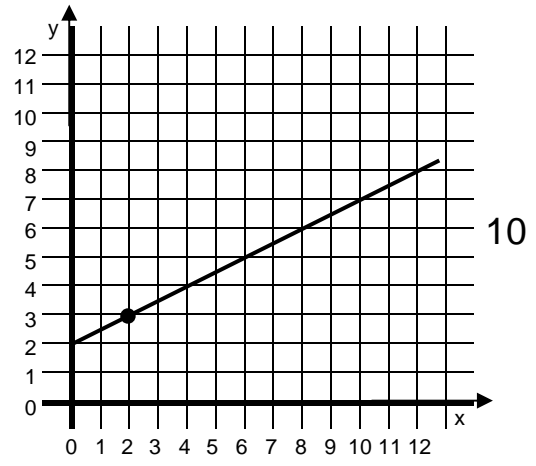
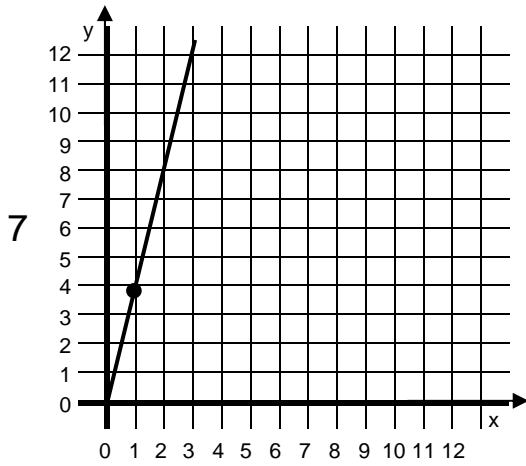
equation	(m) slope	(b) y-intercept

- Write your theory about how the value of m affects the graph.
- Write your theory about how the value of b affects the graph.

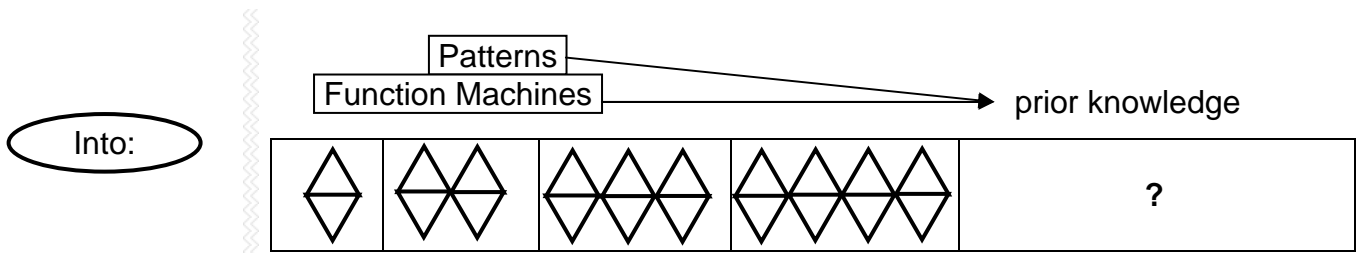
GRAPHS TO EQUATIONS 1



GRAPHS TO EQUATIONS 2



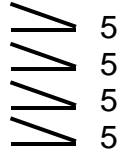
DECONSTRUCTION OR SUMMARY



Through:

1 T-tables

step	#of sticks
1	5
2	10
3	15
4	20
5	25
.	.
.	.
.	.
n	5n



SDAIE Strategies:

- word wall
- manipulatives
- TPR
- posters
- cooperative group
- presentations
- asking questions

2 Explicit Rule

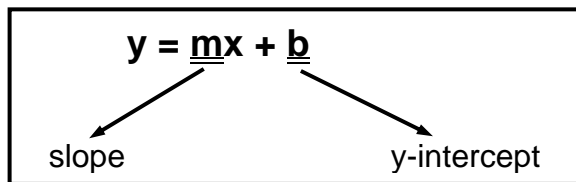
3 Slope-Intercept Connection

- algebra walk
- motion detector

Beyond:

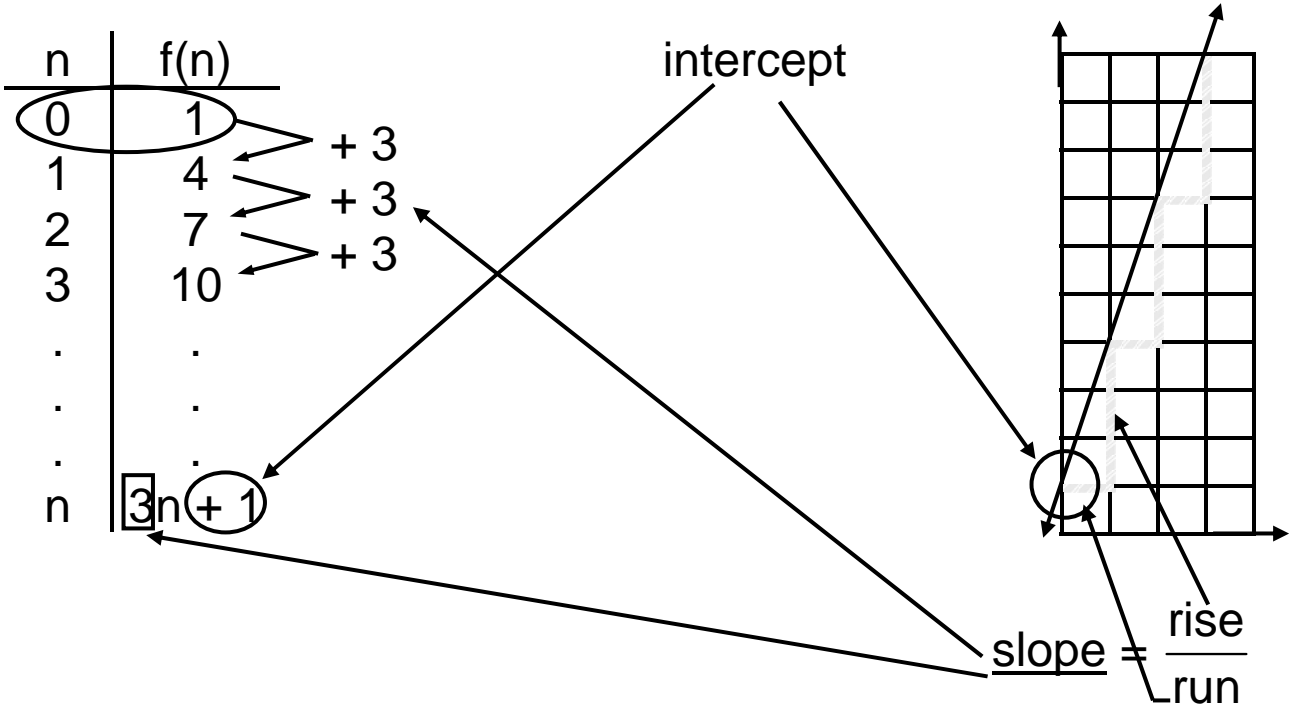
Patterns
Explicit rules
T-tables

can be formalized as graphs



- ◆ Culminating activity – assessment – drives into, through, and beyond ELD/math standards

THE SLOPE-INTERCEPT CONNECTION!



ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 8

REAL WORLD APPLICATIONS

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants will explore writing in mathematics through a series of real world problems.

Focus Question

How do you promote writing in your mathematics classroom? What specific strategies/activities could you use to achieve this goal?

Mathematics

- Examine slope as a rate of change by looking at real life problems
- Examine real life applications of mathematics
- Examine the pattern-function connection

Language

- Examine writing in mathematics

Problem of the Day

Murfs, Nurfs, and Motts

Homework/ Article

Does Everybody Need Algebra?
Lynn Arthur Steen

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

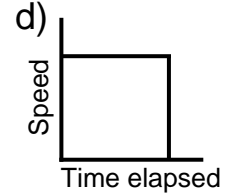
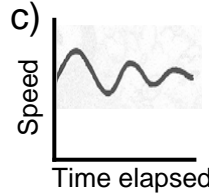
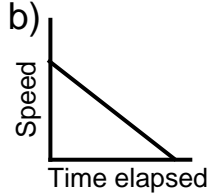
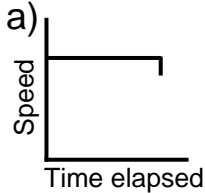
Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

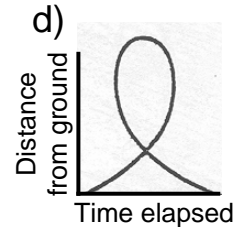
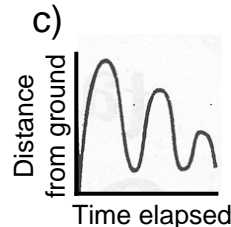
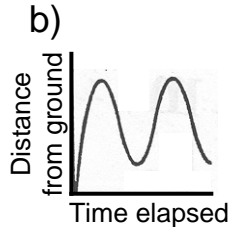
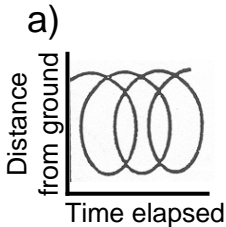
IDENTIFYING QUALITATIVE GRAPHS

Identify which graph matches the statement.

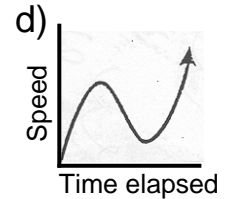
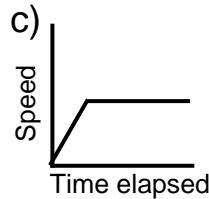
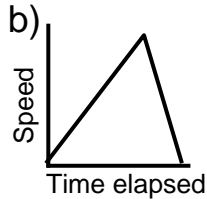
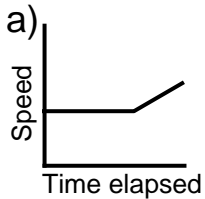
1. A train pulls into a station and lets off its passengers.



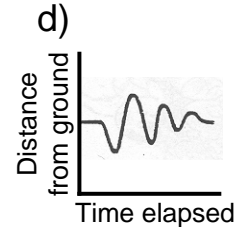
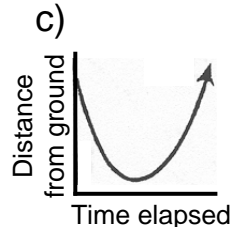
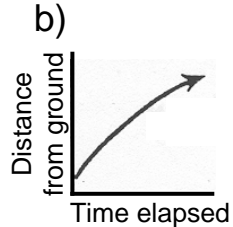
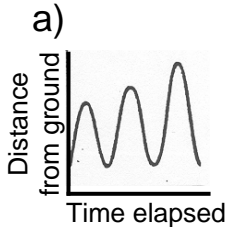
2. A man takes a ride on a ferris wheel.



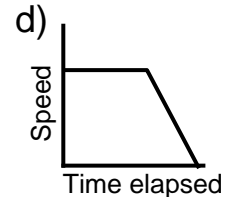
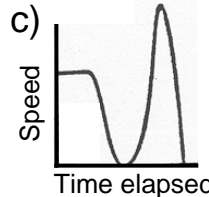
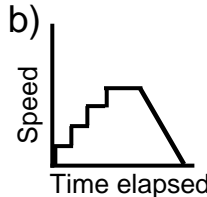
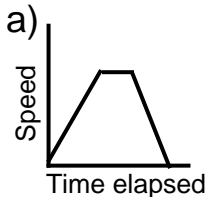
3. A woman climbs a hill at a steady pace, and then starts to run down one side.



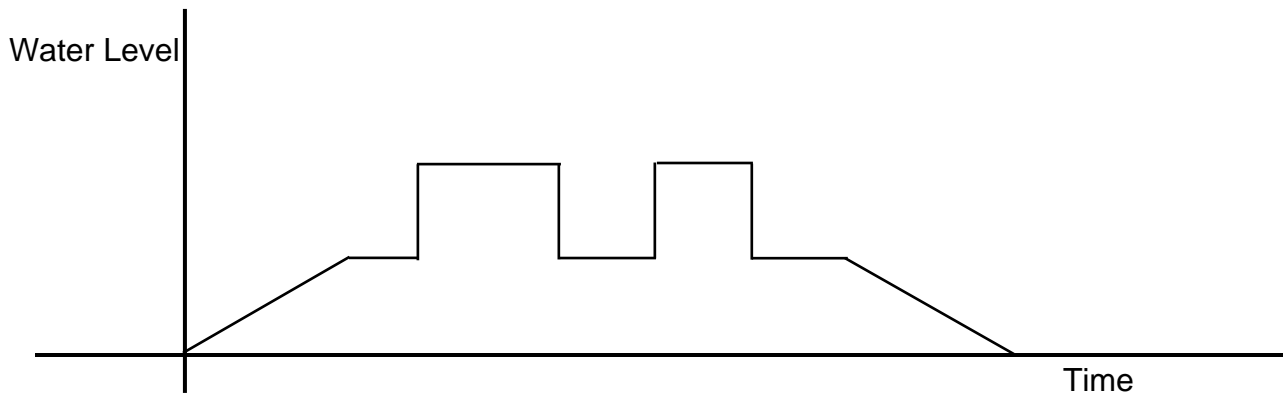
4. A child swings on a swing.



5. A child climbs up a slide and then slides down.



BATHTUB PROBLEM



The graph above depicts the water level of a bathtub with respect to time. Write a paragraph that might describe what occurred.

LET'S FIND THE ALGEBRA IN A BOLT!

Have your group pick 5 different carriage bolts.
Follow the instructions below for each bolt.

Bolt #1

Measure the bolt: diameter _____ length _____
Twist the nut on the bolt until it reaches the top.
Measure the distance between the head of the bolt and the top of the nut.
Record this distance on the table across from 0.
Turn the nut five complete turns.
Record this distance on the table across from 1.
Repeat this five times, if possible, and fill the table.
Find the n th term.
Graph the function. Use the same graph for all the bolts. Use a different color for each bolt.

Set of turns	Distance
0	
1	
2	
3	
4	
5	
.	
.	
.	
n	

Bolt #2

Diameter = _____
Length = _____

Bolt #3

Diameter = _____
Length = _____

Bolt #4

Diameter = _____
Length = _____

Bolt #5

Diameter = _____
Length = _____

Set of turns	Distance
0	
1	
2	
3	
4	
5	
.	
.	
.	
n	

Set of turns	Distance
0	
1	
2	
3	
4	
5	
.	
.	
.	
n	

Set of turns	Distance
0	
1	
2	
3	
4	
5	
.	
.	
.	
n	

Set of turns	Distance
0	
1	
2	
3	
4	
5	
.	
.	
.	
n	

Compare your group's work with other groups.
Answer these questions:

1) Compare the slopes of the lines determined for each bolt on the previous page. Do you see any patterns? Explain your observations.

2) What does the slope tell you about the bolt?

3) Can you predict the size of the bolt by looking at its n th term?

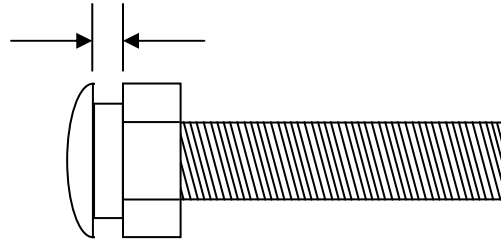
4) Why do you think the data collected from each bolt shows a linear function?

Algebra in a Bolt: from The Pattern and Function Connection by Brad S. Fulton and Bill Lombard. Key Curriculum Press.
Emeryville, CA. 2001. pp. 60-64

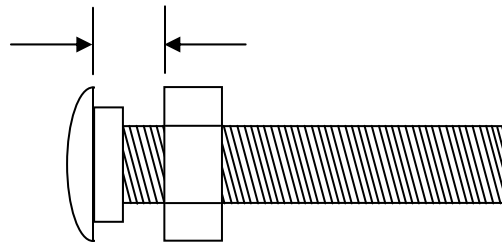
STUDENT WORKSHEET

Find the algebra in a bolt! Twist the nut on as far as it will go and measure in millimeters the distance between the head of the bolt and the top of the nut.

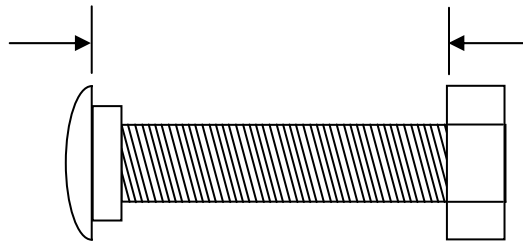
measure in millimeters



Record this distance on the graph. Now turn the nut five complete turns. Measure the distance again.



Record the measurement on the graph again. Repeat this process (five turns, measure, graph) until you are finished.



ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 9

GROUP PRESENTATIONS

READER

CALIFORNIA MATHEMATICS PROJECT

DAILY GOALS AND REFLECTION

Lesson Summary

Participants will present their group lessons. Participants will explore the use of math stations. Participants will construct various graphic organizers that can be used in the math classroom with EL students.

Focus Question

What have you gained from planning a math lesson for EL students? Are there any specific strategies/techniques that you will take back to your classroom and take into consideration when planning a mathematics lesson for your EL students?

Mathematics

- Explore the use of math stations in the mathematics classroom

Language

- Math lesson presentations for EL students
- Explore the use of graphic organizers

Problem of the Day

Frogs

Homework/ Article

None

ORGANIZER

Rough Draft for POD# _____ Title _____

Vocabulary:

New/Nuevo

Math/Matemáticas

What to do/ ¿Que debes hacer?

Paragraph #1: Rewrite the problem in your own words. / Escribe el problema de Nuevo en tus propias palabras.

Work: Show how you solved the problem. / Muestra como resolviste el problema.

Paragraph #2: Write a detailed list of how you solved the problem. / Escribe una lista detallada de cómo resolviste el problema.

Paragraph #3: Solution: Answer the problem using complete sentences. / Solución: Contesta el problema usando oraciones completas.

Paragraph #4: Reflection: What do you think of this problem? / Reflexión: ¿Qué es lo que opinas de este problema?

FOUR SOCK DRAWER

- Each drawer contains black, red, blue and white socks. Each sock is only a single color. Work with your fellow students to find how many socks of each color there are in each drawer.
- You may want to try a combination of guess and check and algebra methods for drawer 7.
- When you have solved the puzzles, make up sock drawer puzzles to share with others.

<p>Drawer 1</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • Three times as many blue socks as black • Two more blue socks than red • One fourth as many black socks as white • 20 socks in all 	<p>Drawer 5</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • 13 black socks • red and blue socks together that equal black socks alone (more blue than red socks) • Less than half as many blue socks as white • A list of sock numbers that is part of the Fibonacci series • The Fibonacci series goes 1, 1, 2, 3, 5, 8, and so on
<p>Drawer 2</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • Three blue socks • A total of seven white or black socks • In alphabetical order, one more of each color of sock than the color before 	<p>Drawer 6</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • Socks of all colors that do not have mates • An equal number of blue and white socks • 20 blue or black socks • 22 black or red socks • 16 red or white socks
<p>Drawer 3</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • Three more white than blue socks • Twice as many red as blue socks • Four more black than red socks • A sock that could not possibly have a mate of the same color 	<p>Drawer 7</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • 482 socks • 202 black or red socks • 240 black or white socks • 280 white or blue socks • 242 red or white socks
<p>Drawer 4</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • Twelve socks that are red or white • Six socks that are black or blue • Twice as many white as blue socks • Half as many black as red socks • One and a half pairs of blue socks 	<p>Drawer 8</p> <p>This drawer contains</p> <ul style="list-style-type: none"> • One more pair of black socks than red • One more than twice as many white socks as black • One more blue pairs than black pairs • 12 red socks

NONCONSECUTIVE NUMBER BOXES

- Work with a partner
- Arrange the numbers 1, 2, 3, 4, 5, 6, 7, 8 in grid A, so no two consecutive numbers are in squares with a common side or corner (vertex).
- Do the same for grid B.
- Use 1 through 10 for grid C and follow the same rules.
- Do you think your solutions are unique?

1	2	3	4	5	6	7	8	9	10
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Grid A

Grid B

Grid C

THE LOST SQUARE

Cut an 8x8 square along the bold lines shown in figure 1

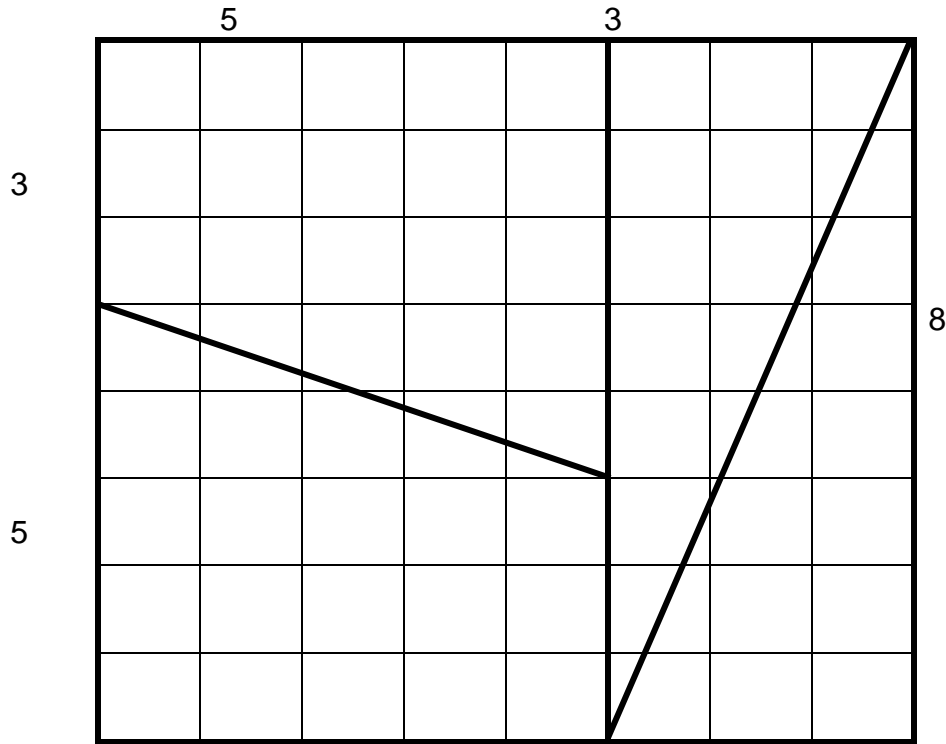


Figure 1

Now rearrange the pieces to form a rectangle as shown in Figure 2.

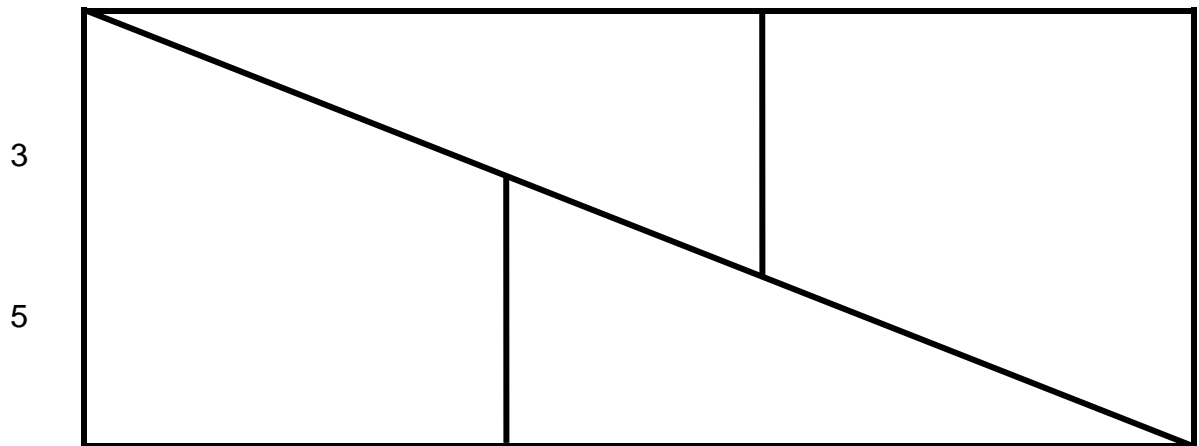


Figure 2

The area of the square is $8 \times 8 = 64$, and the area of the rectangle is $5 \times 13 = 65$.
Where did the extra area in the rectangle come from?

GOING BANANAS

Cleopatra (“Cleo”) the Camel works for the owner of a small, remote banana plantation. This year’s harvest consists of three thousand bananas. Cleo can carry up to one thousand bananas. The market place where the bananas are sold is one thousand miles away. Unfortunately, Cleo eats one banana each and every mile she walks.

Your task: Of the three thousand bananas harvested, what is the largest number of bananas Cleo can get to the market?

P.S. This problem is not impossible!

GREEDY POLITICIANS

Three politicians land on an island where they find a pile of million dollar bills. They agree to sleep overnight and divide the pile in the morning. During the night, one politician wakes up, sets aside one bill for the public welfare, takes exactly $\frac{1}{3}$ of the remaining bills for his campaign fund, and falls back asleep. Then the second politician wakes up and does the same. Later, the third politician wakes up and does the same. In the morning, there are fewer than 10 bills left. They each take $\frac{1}{3}$. How many million-dollar bills were there in the original pile?

Attempt to solve this two different ways.

THE BEDOUIN WILL

An old Bedouin died and left 17 camels to his three sons. His will specified that $\frac{1}{2}$ the camels should go to his eldest son, $\frac{1}{3}$ to his second son, and $\frac{1}{9}$ to his youngest son. His sons could not see how to distribute the camels without cutting some of them up, or selling them and dividing the money, which they did not want to do. They went to a tribal elder for advice.

The old man thought for a while and then said, "I have 1 camel. I will add it to your 17 to make 18 camels. Now we shall divide them. The eldest son takes $\frac{1}{2}$ the camels, or 9. The second son takes $\frac{1}{3}$, or 6. The youngest son's share is $\frac{1}{9}$ or 2. Because $9 + 6 + 2 = 17$, there is 1 camel left over, so I get my camel back.

How could it be that the tribal elder succeeded in solving a problem the sons thought was impossible?

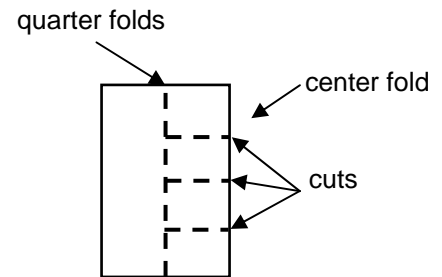
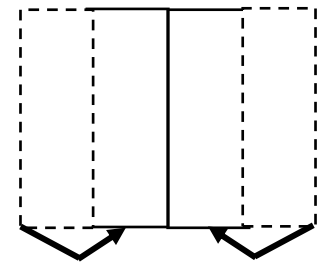
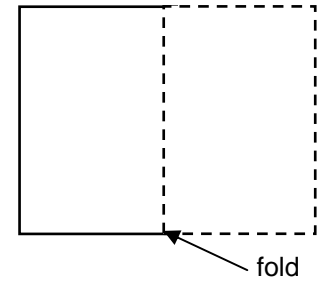
SECRET BOOK

Materials:

2 pieces of construction paper (2 different colors):
 scissors
 markers, colored pencils, or crayons

Procedure:

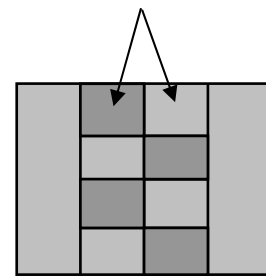
1. Take one of the pieces of paper, fold it in half the short way.
2. Open it up again and fold each side to the middle.
3. Cut from the center fold to the quarter folds for as many sections as needed greater than three. (If available, fancy craft scissors make interesting cuts.)
4. Fold the second piece of construction paper in the same manner, but it will be cut a little differently. Cut the piece in four pieces. You will need two pieces; you can share or save the other two.
5. Weave each strip alternately through the cuts in the first piece (the larger one).
6. With the book closed, reach between the weaves (along the middle fold) to open the secret compartment.
7. Students can now organize the information using markers, gel pens, or crayons.



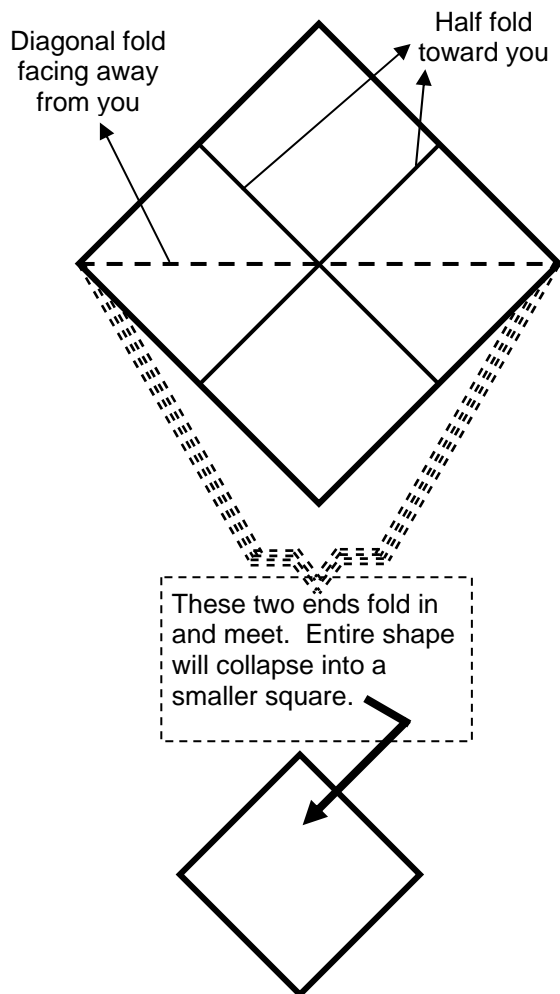
use these two

save this piece

weave strips alternately



FAN AND ACCORDION BOOK



Basic Instructions:

- 1) Make a square.
- 2) Fold square diagonally.
- 3) Open up the fold and face fold away from you.
- 4) Fold square in half (solid line) towards you.
- 5) Open up and face fold toward you.
- 6) Fold in half again, the other way, toward you again.
- 7) Lay square out. It should angle up like a cup.
- 8) Fold in to form smaller squares by joining two diagonal halves.

Instructions to make fan and accordion book:

- To make fan book, glue tops of folded squares with opening facing the same direction.
- To make accordion shape, glue tops of folded squares with opening alternating first one way then the other.
- A card stock square can be glued on the ends to make it more rigid.
- A ribbon can be glued under card stock to complete package.
- It is best if writing is done on squares before they are glued.

FLIP CHART

1. Distribute 5-10 sheets of brightly colored paper to each student.
2. Instruct students to stack the 5-10 papers on top of each other, separating the papers an inch apart. See illustration below:



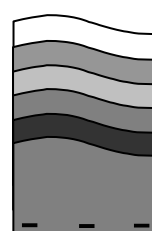
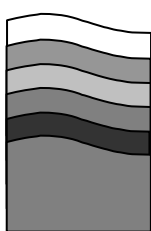
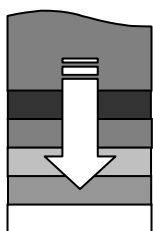
3. Tell students to estimate the midpoint of the paper (end-to-end). Put a paper clip in the middle of the stacked paper.



4. Using the paper clip as a guide, cut the stacked set in half using regular scissors or fancy craft scissors (with design).



5. Stack the paper from the cut edge down and staple in 3 places across the bottom edge.



6. Tell students to turn or rotate the stapled stack. Students can now use the flip chart as a study guide to summarize important information from a lesson, a chapter, or projects.



Example: Operations with Integers
Solving Equations
Graphing and Solving Inequalities
Functions, and many more...

PLACE VALUE FLIP CHART

1. Distribute 9 sheets of brightly colored construction paper to each student (white, green, yellow, red, blue, purple, red, orange, brown). The dimension of each sheet is 3"x12".
2. Distribute 1-3"x12" sheet of black construction paper and 1-4"x12" sheet of black construction paper to each student.
3. Instruct students to stack the 9 sheets of construction paper with the 1-3"x12" sheet of black construction paper on top and the 1-4"x12" sheet of black construction paper on the bottom.

Note: The order the students stack the construction paper should be the same. For example, black, white, green, yellow, red, blue, purple, red, orange, brown, and black.

4. Have the students staple the construction paper on top. See illustration below:



5. Have the students staple the construction paper $1\frac{1}{2}$ inches apart except for the bottom 4"x12" sheet of construction paper.

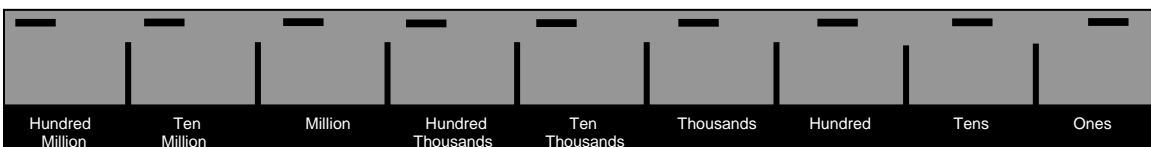


6. Instruct students to write the following numbers on each sheet of construction paper.

Nothing on Black

- | | |
|------------|------------|
| 0 – white | 5 – purple |
| 1 – green | 6 – red |
| 2 – yellow | 7 – orange |
| 3 – red | 8 – brown |
| 4 – blue | 9 – black |

7. Have students write the place value on the last page of the place value flip chart (see below).



ENGLISH LANGUAGE DEVELOPMENT INSTITUTES
IN MATHEMATICS CONTENT

ALGEBRA

DAY 10

GROUPS PRESENTATIONS & WRAP UP

READER

CALIFORNIA MATHEMATICS PROJECT

ORGANIZER

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