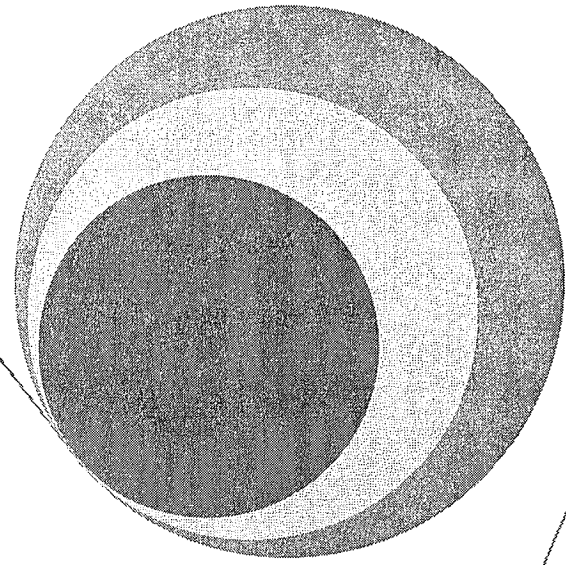

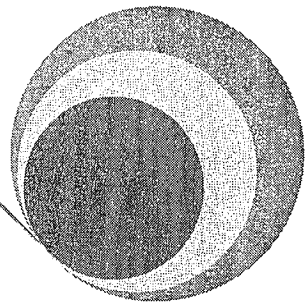

The Struggling Math Student: From Mindless Manipulation of Numbers to Mastery of Mathematical Concepts and Principles

Games and Activities

Developed by:

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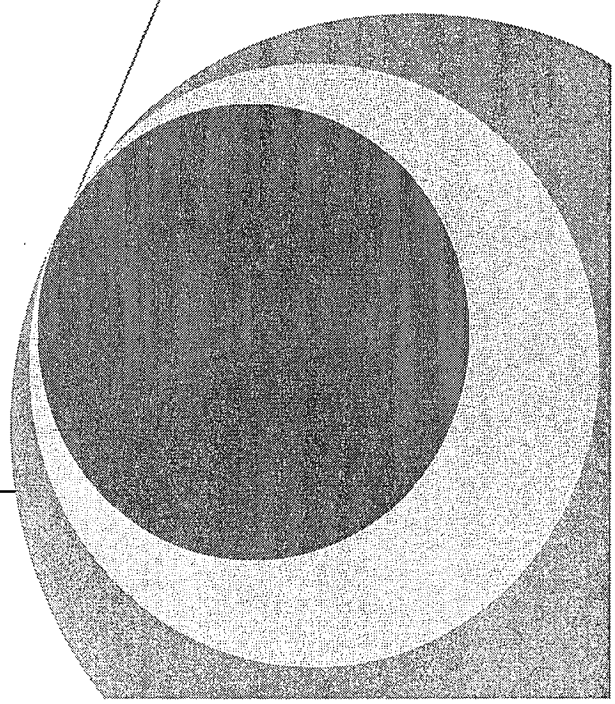

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Ten of the Very Best Reasons for Using Classroom Games and Activities

Classroom games and activities are an excellent way to develop mathematical skills through practice, as well as to develop problem solving, critical thinking, and teamwork. Games can be used in the adult education classroom to engage students in the learning process while having fun. The primary goal of games should be to build teamwork while developing new skills and knowledge. From games, students can learn not only the "what," but also the "why" and "how" of the topic. The real benefit of creating games for the adult education classroom is that the activities can meet the individual needs of the student and the subject matter being taught.

The potential list of games is endless. This section includes an article from Steve Sugar on "Ten of the Very Best Reasons for Using Classroom Games," as well as a few ideas to get teachers started in creating games and activities for the classroom.

Ten of the very best reasons for using classroom games as part of the curriculum are:

Reason #1: Games are Fun with a Purpose
Games create a cognitive engagement between the learner and the topic in a flowing, smiling environment. Games celebrate your topic and reward individual and group achievement. Games bring fun and energy into a buoyant learning zone, but with the focus on learning.

Reason #2: Games Provide Feedback to the Learner
Learners want and need feedback on their performance. Games give them immediate feedback on the quality of their input — their successes and their errors. With the appropriate corrective feedback, this can become an invaluable learning opportunity.

Reason #3: Games Provide Feedback to the Teacher
Games provide a practice field where learners interact with the topic, demonstrating their knowledge and ability to apply the information. By observing this real-time demonstration, the teacher can adjust the subsequent level of lecture, readings, and interventions accordingly.

Reason #4: Games are Experiential
Today's learner needs to do and to try things on his/her own. Games provide an environment that transforms the passive student into an active part of the learning process where he/she can connect his/her own dots and experience his/her own ideas. Games also remind both player and teacher that energy in the classroom is a good thing.

Reason #5: Games Motivate Learners
Games engage players and then motivate them to interact with the topic. This interaction drives players to demonstrate their understanding of the topic in a friendly contest where successes are memorable moments of shared triumph and celebration and where mistakes mean only that the learner is being stretched to his or her own limits.

Reason #6: Games Improve Team Work
Games are real-time activities that bring players into teams, demonstrate the rules and roles of working together as a team, and underscore the value of team collaboration. Games give your learners a chance to know their peers as they share the same real-time experiences, allowing for strong networking and bonding.

Reason #7: Games Provide a Less Threatening Learning Environment
Because the game format is playful, the inherent challenge of the material, even new or difficult material, is less threatening. During game play, seemingly difficult questions and scenarios are "just part of the game." And, teachers can use the window following responses to build a bridge between the topic and the learner.

Reason #8: Games Bring Real-World Relevance
Games allow you to present real-world information in the form of questions, scenarios, role-plays, and so forth. In this way, players learn not only the "what," but the "why," of the topic from a real-world perspective. Players also observe their own behavior and that of others during game play. Post-game debriefings give insights into those behaviors in thoughtful examples observed during game play.

Reason #9: Games Accelerate Learning
Games allow you to compress your topic and demonstrated learning into shorter periods of time, accelerating the speed of learning. The visual presentation, oral interactions, and active participation of game play appeal to all of the learning styles (visual, auditory, and kinesthetic), involve both the rational and experiential mind, and help players remember what they have learned.

Reason #10: Games Give You Choices for Your Classroom
Games allow you to add variety and flexibility to your teaching menus. Games can allow you to do any or all of the following:

- Increase the level of learner involvement
- Vary the level of skill and knowledge
- Customize to any size of audience, even one-on-one
- Vary the type and level of activity
- Vary the level of classroom control
- Introduce or review topics, or both
- Vary the mix of theoretical and practical information

Sugar, S. The Game Group. Retrieved from the World Wide Web at: http://www.thegamegroup.com/article1.htm.

Fact Drills

Fact drills are the best way to help students learn the basics. There are pre-made flash cards for almost any type of fact, but having students make their own cards is a great way to reinforce the facts that they will be learning.

Bingo

Everyone knows the game. It is for exactly that reason that bingo is such a useful game to play in the classroom. The thrill of shouting out "BINGO!" lasts a long time. Of all the games that can be used in the classroom setting, the game of bingo is among the most useful and effective. Below is a list of suggestions for some ways to use bingo in your math class.

Addition Bingo

This version of bingo is a good tool for helping students learn basic addition and subtraction fact. The teacher calls out "seven plus two" and the students look for a nine to cover up, or the teacher calls out "14 minus seven" and the students look for a seven to cover up on their bingo cards. This game can also be played in reverse, with problems like 11-4 or 5+7 on the cards and the teacher calling out possible answers for the students to match with problems.

Multiplication Bingo

This game is almost exactly like addition bingo except that multiplication (or division) problems are used. If you're making cards that have answers and you're calling out problems, be sure not to put prime numbers on the cards; the student will never cover 23, 57, or 59, for example, because there are no multiplication problems that have those numbers as answers (except one times that prime number). It's an easy mistake to make.

Rounding Bingo

Using a normal bingo card, call out multiples of 10 and tell students that they can only cover up one number that can be rounded to that particular multiple of ten. You call out 20 and the student can cover, for example, 17 or 22. Of course, this is another game that can be reversed. The card can contain only multiples of 10 (or one hundred, or one thousand...) and when the teacher calls out 39 or 43, the students have to cover 40.

Factor Bingo

Fill up a small bingo card with numbers under 20 or 30 and call out larger numbers. The students can cover up a number if it is a factor of the number you called out. So, if you called out 60, a student could cover one, two, three, four, five, six, 10, 15, 20, 30, or 60, since all of those number are factors of 60. Of course, the student can only cover one number.

Fraction and Decimal Bingo

This version of bingo is used to practice converting fractions to decimals and vice versa. The teacher calls out "zero point two five" and the students cover up 1/4 on their cards. In the reverse version the teacher calls out fractions like 11/20 and the student has to cover up 0.55 on the card.

B	I	N	G	O
		Free Space		

Math Test Instructions

Tell participants that the following test is a simple one involving easy addition, subtraction, multiplication, and division problems. Often our students need basic review in number operations before they can go on to higher order math skills so this is a good quick review system.

Pass the papers out face down. Then tell them that as soon as you say "Go," turn the papers over and work as fast as they possibly can so that they are the first ones done. As soon as someone is finished, he/she should shout, "Done."

Provide instructions hurriedly and allow no time for questions. Allow them about 30 seconds and say: I see that most of you are done so let's begin.

Have the participants share their answer for the first few questions. When there is a discrepancy, ask: Did you all get the same sheet?

Have the group discover the problem by reading the directions to themselves.

Discussion Questions

1. Remember the saying, "If all else fails, read the directions?" Why didn't we all read the directions? (pressed for time, saw familiar problems)

2. Have you ever seen incidents where poorly given or rushed instructions may be worse than none at all?

3. Did anyone experience group pressure when you began to start this exercise? What effects did this have on your performance?

4. Are there any similarities to how the group responds to math problems?

Mathematics Test

In the following simple math problems, a plus (+) sign means to multiply, a divide (÷) sign means to add, a minus (–) sign means to divide, and a times (×) sign means to subtract. Complete the problems.

17 x 2 =

14 ÷ 7=

8 + 2 =

9 + 11 =

4 x 3 =

6 ÷ 2 =

9 – 3 =

7 x 4 =

4 + 4 =

8 – 4 =

12 x 2 =

20 – 1 =

9 – 1 =

5 + 6 =

2 x 1 =

10 – 5 =

12 + 2 =

6 ÷ 6 =

8 + 5 =

6 + 6 =

17 x 2 =

14 ÷ 7 =

8 + 2 =

15 x 3

14 – 7 =

6 x 5 =

8 + 3 =

7 x 2 =

9 + 2 =

8 – 4 =

9 + 6 =

1 ÷ 1 =

8 x 7 =

13 – 1 =

16 – 4 =

9 x 2 =

9 ÷ 9 =

6 x 2 =

8 + 4 =

10 – 2 =

4 – 1 =

18 – 3 =

8 + 2 =

15 x 3 =

Card Games

Whole Numbers

Multiplication War (Multiplication Fact Practice)

Objective: To provide practice in basic multiplication facts.

Materials:

Deck of playing cards

How to Play:

1. Divide students into pairs. Remove the Kings, Queens, Jacks, and tens from the deck of cards. Use the Ace as a one. Cards rank from high to low: 9, 8, 7, 6, 5, 4, 3, 2, 1 (Ace). Suits are ignored in the game.

2. Deal out all of the playing cards between the players. Players do not look at their cards, but keep them in a pile face down. The object of the game is to win all of the cards.

3. Both players turn their top card face up and put them on the table. The player who says the product correctly first, gets to keep both cards.

4. If the turned up cards are equal, there is a war. The matching cards stay on the table and both players play the next card of their pile face down and then another card face up. The player who says the product of the new face up cards quickest wins the war and adds all six cards face down to the bottom of their pile. If the new face up cards are equal as well, the "war" continues until the cards are different.

5. The game continues until one player has all of the cards. This can take time, so the teacher may wish to give a time limit.

Bull's Eye (Order of Operations Practice)

Objective: To hit the target number first by arranging cards to create an equation.

Materials:

A deck of playing cards

How to Play:

1. Remove the 12 face cards from the deck and set them aside.

2. Shuffle the rest of the deck and deal four cards face down to each player. Turn the next card face up in the center of the table. This is the target number.

3. At the count of three, all players turn their cards over at the same time. Then they $+$, $-$, $\times$, or $\div$ the numbers on their cards (Aces = 1)[2] and try to equal the target number. All four cards must be used.

4. Examples: If the target number is 5 and one draws a 2, 9, A (1), and 7, an equation to equal the target number could be: $(9-7) \times 2 + 1 = 5$.

5. The first player to equal the target number gets 1 point., with 3 points winning the game.

6. If no one can equal the target number, turn over another card for a new target number or redeal.

Winning Strategy: Keep rearranging your cards until you see the right combination. Also, try to group a pair of cards together.

Fraction Activities

Activity I

List some measurements in everyday life that require the use of fractions.

Activity 2

Have students work in teams of two. Give each team one pair of dice. The object of the game is to see which member of the team is the first to score 20.

Each team member rolls the dice in order to get a fraction.

Example: 4 and 5 gives 4/5

Player A gets a point if the fraction is in lowest terms (like 4/5)

Player B gets a point if it is not in lowest terms (like 4/6)

The first player to reach 20 points wins.

Activity 3

Have students work in teams of two. Give each team one pair of dice. The object of the game is to see which member of the team is the first to reach a total of 10.

Each team member rolls the dice in order to get a fraction.

Example: 4 and 5 gives 4/5

Each player must add his/her fractions each time the dice is rolled. For example on the first roll Player A get 2 and 3 (2/3). On his/her second roll he/she gets 3 and 4 (3/4). The player must then add 2/3 and 3/4 to get a total of 1 5/12 on his/her next roll, the player must add the new fraction to the last total and so on.

The players alternate rolls until one of the players has reached at least 10.

Activity 4

Develop a set of fraction cards. You will need two of each fraction card. Index cards are the best with which to work because they are similar to regular playing cards.

- 1/2, 2/2
- 1/3, 2/3, 3/3
- 1/4, 2/4, 3/4, 4/4
- 1/6, 2/6, 3/6, 4/6, 5/6, 6/6
- 1/12, 2/12, 3/12, 4/12, 5/12, 6/12, 7/12, 8/12, 9/12, 10/12, 11/12, 12/12

Divide students into teams of 2, 3, or 4. Each person is dealt one fraction card up and one fraction card down. Players can look at the card turned down and decide whether they want another card or whether they want to pass. The goal is to be closest (without going over) to the whole number 2.

This activity requires that students be able to add unlike fractions and be able to change improper fractions to a mixed number.

Fractional Go Fish! (Equivalent Fraction/Decimal Practice)

Objective: To create pairs of equivalent fractions/decimals.

Materials:

- Deck of 40 cards with at least one equivalent for each card (e.g. ½ and .5)

How to Play:

1. In small groups of 3-4, students play with a deck of 40 cards (larger if desired). Within each deck there needs to be at least one equivalent for each card. (May be more for faster games.) Fractions pair with equivalent decimals.

2. Cards are dealt out 5 cards per player and the rest are spread out in the centre. Players must make pairs, which they set down on the table.

3. After the deal, the first player in turn asks another player "Do you have _____?" The card the student asks for must be stated in the equivalent form to the card for which the student is seeking a match. (e.g., If the player is holding decimal five, the player would ask for one half. If the player is looking for the match of two thirds, the player would ask for decimal six repeating.)

4. A player lays down matching pairs during his'/her turn and the turn passes. If the player does not get what the player needs, the player is told to "Go Fish" and draws one from the center and the turn moves on.

5. The game ends when either one player is out of cards or center cards are gone. The winner is the person with the most pairs.

6. Determining the player with either the greatest or least cumulative value in the pairs could break ties.

A Variation on "Old Maid"

Objective: To match fractions and decimals or percents dependent on what type of practice is needed by students.

Materials:

- A created deck of 40-50 matching cards (larger if desired) and one non-matching card. The non-matching card can be an irrational value, such as pi or it may be a numerator divided by zero. The students should know why this value cannot be matched.

How to Play

1. Deal out all of the cards to the players. Deal and play are clockwise.

2. Players should make as many pairs from their cards as possible and set them down on the table.

3. Next, the dealer begins. At each turn, the player offers his/her cards spread down to the player to his/her left. That player selects a card from the other's hand without seeing it and adds it to his/her hand. If it makes a pair, he/she discards the pair. The player who just took a card then offers his/her hand to the next player to his/her left, and so on.

4. Players who make pairs and lay down all their cards are safe - the turn passes to the next player. Eventually all the cards will have been matched except for the odd card (the old maid) and the final holder of this non-matching card loses.

A Variation on Rummy (Equivalent Fraction and Decimal Practice)

Objective: To match three fractional equivalencies and the equivalent decimal value.

Materials:

- Deck of 52 matching cards. There should be three equivalent fractions and the equivalent decimal for each value. Example: ½, 2/4, 3/6, and .5.

How to Play:

1. Deal out seven cards to each play. Deal and play are counter clockwise. Place the remaining cards face down in the center of the table with the top card turned up.

2. Players make matches of three fractional equivalency cards, which they set down on the table.

3. The player left of the dealer begins. At each turn, the player either picks up a card from the face down pile or takes the top card of the discard deck. If more than one card is in the discard pile, a player has the option of picking up one card or the entire discard pile. If the player has three values that are equivalent, the player lays down his/her "three of a kind." The player then ends his/her turn by discarding a card.

4. If someone has played one half, two fourths and three sixths, another player can play his/her matching decimal five during his/her turn.

5. Play continues until one player lays down his/her final card. The winner is the player with the greatest number of matching cards laid down.

Number Cubes/Dice Games

Snake Eyes (Addition Practice

Objective: The winner is the first person to score 100 points by rolling the dice. It's not as easy as it sounds, because there is a dangerous "snake" waiting to steal all of your points every time you roll the dice!

Materials:

- A pair of dice/number cubes
- Paper and pencil
- Calculator

How to Play:

1. Make a score card with each player's name on a piece of paper.

2. Roll the dice to see who goes first, then each player takes turns rolling the dice.

3. On your turn, roll the dice and find the sum of the numbers rolled. You can quit and write down that total or you can roll again. As you continue rolling the dice, keep a running total in your head. When you decide to quit, add that total to your score on the score card.

4. You can keep rolling as long as you want, but if a 1 comes up on one of the dice, you lose all of your points for that turn. If two 1s come up (snake eyes), you lose all of your points for the whole game and must start over again at 0.

5. The first person to score 100 or more points is the winner.

Winning Strategy: The probability of getting a 1 on one of the dice is 10 out of 36. This is about one-third. The probability of getting snake eyes is 1 out of 36. Keep this in mind as you decide how many times to roll the dice on each turn.

Variation: Change the winning total to 250 points and count doubles as double their sum. For example, two 6x equals 12 and double that would add 24 to your total. If a 1 comes up, you still lose your points for that turn. However, in this game, snake eyes (two 1s) is worth 25 points.

Race to Zero (Subtraction Practice)

Objective: Use problem solving and subtraction skills to try and race each other to the number zero, without going below zero. Students must find the difference of two numbers by solving self-generated subtraction problems.

Materials:

- A pair of dice/number cubes
- Paper and pencil
- Calculator

How to Play:

1. Divide students into pairs. Give each pair a set of dice/number cubes, pencil, two pieces of paper, and a calculator.
2. Tell the students to write the number 100 at the top of their sheet of paper and 0 at the bottom.
3. Students should decide who will be Player A and who will be Player B. Player A tosses the dice and creates a two-digit number (e.g., 4 and 5 could be 45 or 54). The player then subtracts that number from 100 and checks his/her answer on a calculator. Play B then takes a turn. Play continues alternating between Players A and B. The winner is the player who comes closest to zero without going below zero.

Winning Strategies: Have students share what strategies they used to try and win the Race to Zero. Have students share their responses and play the game with a new partner. Discuss new strategies that they tried.

Calculator Activities

Beat the Calculator

Materials:

- A calculator
- Number cards 0-9 (4 of each)

How to Play:

1. Each group has three players. One player is the "Caller." A second player is the "Calculator." The third player is the "Brain."
2. Shuffle the cards and place them facedown on the table.
3. The Caller draws two cards from the number deck and asks for the sum of the numbers.
4. The Calculator solves the problem with a calculator
   The Brain solves it without a calculator. The Caller decides who got the answer first.
5. Players trade roles every 10 turns or so.

Variations:

- Play the game with multiplication facts instead of addition facts.
- Play the game with the entire class. Students on one side of the room are Brains and the other students are Calculators.

Place Your Order!

Use your calculator and insert the addition, subtraction, multiplication, or division signs into the blanks. You may also use any other mathematical symbol that might help (such as parentheses or a square root). You may use any operation or symbol more than once.

1 ____ 1 ____ 1 ____ 1 = 1

2 ____ 2 ____ 2 ____ 2 = 2

3 ____ 3 ____ 3 ____ 3 = 3

4 ____ 4 ____ 4 ____ 4 = 4

5 ____ 5 ____ 5 ____ 5 = 4

6 ____ 6 ____ 6 ____ 6 = 4

7 ____ 7 ____ 7 ____ 7 = 3

8 ____ 8 ____ 8 ____ 8 = 2

9 ____ 9 ____ 9 ____ 9 = 1

Place Your Order Answer Key

(1 + 1) / (1 + 1) = 1

2 / 2 + 2 / 2 = 2

3 x 3 – (3 + 3) = 3

(4 - 4) / 4 + 4 = 4

(5 x 5 – 5) / 5 = 4

6 – (6 + 6) / 6 = 4

(7 + 7 + 7) / 7 = 3

8 / 8 + 8 / 8 = 2

9 – 9 + 9 / 9 = 1

Calculator Riddles (Solve the problems and turn your calculator upside down to see the answer.)

1. What is the name of your calculator?

   353 X 9 x 10 + 18 =

2. What is the only thing that gets larger the more you take away?

   25,000 – 68 – 952 – 8,956 – 11320 =

3. Picture these U. S. coins: a nickel, a penny, and a dime. Ellie's parents have three children. One is Nick and another is Penny. Who is the third?

   .05 ÷.01 ÷ .10 x 3 x 211 + 123 =

4. A pet store owner has 17 eels. All but 9 were sold. How many eels does the owner have left?

   337.8 x 17 – 9 =

5. Who weighs more, Lee the 5-foot (152 cm) butcher or Bob the 7-foot (213 cm) wrestler?

   5 x 7 x 10 – 13 =

6. A barrel of water weighed 100 kilograms, but after somebody put something in it, it weighed only 25 kilograms. What was put in the barrel?

   500 x 100 + 4000 – 300 + 4 =

7. Bob says that only one month has 28 days. His boss says that there are more. Who is right?

   28 x 29 x 30 + 31 – 18,882.486 =

8. Take two eggs from three eggs and what do you have?

   9,992 x .2 x 3 – 2 =

Answers:

1. B. B. Lie
2. Hole
3. Ellie (The coins have nothing to do with the answer.)
4. 9 eels
5. Lee (a butcher weighs more things than a wrestler)
6. Holes
7. His boss (all months have at least 28 days)
8. 2 eggs (that is what "you" took)

Upside Down Calculator (Perform each of the indicated computations on the calculator, turn the calculator upside down and read the answer. A clue is given for each problem.)

Calculation	Numerical Answer	Clue	Word Answer
0.140		A name of a state	
15 + 2 + 150 + 95 + 55		His story was a	
2101 x 9 x 2		An important book	
2538.67 x 2		They said a lot of	
501 ÷ 12500		After peeling onions you would	
(354 x 15) + 7		What you should never tell	
141 ÷ 200		The baritone sang	
48450 ÷ 6		A messy person	
40 ÷ 99		What Santa Clause said	
$88^2 - 3^2$		Opposite of buy	
(362536 + 61) ÷ 71		A girl's name	
463 x 79 – 1469		The capitol of Idaho	
1911 x 3		Snake like fish	
15469 ÷ 20000 + 190 + 520		The name of an oil company	
$19^3 + 879$		It rings	
514 + 3237		A tropical	
106 x 35 – 5		The bottom of a shoe	
$84^2 + 7^2$		To make dirty	
1377 x 4		Person in charge	
(29 x 16 – 1) x 8		This is a big	
625 ÷ 5/23 + 2463		They sting	
(9 x 20) – 7		What Whitney was called	
11 x 7 x 40		Musical instrument	
½ x 500 x 140 + 7		Opposite of tight	
$\sqrt{625}$ x 2564 - 6382		Have to be paid each month	

Upside Down Calculator – Answer Key (Words)

OHIO

LIE

BIBLE

HELLOS

BOOHOO

LIES

SOLO

SLOB

HOHOHOHOHO

SELL

LOIS

BOISE

EELS

SHELLOIL

BELL

ISLE

SOLE

SOIL

BOSS

HOLE

BEES

ELI

OBOE

LOOSE

BILLS

Calculator Tic – Tac – Toe

Play calculator tic – tac – toe! Choose a partner to play against. The first player chooses a number from 1 to 25. The player completes the calculation. If the answer is one of the numbers in the square, the player marks that square with either an X or O. It then is the next player's turn. If the answer is not in a square, the player loses that turn and it becomes the next player's turn. Alternate until someone has tic – tac – toe! The game can be played repeatedly.

189	87.5	-3
25	10	12.5
-66	4 5/6	7/16

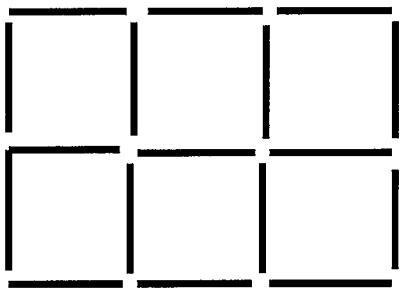
1. 10 (3 + 12) + 39=
2. 100 ÷ (12 – 8) + 62.5 =
3. 3 ½ + 4 2/3 – 3 1/3 =
4. (3.59 + 4.2 + 7.9) ÷ 3 =
5. (2 5/8 – 1 3/8) x 4 + 20 =
6. (3/4 + 1/8) ÷ 2 =
7. 1/2 x 7/8 =
8. 4 is 16% of what number?
9. What is 125% of 70?
10. 10 is what percent of 80?
11. Subtract a 15% discount from $180
12. What is the increase from $147.50 to $162.25?
13. What is the decrease from 32 to 24?
14. 15 – (-35) =
15. (7)(3) + (-7) (-7) – 3 =
16. (-12) + (-31) + (-23) =
17. (-2) (6¼) (-7) =
18. 5x + 2 = -13, x = ?
19. $5^2 \times 3^2 - (-6^2) =$
20. $\sqrt{9} =$
21. 4 5/6 + (4 5/6 x 2) – (9 2/3) =
22. $7.5^2 + \sqrt{100} - (-21.25) =$
23. 33 + (-99) =
24. (–35 x 7) + 179 =
25. 2 x 1 1/5 + 4 x 2.5 – 2 2/5 =

Toothpick Puzzles

The following are some puzzles using toothpicks that you may want to use to improve problem solving skills in a fun way.

Puzzle #1

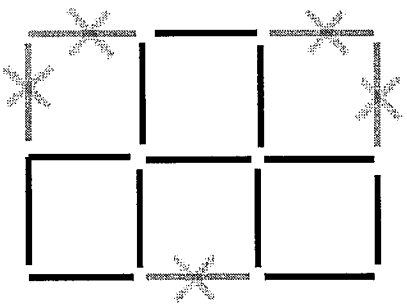
Use 17 toothpicks to construct this figure.

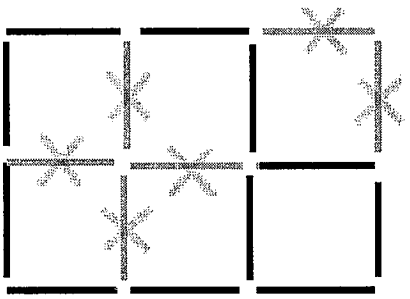


Remove 5 toothpicks and leave 3 squares.

b. Remove 6 toothpicks and leave 2 squares.

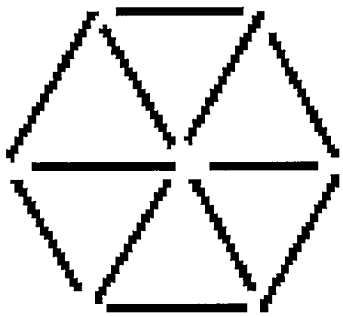
Answers for Puzzle #1





Puzzle #2

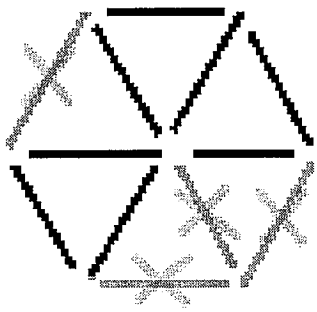
Make this figure with 12 toothpicks.

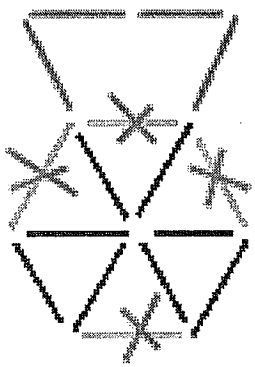


a. Remove 4 toothpicks and leave 3 triangles.

b. Move 4 toothpicks and form 3 triangles.

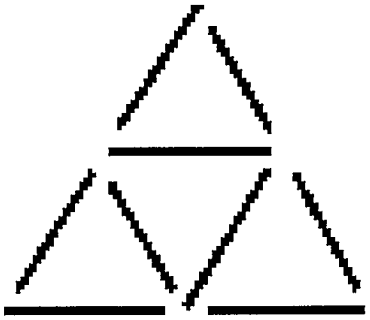
Answers Puzzle #2





Puzzle #3

With 9 toothpicks, make this figure.



Remove 2 toothpicks and leave 3 triangles.

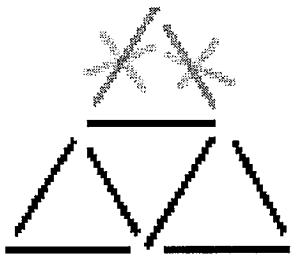
Remove 3 toothpicks and leave 1 triangle.

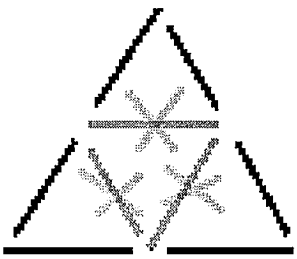
Remove 6 toothpicks and get 1 triangle.

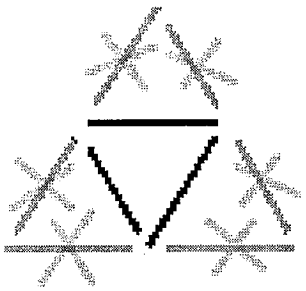
Remove 4 toothpicks and get 2 triangles.

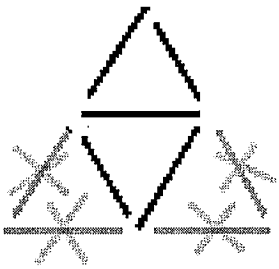
Remove 2 toothpicks and get 2 triangles.

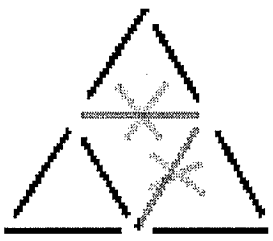
Answers Puzzle #3





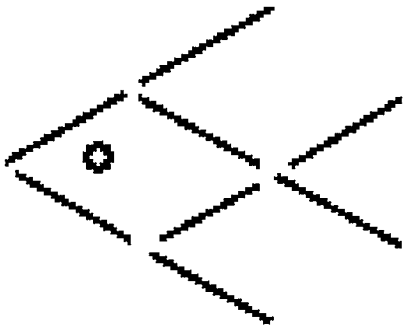






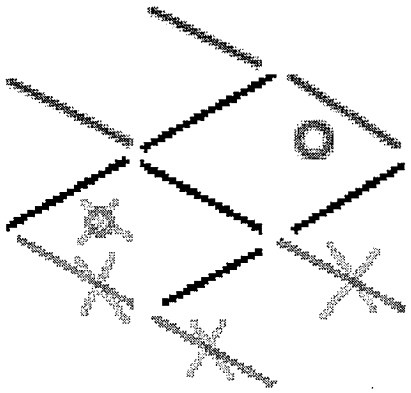
Puzzle #4

Use 8 toothpicks and 1 button to form a fish.



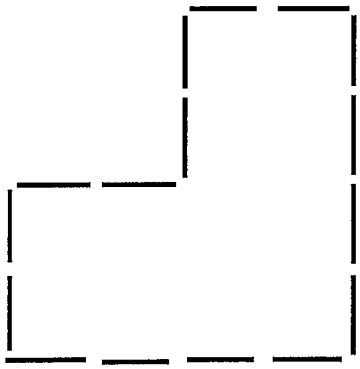
Move 3 toothpicks and the button to make this fish swim in the opposite direction.

Answer Puzzle #4



Puzzle #5

Two farmers have land this shape.

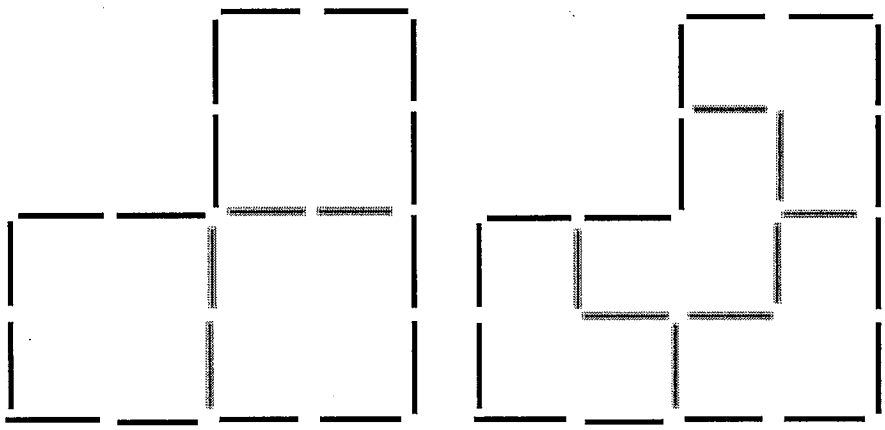


The first farmer wants to divide her land evenly between her 3

daughters. Add 4 toothpicks to form three parcels of equal size and identical shape.

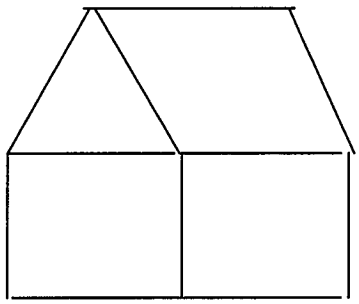
The second farmer wants to divide her land evenly among her 4 daughters. Use 8 toothpicks to form four parcels of equal size and identical shape.

Answers Puzzle #5



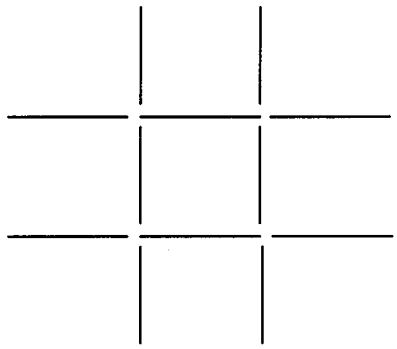
Toothpick Teasers

Problem 1: Build a house using 11 toothpicks as shown in the diagram. See if you can make the house face the opposite direction by moving only one toothpick.

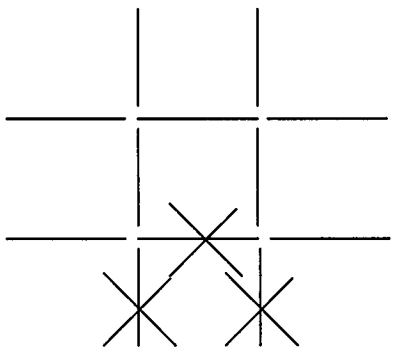


Answer: Move the center diagonal toothpick in the roof and slant it to the right corner.

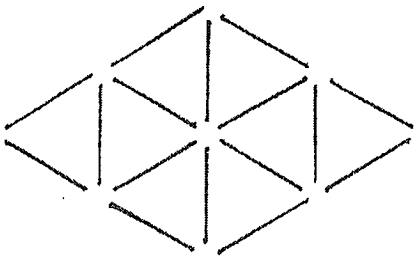
Problem 2: Arrange 12 toothpicks as shown in the diagram. Can you move only three toothpicks and end up with exactly three congruent squares?



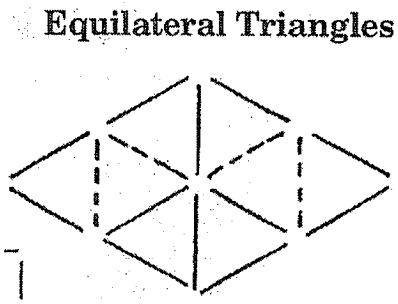
Answer:



Problem 3: Arrange 16 toothpicks as shown in the diagram. Remove four toothpicks so that only four triangles remain.



Answer:



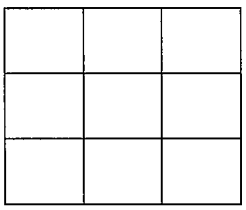
Square within a Square

Directions: Give each participant exactly 24 toothpicks. Ask them to arrange them in the pattern shown: three rows of three each; three columns of three each, resulting in nine adjacent small squares.

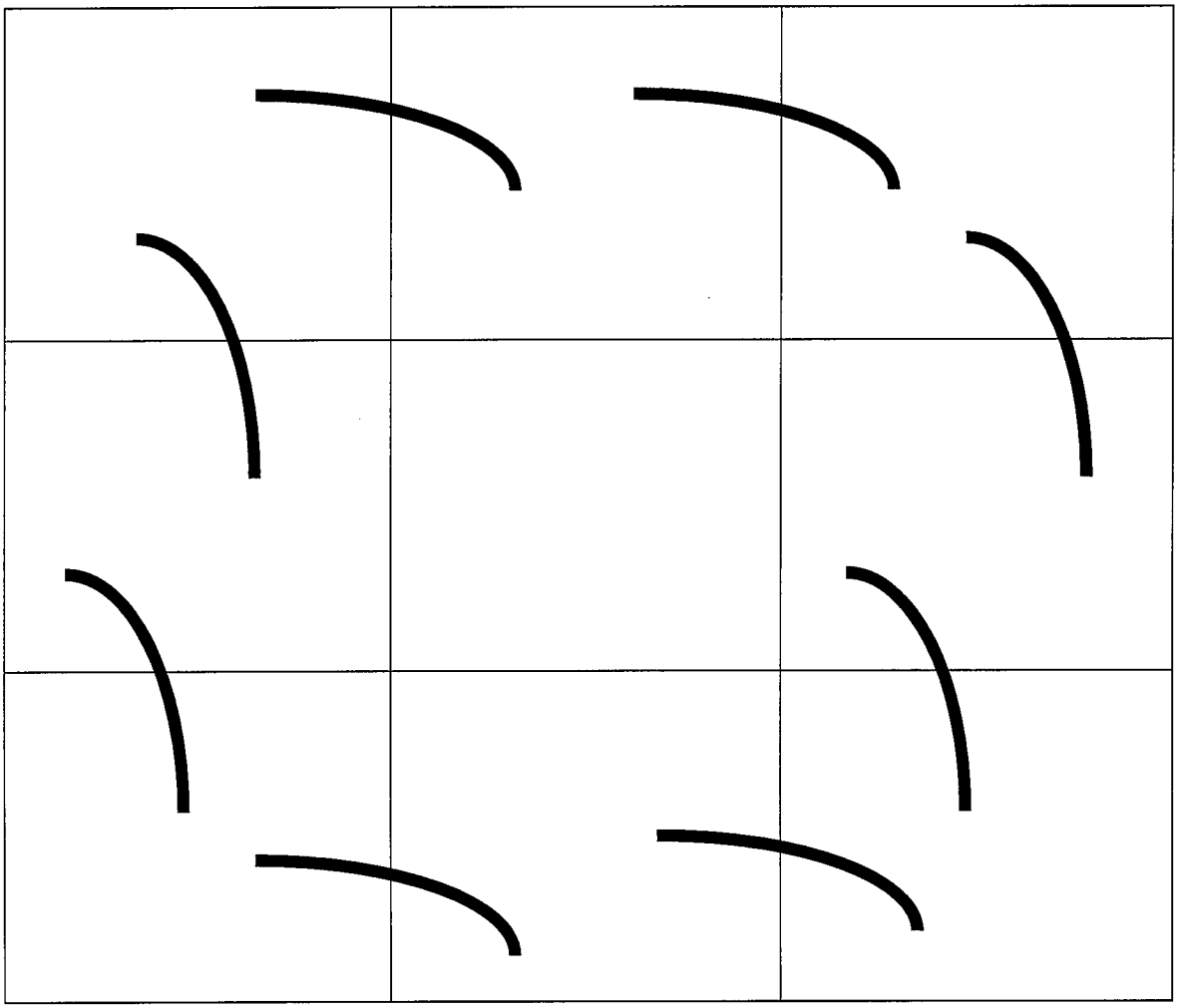
Ask them to remove eight toothpicks so that the result will be the formation of only two squares (which may be different sizes).

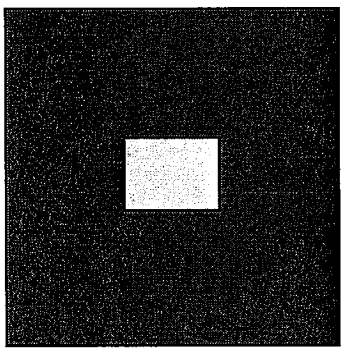
Tell them that if they have difficulty solving the task, they may nonverbally signal a request for corroboration of a potentially correct move. If they are proposing a correct move, respond with a loud and enthusiastic "yes!" Otherwise simply give a silent "no."

When participants have completed the entire task successfully, they may help others by providing feedback and reinforcement.



Answer: Remove the eight toothpicks that surround the smallest square in the center. This leaves a 4-toothpick square and the exterior 12-toothpick square, or a "square within a square." See the key below:





Additional Games/Activities

Mars Fraction Hunt

Objective: To provide students with practice in the use of fractions, changing fractions, using equivalent fractions, and paying attention to detail.

Materials:

- A Mars candy bar
- Classroom globe
- Fraction Hunt worksheet

How to Play:

Before the activity, the Mars bar should be hidden under the classroom globe. The Answer Key for the activity is:

For the first one to finish this there waits a prize if you use your head period clue mars is directly beneath the south pole period go look

Provide each student with an activity page. The students should write the appropriate parts of the word on the line to form a new word. When the message is complete, the first student to decode the message will be rewarded by finding the hidden treat (Mars bar).

Fraction Hunt

The first half of food + the last quarter of door. _____

The last third of hat + the first 2/5 of heavy. _____

The second 1/3 of office + the last 1/4 of door + the first 1/3 of street. _____

The last half of go + the last 1/2 of done. _____

The last 1/8 of elephant + the first 1/5 of order. _____

The first 3/4 of fine + the last 3/4 of dish. _____

The last 1/6 of cement + the first 3/7 of history. _____

The last half of bath + the first 1/3 of end + the last 2/7 of require. _____

The first 2/5 of water + the last 3/4 of fits. _____

The last 1/6 of Glenda. _____

The first 1/3 of principal + the first half of zero. _____

The first 1/7 of instant + the first third of fat. _____

The first 2/5 of young + the first 1/10 of understand. _____

The first 1/4 ugly + the first 1/5 of settlement. _____

The first 1/4 of youthful + the last half of pour. _____

The first 1/4 of hesitate + the last 2/3 of sad. _____

The first 1/3 of permanent + the first half of iodine. _____

The first 2/6 of clover + the last 2/4 of blue. _____

The first 1/4 of Mark + the last 3/5 of stars. _____

The last 1/4 of Meri + the first 1/5 of Susan. _____

The first 3/5 of dirty + the last 3/7 of perfect + the first 2/5 of Lynda. _____

The first 3/4 of bent + the last 2/3 of breath. _____

The first 1/3 of Thomas + the first 1/8 of Endicott. _____

The first 3/5 of sound + the last 2/9 of Aylsworth. _____

The first quarter of positive + the first two thirds of Lee. _____

The first 4/9 of periscope + the last 2/5 of blood. _____

The first third of get + the second fourth of Jody. _____

The first half of loud + the last half of book. _____

Measurement Scavenger Hunt

Each team is responsible for finding everything in the following list. There is a prize for the team that finds the most items on the list. After each item, describe the object you found and where you found the object that matches that item.

1. An object that has length approximately 5 inches

2. An object that has length approximately 2 yards

3. An object that has a surface with area approximately 15 square inches

4. An object that has a surface with area approximately 2 square yards

5. An object that has volume approximately 30 cubic inches

6. An object that has volume approximately 1 cubic yard

7. An object with perimeter approximately 20 inches

8. An object with perimeter approximately 3 yards

9. An object with perimeter approximately 10 feet

10. A container that will hold approximately 1 quart

11. A container that will hold approximately ½ gallon

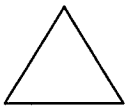
12. An object that has approximately 1 pound of mass

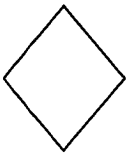
13. An object that has approximately 1 ounce of mass

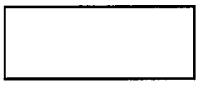
14. An object that has approximately 20 pounds of mass

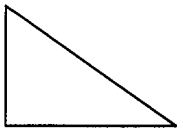
Geoboards: Let's Get Started!

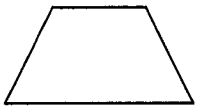
To get you started, make an interesting figure on your geoboard. How many of these figures can you show on your geoboard?

Isosceles triangle 

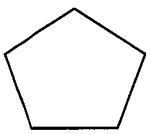
Diamond 

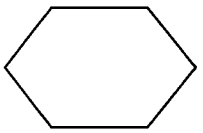
Rectangle 

Right triangle 

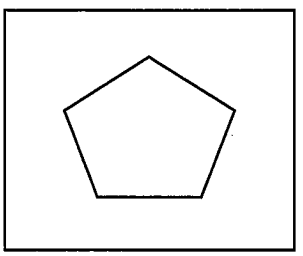
Trapezoid 

Parallelogram 

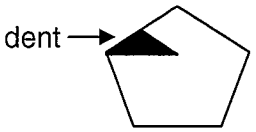
Pentagon 

Hexagon 

The figure on the geoboard has 5 sides. It has no dent in it.



Can you make a geoboard figure (no dents) with 6 sides? 7 sides? 8 sides? More than 8 sides?



Sample Geoboard Lesson Plan

Content Area/Theme

Geometry and Problem Solving

Title of Activity

Exploration of the World of Geometry with Geoboards!

Time

1 hour

Objectives/Learning Goals

Students will:

- Develop and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions
- Learn how to use geoboards to pictorially display geometric concepts
- Use geoboards or dot paper to draft solutions to problems regarding area and perimeter

Prerequisite Knowledge

Students should be able to:

- Understand and identify the basic concepts of dimensions (e.g., length and width)
- Identify different polygons and triangles

Content/Cognitive Skills

- Geoboards can be used to teach many different types of mathematical skills as well as to build better understanding of mathematical processes and formulas. This lesson provides the teacher with the basics of using geoboards. Additional lessons are suggested at the end of this lesson.

Materials/Resources/Internet Sites/Handouts

- Geoboard and rubber bands for each student or team
- Geoboard for overhead projector or virtual geoboard
- Overhead projector or projection system for Internet to access virtual geoboards
- Dot paper

Activity Procedure

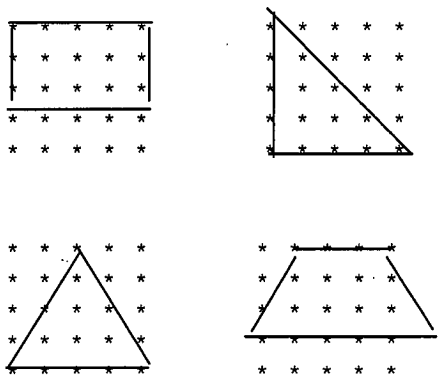
- Introduction to Lesson/Activity Starter (15 minutes)
  - Ask: Have any of you ever had to install a tile floor or seen one installed? You know that the tiles are generally in a square format. What happens if the number of tiles needed to tile the floor do not fit perfectly? (Answer: Tiles would have to be cut or shaped to fit the area.) Discuss that today students are going to use geoboards to experiment with different types of polygons, angles, and circles. Since many students have not had experience using manipulatives, introduce the lesson by showing students how to use the geoboard by experimenting with different shapes and designs. Have them share their designs with the class.
  - Next, have the students complete the Geoboards: Let's Get Started! Worksheet by designing the different types of geometric figures on their personal geoboards. Discuss as a class which shapes were easy to design and which were more difficult.
  - Debrief the final question on the sheet by discussing the types of polygons that have five, six, seven, eight, or more than eight sides.

- Key Words
  - Area
  - Perimeter
  - Parallelogram
  - Polygon
  - Quadrilateral

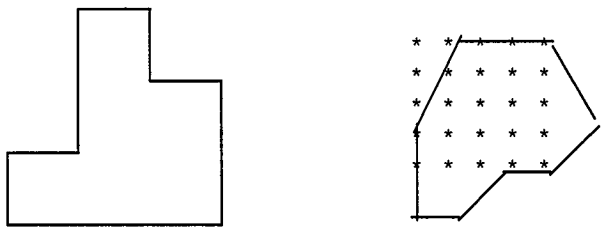
- Question Starters
  - What type of unit of measure do you use when calculating area? (Square units)
  - How do you figure the area of a square? Rectangle? Trapezoid? Rhombus? Parallelogram? Triangle? (Discuss how each figure has a formula. You may wish to refer to the formulas page used for the GED Mathematics Test.)
  - How would you figure the area of a non-traditional figure, such as a building lot or a star-shaped figure? (Discuss the concept of partitioning and the need to sometimes use multiple formulas for figuring area of a non-traditional figure. Example: A figure can be partitioned into a rectangle and a triangle. Figure the area for each type of figure and add the two separate sums to create the sum of the total area.)

- Instructional Outline
  - Geoboards are particularly useful in developing conceptual understanding of area and perimeter. However they can also be used to explore mathematics from different curriculum strands, such as fractions, the Pythagorean Theorem, tessellations, transformations, and patterning. Geoboard activities are often done with pairs of students, so in most cases, one geoboard per pair of students is sufficient.
  - Many students will already know how to calculate the area of squares and rectangles. Some will also know how to compute the area of parallelograms and triangles. The geoboard will help these students strengthen their understanding of area even more. But rather than to just give students formulas to calculate area, geoboards provide a conceptual tool that assists students in visualizing processes.

- To get started, have students locate as many squares as they can on their 11 by 11 geoboard. It is visually challenging for students to find all of them, especially the ones whose sides are not horizontal or vertical or those which reside "within" other squares. It is important that students have time for exploration with geoboards before they are asked to hypothesize about their activities or transfer their skills to other types of problems. Once they have had experience in "locating the squares," have them discuss how drawings can assist them in finding area and perimeter of not only traditional shapes, but also non-traditional shapes.
- Begin by having students set up depictions of traditional polygons, such as a rectangle, parallelogram, triangle, and trapezoids, such as the following. Provide students with instructions, such as:
  - Set up a rectangle that has a width of 4 and a height of 3
  - Set up a right triangle that has a base of 3 and a height of 4.



- Have students figure the area or perimeter of each figure and document what formula would be used, such as the area for a trapezoid is ½ (a + b) x w.
- Once students are comfortable in counting the square units of the figures, ask them what they would do to find the area of a non-traditional figure. For example, the following eight-sided polygons:



- After spending time calculating the area of squares, rectangles, and triangles, most students will break up a complicated polygon into more manageable pieces. Partitioning is an important skill for students to master.
- You may wish to use the first figure above to have students make another figure that has the same area and a larger perimeter, recording it on dot paper with its area and perimeter. Next, have students change the figure to make another figure that has the same area and a smaller perimeter, recording it on dot paper with its area and perimeter. Finally, have students make three more figures that have different perimeters but the same area, recording them on dot paper. This type of

activity helps students develop problem solving skills in the area of comparison of geometric figures. Have students discuss their results.

- Evaluation
  - Observe students during the individual or group projects. Use note cards to record whether or not they are making connections to the various geometric concepts being taught.
  - Ask students to write about what they learned or what they found difficult about the different projects in their mathematics journal.

Extension Activity

- Relate the lesson to real life: We build yards and farms with rectangular patterns because rectangles have smaller perimeter to area ratios; e.g. you use less fence to have more yard.
- Sample lessons using geoboards:
  - Burns, Barbara A. and Brade, Gail A. Using the geoboard to enhance measurement instruction in the secondary school mathematics classroom. Learning and Teaching Measurement 2003 Yearbook: 256-270. Reston, VA: National Council of Teachers of Mathematics, Inc.
  - Scavo, Tom. Geoboards in the Classroom. The Math Forum. Retrieved from the World Wide Web on 05/06/06 at: http://mathforum.org/trscavo/geoboards/.
  - Interactive Geoboards. NCTM. Retrieved from the World Wide Web on 05/07/06 at: http://standards.nctm.org/document/eexamples/chap4/4.2/index.htm.
  - Virtual Manipulative Geoboard. Utah State University. Retrieved from the World Wide Web on 05/07/06 at: http://nlvm.usu.edu/en/nav/frames_asid_172_g_2_t_3.html?open=activities.
  - National Library of Virtual Manipulatives. Utah State University. Retrieved from the World Wide Web on 04/20/06 at: http://nlvm.usu.edu/en/nav/grade_g_4.html.

To the Teacher: Note: If using a circular geoboard, make students aware that a rubber band stretched to form a circle is truly not circular, but is rather a type of polygon since there are straight lines rather than arcs formed. However, a circular geoboard is an excellent manipulative to use with students who have difficulty in visualizing arc measurements and length, circumference, radius, and angles formed by segments of a circle, and the sum of interior and exterior angles of polygons.