Algebra/Geometry Institute Summer 2005

Combinations and Permutations

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School: Solomon Middle School
**   Greenville, MS 38701**
Grade Level: 7

1   Teaching objective(s)

> *Mississippi Benchmark Framework*
> > *Collect, organize, and summarize data and use simple probability*
> > o   *The students will learn to identify, describe, and calculate simple combinations and permutations.*
>
> *Institute Content Based on MS Framework*
> > *Collect, organize, and summarize data and use simple probability.*
> > o   *The student will calculate and apply basic probability.*

2   Instructional Activities
(Class entrance – the teacher will give the first two students who enter the classroom a blue card each (one card labeled D and one card labeled E). The teacher will give the last three students who enter the classroom a red card each (one card labeled A, one card labeled B, and one card labeled C). This example will be used for the introduction of combinations and permutations.

The teacher will demonstrate how to calculate and describe a combination and a permutation. The teacher will ask the students who received cards while entering the class to come to the front of the class. The teacher will ask the students to make a straight line facing the class with the red cards at the beginning of the line in alphabetical order. The teacher will ask the students to hold the cards up in front of them. The teacher will read the questions from the blackboard.

Question 1: How many possibly pairs can be made from the three red cards and the two blue cards?

Question 2: How many possible arrangements can be made from the letters A, B and C?

The teacher will tell the students to complete the two questions written on the blackboard using the cards that their classmates are holding.
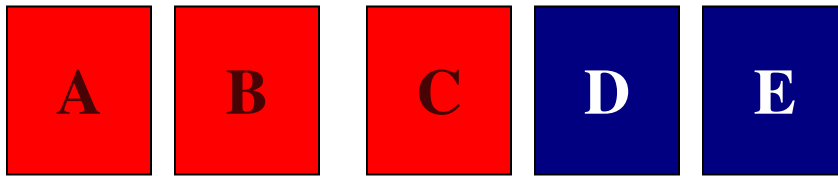
The students will calculate on a sheet of paper the number of possible choices they believe can be formed from the three red cards and two blue cards and how many possible arrangements they believe can be made from the letters A, B and C.

The teacher will call upon a student to give the number of possible choices from question 1 that he or she believes is correct.

The student will give his or her response to question 1.

The teacher will ask the students, "Does anyone have something different?"

The students will give their responses to the question.

The teacher will tell the students that the total number of combinations that can be formed using three red cards and two blue cards are 6 combinations. The teacher will demonstrate how the 6 combinations are formed using the students who are holding the cards.

Demonstration Steps for Question 1

1. *The teacher will combine the student holding the blue card labeled D with the student holding the red card labeled A. The teacher will tell the students that this is one combination.*
2. *The teacher will combine the student holding the blue card labeled D with the student holding the red card labeled B. The teacher will tell the students that now we have two combinations.*
3. *The teacher will combine the student holding the blue card labeled D with the student holding the red card labeled C. The teacher will tell the students that now we have three combinations. The teacher will tell the students that we have just completed all the possible combinations that can be formed with the blue card labeled D and one red card.*
4. *The teacher will repeat steps 1 through 3 with the student holding the blue card labeled E. The teacher will tell the students that we have just completed all the possible combinations that can be formed with the blue card labeled E and one red card.*

The teacher will tell the students to add the combinations together (the first set with the blue card labeled D (3) and the second set with the blue card labeled E (3). The teacher will tell the students that $\left(3+3=6\right)$ which is the total number of combinations that could be formed using 2 blue cards and 3 red cards. The teacher will tell the students that a combination can also be calculated by using

multiplication. The teacher will tell the students that multiplying the total number of the first set of items (3) by the total number of the second set of items (2) will give you 6 combinations. The teacher will ask the students, "Do you understand?"

The students will give their responses to whether they understand how the 6 combinations were formed.

The teacher will ask the students who are holding the letters D and E to have a seat. The teacher will call upon a student to give his or her response to question 2. How many possible arrangements can be formed from the letters A, B and C?

The student will give his or her response to question 2.

The teacher will ask the students, "Does anyone have something different?"

The students will give their responses to the question.

The teacher will tell the students the total number of arrangements that can be formed from the letters A, B and C is 6. The teacher will demonstrate how the 6 arrangements were formed using the students holding the letters A, B, and C.

Demonstration Steps for Question 2

1. *The teacher will arrange the students in a row in the following order A, B, C. The teacher will tell the students to log each row on their own sheet of paper. The teacher will tell the students that this is one arrangement.*
2. *The teacher will arrange the students again as A, C, B. The teacher will tell the students to log this row on their own sheet of paper as the second arrangement.*
3. *The teacher will arrange the students again as B, A, C. The teacher will tell the students to log this row on their own sheet of paper as the third arrangement.*
4. *The teacher will arrange the students again as B, C, A. The teacher will tell the students to log this row on their own sheet of paper as the fourth arrangement.*
5. *The teacher will arrange the students again as C, A, B. The teacher will tell the students to log this row on their own sheet of paper as the fifth arrangement.*
6. *The teacher will arrange the students again as C, B, A. The teacher will tell the students to log this row on their own sheet of paper as the sixth arrangement.*

The teacher will tell the students that a total of 6 arrangements can be made by arranging the letters A, B, and C. The teacher will tell the students that a permutation can also be calculated by using multiplication. The teacher will tell the students that in question 2 you had 3 letters that had to be arranged to see how many possible arrangements could be formed. The teacher will tell the students that when using multiplication you must use numbers to represent the

number of letters you are trying to arrange. The teacher will draw three lines on the blackboard ____, _____, ____ with a space between each line. The teacher will draw a 3 on the first line. The teacher will draw a 2 on the second line. The teacher will draw a 1 on the last line. The teacher will draw multiplication symbols between the numbers 3 and 2 and the numbers 2 and 1 $\left(3 \times 2 \times 1\right)$. The teacher will multiply the numbers. The teacher will write the product of the three numbers (6) on the blackboard. The teacher will tell the students that the choice of the first letter (three) is multiplied by the choices of the second letter (two) which is multiplied by the choices of the third letter (one): $\left(3 \times 2 \times 1\right)$. The teacher will tell the students that this multiplication method of permutation is called n factorial.   The teacher will ask the students, "Do you have any questions?"

The students will give their response to the question.

The teacher will tell the students that the first example that was demonstrated was an example of a combination. The teacher will tell the students that a **combination** *is a selection of items in which order is not important. The teacher will give the students several real life examples of combinations.*
- o *Example 1 Buying clothes*
- o *Example 2 Selecting a shirt and a skirt*
- o *Example 3 Dealing out playing cards*

The teacher will tell the students that the order in which you select each combination is not important that is why it is called a combination.

The teacher will tell the students that the second example that was demonstrated was an example of a permutation. The teacher will tell the students that a **permutation** *is an arrangement of data in a definite order. The teacher will give the students several real life examples of permutations.*
- o *Example 1 Dialing numbers on a telephone*
- o *Example 2 Opening a combination lock*
- o *Example 3 Keying in a security code on an alarm system*

The teacher will tell the students that order is important when you are arranging permutations. The teacher will say, "For example to open my combination lock I must use a specific order to unlock the combination. The teacher will ask the students to give real life examples of permutations and combinations.

The students will give their examples of real life permutations and combinations.

The teacher will conduct a group activity. The teacher will put the students in groups of fours. The teacher will distribute a small bucket containing 20 cubes to each group. The teacher will distribute a Permutation/Combination Log Sheet to each group.   The teacher will instruct the students to complete the group assignment.

3   Materials and Resources

Bucket of Blocks	*Permutations/Combinations Grading Rubric*
Chalk	*Group Activity Check List*
Construction Paper	*Permutations/Combinations Group Activity*
Scissors	
Markers	

Judy, Goodnow, Shirley, Hoogeboom, <u>Junior High Probability JobCard (cards 12 and 16</u>), *Creative Publications 1991*

Imogene, Forte, Marjorie, Frank, <u>Graphing, Statistics, and Probability Grades 6-8</u>, *Incentive Publications, Inc., 2000*

4   Assessment

The teacher will observe the students during work time. The teacher will use a checklist to record group participation.

Performance Assessment - the teacher will use a rubric to grade group participation.

Name: _____   Date: _____

Permutations/Combinations
Group Activity Rubric

Group Activity		
	Total Possible Points	Total Points Earned
Teamwork Participation	15	
Followed Directions	10	
Demonstrated Knowledge	10	
Effort (problems attempted)	5	
Managed Time Wisely	5	
Legibility	5	
TOTAL POINTS	**50**	

Teacher's Comments:

Group Activity Check List
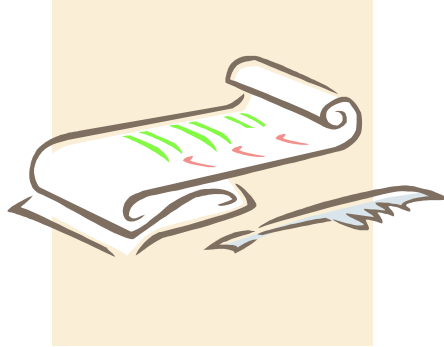
	Group A	Group B	Group C	Group D
Teamwork				
Participation Level				
Knowledge Level				
Time Usage				
Neatness				
Completed Activity				
Followed Direction				

Permutations/Combinations Group Activity
Log Sheet

1. **How many different ways (permutations) can you arrange four cubes of different colors in a row. Select four different color cubes from the bucket. First estimate the number of arrangements you think are possible. Then record your estimation in the estimation column. Then arrange the four cubes in a row. Record the colors of the cubes in the arrangement column using the first letter of each color. Compare your estimate to the actual number of arrangements you found. Then use the multiplication method to see if you found all the possible permutations.**

2. **How many different pairs can you form from six different colored cubes? First, estimate the number of pairs you think are possible. Then record your estimation in the estimation column. Then record your arrangements in the arrangement column using the first letter of each color. For example OY would represent the colors orange and yellow. This will be your first arrangement. DO NOT DUPLICATE LETTERS - OY IS THE SAME AS YO, yellow and orange. Compare your estimate to the actual number of arrangements you found. Then use the multiplication method to see if you found all the possible combinations**

Permutation					Combination			
Estimation	Arrangements				Estimation	Arrangements		

Permutations/Combinations Group Activity

Group Number   _____

Total Permutations _____   **Total Combinations** _____

Total Multiplication Method _____   **Total Multiplication Method**

    _____

3. **Describe how you organized your work in order to find all of the different permutations and combinations.**

Group Number   _____

Student's Name   _____

                        _____

                        _____

                        _____