

## **Lesson Plans**

\*Discrete mini unit covering counting principle, permutations, and combinations.

\*Note: All investigations conducted in groups of 2-4.

### **Day 1**

We will begin this unit with an activity on creating currency for the blind (Sarles). Students will be given many pieces of identical paper and asked to create one, two, five, ten, twenty, fifty, and hundred dollar bills that a blind person could distinguish by feel (not knowing front from back). They are to do this by cutting corners, no more than one cut per corner, and the cuts must be identical so as to be done easily by machine. Groups will present their currency, and class discussion will get us started on the theme of “how many ways?”

We will then begin a lesson from CMP-8<sup>th</sup> grade-Clever Counting book-Lesson 1.1 (pp. 5-7) They will deal with picking an outfit from a given set of clothes and find how many outfits are possible. They will also look at the different possible descriptions of a suspect in a crime and the possibilities for the final appearance of the suspect. In both of these situations students will investigate the use of tree diagrams to count the possibilities.

### **Day 2**

On day two students will investigate more counting situations in which a tree diagram works nicely to find total possible outcomes or ways to do multiple events. This lesson comes from MathScape-Looking Behind the Numbers (pp. 28-31) Students will work through activities dealing with making choices to assemble a lunch from a given menu and finding the number of different lunches possible, as well as situations around the theme of a rock band and different counting problems they encounter.

---different ways to tour 5 cities

---if there are 4 bands playing, how many band orders are possible

---in how many will you play first? Last?

### **Day 3**

On the third day students will work on a lesson from CMP-8<sup>th</sup> grade-Clever Counting-Lesson 1.2 The crime theme continues as someone noticed part of the license plate number of the thief. This lesson is based on license plates, how they are set up, and how many distinct plates can be made. The rules of making plates can be altered to look at many different counting problems within this context.

Students will also investigate some ways to create simple codes and phone numbers using the techniques used to find all the possible license plates above.

### **Day 4**

Now we move into some larger permutation situations, the first dealing with push-button locks out of CMP 8<sup>th</sup> grade-Clever Counting-Lesson 2.1 (pp. 15-16). The push button situation deals with a push pad of five letters, and deals with finding all the possible codes of 1, 2, 3, 4, or 5 letters ( with or without repeating letters in the code). You can add stipulations in how a code can look to further practice and deepen the study of permutations.

Students will also investigate different ways to create a phone number system for different sized groups, cities, states or countries.

Lastly in this section we will investigate different ways to assign codes for several realistic situations such as car alarms, door entry, social security numbers, passcodes, and computer access.

### **Day 5**

This next section moves into dialing combination locks, which by the way is a permutation since the three numbers in the combination for a lock must be used in order. I call this the TF paradox. This section is supported by CMP-Clever Counting-8<sup>th</sup> grade-Lesson 2.2 and 2.3 (pp. 16-19).

We start this investigation by contemplating the number of possible combinations for a combination lock marked with numbers from 0 to 39.

We will build some patterns before we actually answer the question posed above by investigating locks with 3 marks, 4 marks, 5 marks, etc....

This investigation is embedded in a context in which we need to know if it is reasonable that the thief could have opened the lock by trying all the possible combinations, and then discuss what characteristics a “safe” lock would have.

### **Day 6**

We now are moving into situations in which students need to decide: Does order matter? Combinations deal with counting problems in which order does not matter.

We will use CMP-Clever Counting-8<sup>th</sup> grade-Lesson 4.1 (pp. 37-38).

We begin with the question: How many dominos are in a set of double-six dominos? I will pass out some dominos for students to look at, and make their conjecture.

Often, students will come up with 49 using the counting principle. The problem with that is you will count some dominos twice since order does not matter. A domino with a 2 on the left and a 4 on the right can be turned so 4 is on the left and 2 is on the right. They are the same!

Students will work in groups to find a total and present their case.

We will also extend this to larger and/or smaller domino sets after we find some comfort with a solution to the number of double six dominos.

### **Day 7 and Day 8**

During the course of days seven and eight we will explore a multitude of situations in which the students must decide whether order is important or not, and then how to count the possibilities.

Some of the topics we will work with:

- \*If we all shake hands with each other once, how many hand shakes have occurred?
- \*How many games are played if 5 people are entered in a round-robin cribbage tournament?
- \*How many different ways can we pick two toppings for a pizza, from a list of seven toppings?
- \*How many different ways could seven horses finish if we look at first, second, and third place?
- \*How many different ways could the top three horses move to the next race, with seven horses running?
- \*How many different ways could we pick a president and vice-president from our class?
- \*How many different ways could we pick two representatives from this class to go meet with the school board to discuss longer vacations?
- \*If you have nine cd's that you really want to get, and mom is willing to buy you 3, how many different ways can you pick?
- \*You and your brother knock your mom's turtle collection off the shelf, and one of the six different turtles breaks. You know that your mom had them in a specific order, but you don't have any idea what the order was. How many different ways can you place them on the shelf?

Assessment opportunity.

## Going to the Movies

Name:

*You are going to turn in a report in which you will give solutions and explanations for each of the situations listed below. Be neat, show all necessary work and explain clearly and completely. Can you smell the popcorn?*

1. You and your mother are going to pick up your 4 friends to go to the movies. They all live in different parts of town. How many different ways are there to pick up your friends?
2. You have set out on your bed a number of shirts, pants and pairs of shoes that all sort of go together. You need to select an outfit (a shirt, pair of pants and pair of shoes) to wear to the movies, and you know there are at least 100 possible outfits you could pick.

How many shirts are on your bed?

How many pairs of pants?

How many pairs of shoes?

3. When you go to the movies, you really enjoy having pop, popcorn, milk duds, hot tamales, twizlers, and sour-patch kids.

If you could only have two things, how many ways can you pick two?

If you found more money in your pocket, how many ways could you pick three items?

What if you could have four of them, how many ways could you pick?

4. Your friends insist on sitting in the back row, and there are some seats open in the back row. The seats all happen to be next to each other. You know that there are somewhere between 1,000 and 100,000 seating arrangements possible.

How many seats could be open in the back row?

How many seating arrangements are possible if your friends want you to sit in one of the middle seats, and the entire row (20 seats) is open?

5. Your mom said you could choose two of your buddies that went to the movies to go boating with you tomorrow.

How many ways could you pick two of your friends to go boating?

\*As an additional activity, or in place of one of the above problems you could have the kids create their own counting problem, solve it, and explain it.

\*Optional part to question 3: If you could only have 2 and chose popcorn and pop, how many ways could you give the popcorn to one of your friends and the pop to another?

\*Optional part to question 4: If you were sent to choose seats in the theater for you and your friends to sit in, and there were only 8 seats left, how many ways could you do that?

PERFORMANCE PACKAGE TASK 1

(Title of Package)

Content Standard: Discrete

Level: Partial

***Specific Statement(s) from the Standard:***

Select and apply appropriate counting procedures to solve real world and mathematical problems.

***Product(s):***

A report discussing, solving, creating, and explaining several counting problems related to attending a movie with some friends.

***Task Description:***

1. Assemble one or more laundry lists that will create at least 100 possible outfits.
2. Determine how many orders possible to pick up four friends going to movie.
3. Find number of ways to choose a few concession items from a list of desired.
4. Find number of seating arrangements possible for friends, given certain number of open seats.
5. Find ways to choose some of the friends from group for another outing.
6. Create their own “movie” question, explain and answer it.

***Special Notes:***

This could be used as a take-home project or an in class assessment.

PERFORMANCE PACKAGE TASK 1  
(Title of Package)

**FEEDBACK CHECKLIST FOR TASK 1**

The purpose of the checklist is to provide feedback to the student about his/her work relative to the content standard. Have the standard available for reference.

Y=Yes

N=Needs Improvement

<u>Student</u>		<u>Teacher</u>
_____	Student properly calculated and explained different ways to pick up friends.	_____
_____	Student has a given a selection of clothing that will render at least 100 outfits, And shown how mathematically.	_____
_____	Student properly finds all possible combinations choosing from concessions list.	_____
_____	Student shows method of counting permutations of five people among their Given number of seats.	_____
_____	Can find and explain number of combinations of choosing some of friends.	_____

Overall Comments (information about student progress, quality of the work, next steps for teacher and student, needed adjustments in the teaching and learning processes, and problems to be addressed):