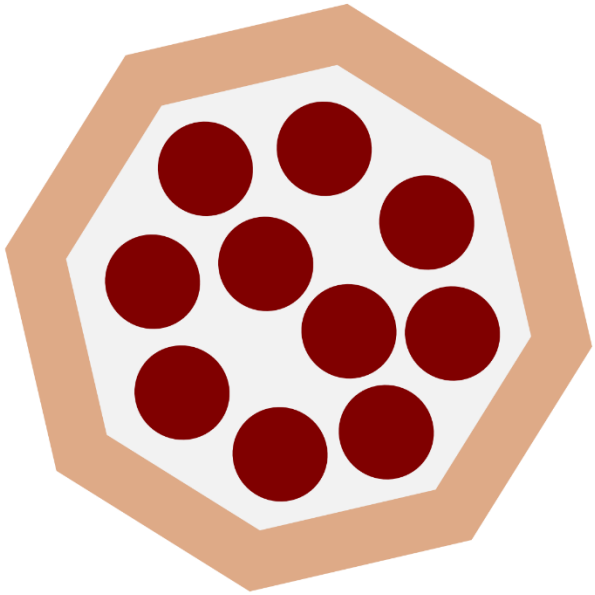
Pizza Place Combinations

21st Century 21 Math Projects



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Pizza Place Combinations

Ideal Unit: Combinations & Permutations	**Time Range**: 2-3 Days	**Supplies**: Pencil & Paper

Topics of Focus:

- Combinations
- Permutations

Driving Question *"How many ways can you make a pizza?"*

Culminating Experience Design your own pizzeria menu

Common Core Alignment:

S-CP.9	Use permutations and combinations to compute probabilities of compound events and solve problems.

Procedures:

A.) In "Pizza Place Combinations", students will calculate the possible combinations of different pizzas based on the ingredients provided. These are all combination questions because the order of the ingredients does not matter. Students will then use the combinations to determine the probability that Mario and Luigi can guess the ingredients.

B.) In "Layers of Lasagna", students will calculate the possible permutations of different lasagna layers based on the ingredients provided. I have constructed these to all be permutation questions because when layering the lasagna, I am claiming the order does matter. Chefs may disagree, but I think the ways the layers interact is the key ☺

C.) In "Your Own Pizzeria", students will develop their own list of ingredients and construct specialty pizzas and lasagnas. They will need to determine the total number of options for each of their offerings and can design the menu if you'd like.

* Aspects of the project can be completed independently. The entire project does not need to be completed to have a great learning experience, though it is suggested because it will best scaffold the skills and context.

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Pizza Place Combinations

Name _____ Date _____

Pizza! Pizza! Mario & Luigi's Pizzeria wants to make sure everyone knows that they are the best of the best. At their pizzeria, they allow customers to choose any number of toppings from their list and create pizzas like their bestseller "Choose 3" or the goliath "the Dozen". They'd like to make a new commercial and show how many different pizza combinations can be made. The premise of the ad is that Mario & Luigi will read the customer's mind and guess the ingredients that they are going to choose. If they are wrong, the customer will get $1 off the order.

Mario & Luigi's Lista di Condimenti

Carne		Ortaggi e Frutta	
Pepperoni	Ground Beef	Roma Tomatoes	Banana Peppers
Italian Sausage	Chicken	Mushrooms	Green Peppers
Bacon	Anchovies	Olives	Onions
		Pineapples	Spinach

Use the list of ingredients to determine the possible options for each pizza. What is the probability that Mario and Luigi would be able to read the customer's mind?

	Possible Options	Probability Mario and Luigi can guess the correct ingredients
Simple Choose 1 Topping		
Choose 3 (Best Seller!) *Choose Any 3 Toppings*		
Meat Beast *Choose Any 4 Meats*		
Vegginator *Choose Any 5 Veggies/Fruit*		
The Dozen *Choose Any 12 Toppings*		
Deuce Deuce *Choose 2 Meats and 2 Veggies/Fruit*		
The Balanced Beast *Choose 4 Meats and 4 Veggies/Fruit*		

1. Which pizza gives Mario and Luigi the best probability of guessing the right ingredients? Which gives the worst?

2. What is the difference in the probability of guessing the ingredients for the Balanced Beast and the Meat Beast?

3. Do you expect Mario & Luigi to be able to predict the orders based on these statistics? Do you believe they will be giving a lot of discounts or very few?

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Layers of Lasagna

Name _____ Date _____

In addition to their world famous pizza pie, Mario & Luigi's Pizzeria serves up its award-winning primo lasagna. When a customer orders their lasagna that's only the beginning. At Mario & Luigi's, the customer decides the order the layers are stacked, and believe you me, the Noodles, Italian Sausage, Ricotta Cheese option tastes different than the Noodles, Ricotta Cheese, Italian Sausage option. Much of Mario & Luigi's magic is the way the layers interact with each other! They are planning a commercial that focuses on their lasagna options.

Help Mario and Luigi determine how many lasagnas their customers can have. The customers can choose each layer only once. The top and the bottom of each lasagna is layered with lasagna noodles, so they do not need to be factored into the choice options.

Mario & Luigi's Strati di Lasagna			
Carne	Ortaggi	Formaggio	Tagliatelle
Italian Sausage	Roma Tomatoes	Ricotta Cheese	Extra Lasagna Noddles
Ground Beef	Onion	Mozzarella Cheese	Penne
Pepperoni	Peppers	Parmesan Cheese	

Use the list of ingredients to determine the possible options for each lasagna.

	Possible Options
Simple Choose 1 Layer	
Choose 3 (Best Seller!) *Choose Any 3 Layers*	
Carne Lovers *Choose Any 2 Meat Layers*	
Cheese & Veg *Choose Any 3 Veggies or Cheese Layers*	
Mongo *Choose Any 8 Layers*	
The Works *Choose All 11 Layers*	
Deuce Deuce Deuce *Choose 2 Meats, 2 Veggies and 2 Cheeses*	

1. Which lasagna provides the most possible options? Which provides the least?

2. How many more options are there for the Deuce Deuce Deuce than the Cheese & Veg?

3. If Mario and Luigi are considering adding a chicken option to the lasagna menus, how would this affect the possible options for the Mongo?

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Your Own Pizzeria

Name _____ Date _____

After years of developing your perfect crust and sauce, you've finally rented a space and are going to be able to open your own pizzeria! In this project, you will need to construct menu options for your pizza and lasagna offerings. You will need to select ingredients as well as create five pizza and five lasagna specialties. Before you start, you'll need to have a snazzy pizzeria name!

In the table, choose a pizzeria name and list the ingredients that you will provide at your store. You will need to put the ingredients into categories so it's clear what choices the customers have.

Pizzeria Name:			

From the ingredients list, construct five specialty pizzas and determine the possible options. *Your specialty pizzas must allow your customers to make choices.* You will use the possible options to advertise on your menu.

Specialty Pizzas	Possible Options

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From the ingredients list construct five specialty lasagna options and determine the possible options. *Your specialty lasagna must have customers select different ingredients for each layer and they cannot select the same ingredient more than once.* You will use the possible options to advertise on your menu.

Specialty Lasagnas	Possible Options

1. Which pizza and which lasagna provide your customers with the most options?

2. Is there a way to increase the number of options? Explain how this could be done.

3. On your menu, you will be able to have a special feature section for one pizza and one lasagna. Choose which items you will use for these special sections and explain why.

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The Menu

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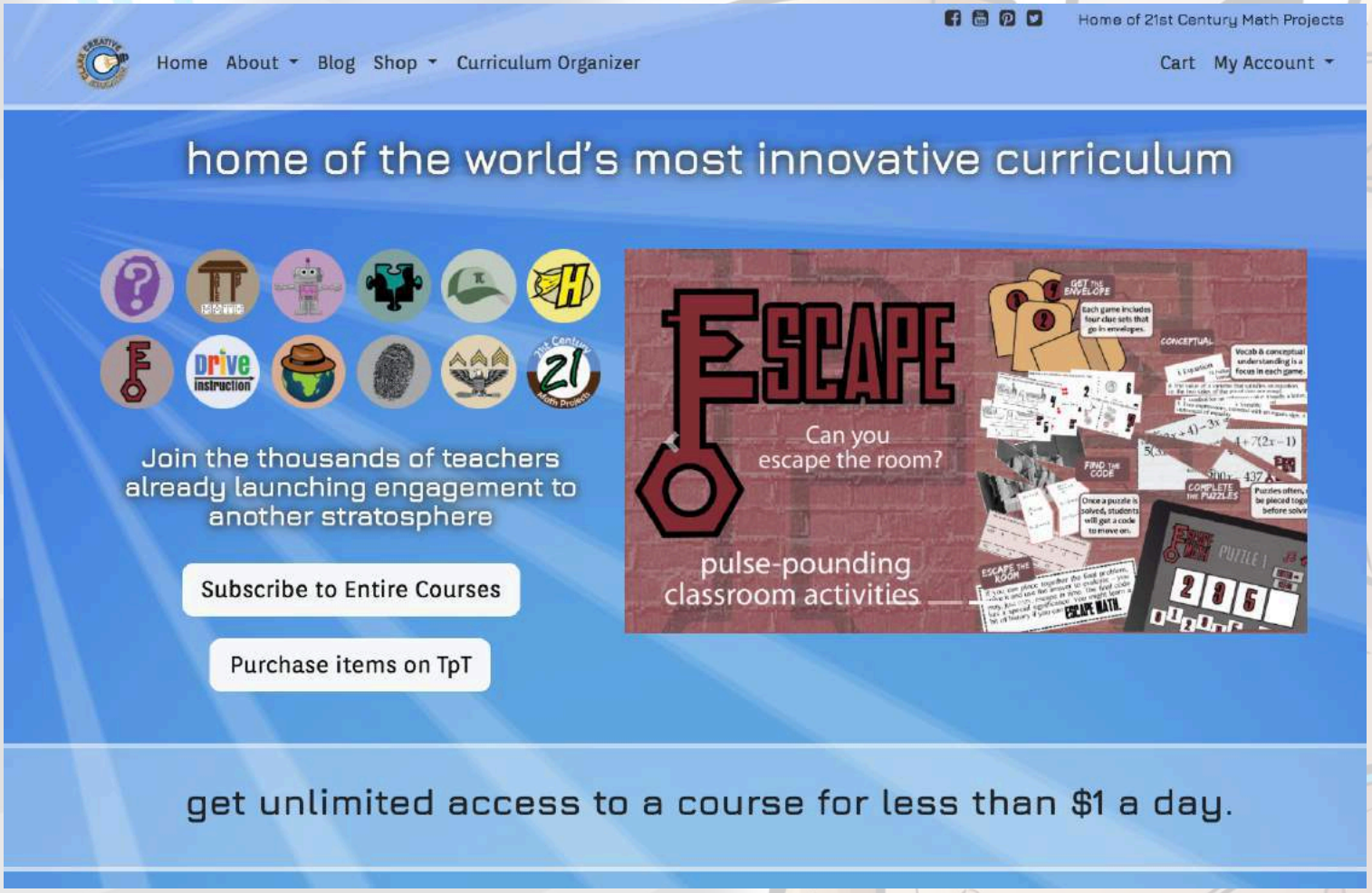

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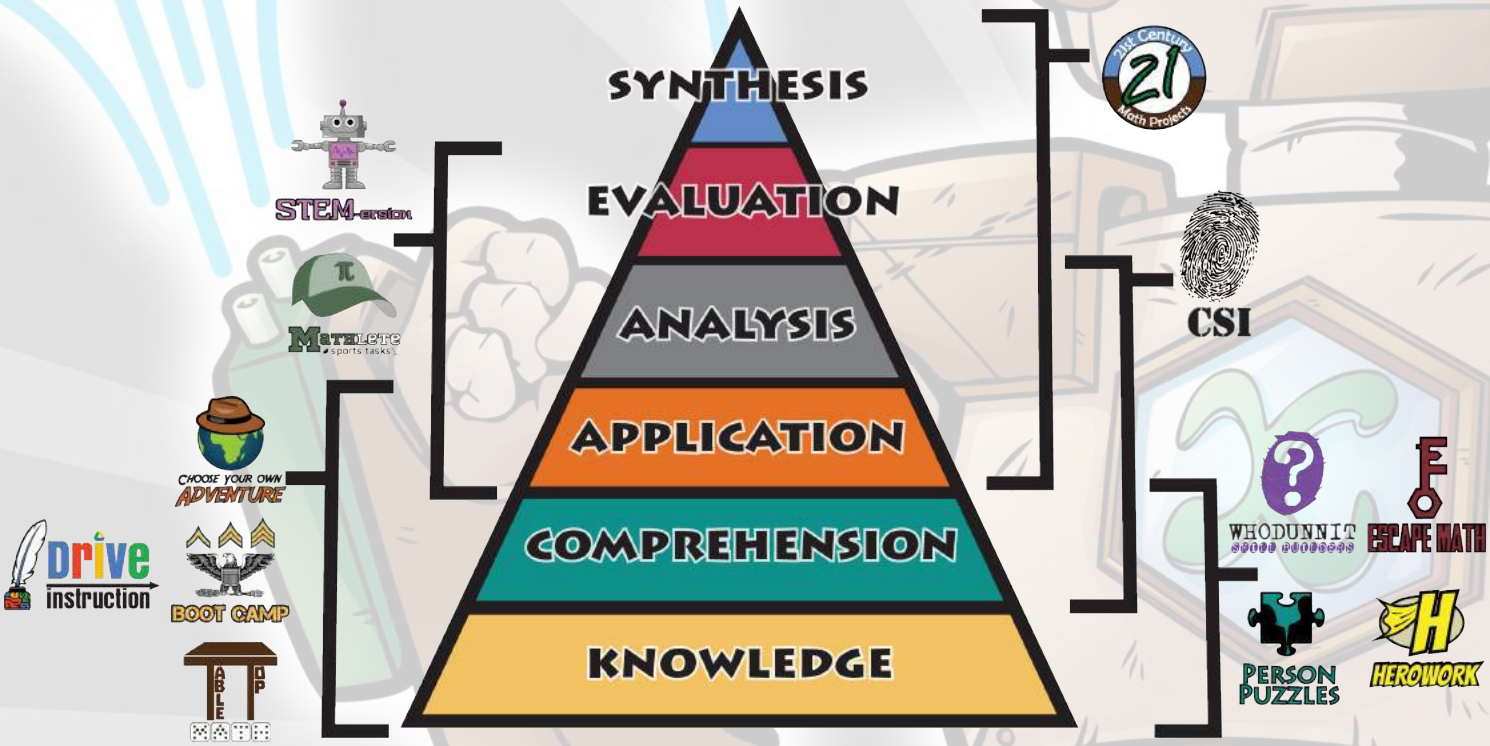

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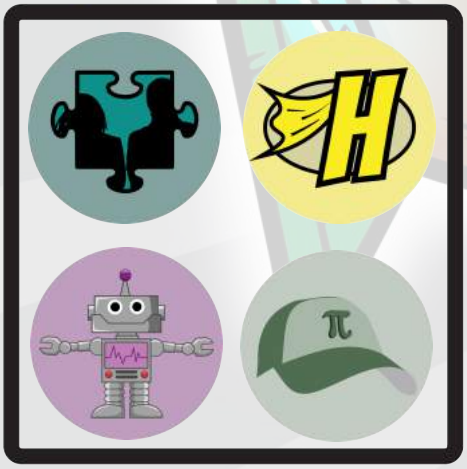

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Pizza Place Combinations

Pizza! Pizza! Mario & Luigi's Pizzeria wants to make sure everyone knows that they are the best of the best. At their pizzeria, they allow customers to choose any number of toppings from their list and create pizzas like their bestseller "Choose 3" or the goliath "the Dozen". They'd like to make a new commercial and show how many different pizza combinations can be made. The premise of the ad is that Mario & Luigi will read the customer's mind and guess the ingredients that they are going to choose. If they are wrong, the customer will get $1 off the order.

Name

Date

Period

Mario & Luigi's Lista di Condimenti

Carne		Ortaggi e Frutta	
Pepperoni	Ground Beef	Roma Tomatoes	Banana Peppers
Italian Sausage	Chicken	Mushrooms	Green Peppers
Bacon	Anchovies	Olives	Onions
		Pineapples	Spinach

Use the list of ingredients to complete the possible options for each pizza. What is the probability that Mario and Luigi would be able to read the customer's mind?

	Possible Options	Probability Mario and Luigi can guess the correct ingredients
Simple Choose 1 Topping	14	7.1%
Choose 3 (Best Seller!) *Choose Any 3 Toppings*	364	0.27%
Meat Beast *Choose Any 4 Meats*	15	6.667%
Vegginator *Choose Any 5 Veggies/Fruit*	56	1.8%
The Dozen *Choose Any 12 Toppings*	91	1.1%
Deuce Deuce *Choose 2 Meats and 2 Veggies/Fruit*	420=15x28	0.24%
The Balanced Beast *Choose 4 Meats and 4 Veggies/Fruit*	1050=15x70	0.095%

1. Which pizza gives Mario and Luigi the best probability of guessing the right ingredients? Which gives the worst? The simple is the best chance. The Balanced Beast is the worst.

2. What is the difference in the probability of guessing the ingredients for the Balanced Beast and the Meat Beast? The difference is 6.57%

3. Do you expect Mario & Luigi to be able to predict the orders based on these statistics? Do you believe they will be giving a lot of discounts or very few? It will likely be many, many discounts.

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Layers of Lasagna

In addition to their world famous pizza pie, Mario & Luigi's Pizzeria serves up its award-winning primo lasagna. When a customer orders their lasagna that's only the beginning. At Mario & Luigi's, the customer decides the order the layers are stacked, and believe you me, the Noodles, Italian Sausage, Ricotta Cheese option tastes different than the Noodles, Ricotta Cheese, Italian Sausage option. Much of Mario & Luigi's magic is the way the layers interact with each other! They are planning a commercial that focuses on their lasagna options.

Help Mario and Luigi determine how many lasagnas their customers can have. The customers can choose each layer only once. The top and the bottom of each lasagna is layered with lasagna noodles, so they do not need to be factored into the choice options.

Mario & Luigi's Strati di Lasagna			
Carne	Ortaggi	Formaggio	Tagliatelle
Italian Sausage	Roma Tomatoes	Ricotta Cheese	Extra Lasagna Noddles
Ground Beef	Onion	Mozzarella Cheese	Penne
Pepperoni	Peppers	Parmesan Cheese	

Use the list of ingredients to determine the possible options for each lasagna.

	Possible Options
Simple Choose 1 Layer	11
Choose 3 (Best Seller!) *Choose Any 3 Layers*	990
Carne Lovers *Choose Any 2 Meat Layers*	6
Cheese & Veg *Choose Any 3 Veggies or Cheese Layers*	120
Mongo *Choose Any 8 Layers*	6,652,800
The Works *Choose All 11 Layers*	39,916,800
Deuce Deuce Deuce *Choose 2 Meats, 2 Veggies and 2 Cheeses*	216

1. Which lasagna provides the most possible options? Which provides the least? The Works provides the most, the Carne Lovers provides the least.

2. How many more options are there for the Deuce Deuce Deuce than the Cheese & Veg? 96

3. If Mario and Luigi are considering adding a chicken option to the lasagna menus, how would this affect the possible options for the Mongo? It would make 19,958,400 or 13,305,600 more options.

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Pizza Place Combinations

Rubric

Standards		Exemplary	Proficient	Developing
HSS-CP.B.9	use permutations and combinations to compute probabilities of compound events and solve problems			
Math Processes		**Exemplary**	**Proficient**	**Developing**
Skills & Mechanics	*accurately performs calculations*			
	demonstrates fluency with mathematical skills and processes			
Applications	*accurately interprets word problems and addresses them with appropriate math skills*			
	can articulate the meaning of calculations in the context of the problems.			
Use of Evidence & Analysis	*can determine what evidence is appropriate to answer a question*			
	utilizes mathematical outcomes to support their conclusions			

Comments:

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