

# GO BIG, PAPA?

name \_\_\_\_\_

date \_\_\_\_\_

Are Papa John's specialty pizzas a good deal?

## Act One: Isn't that Special?

- 1 When you order from Papa John's, you can either create your own pizza or order a specialty kind. For example, **The Works** includes pepperoni, ham, sausage, onions, green peppers, mushrooms and black olives. Look at the pricing chart below. Do you think **The Works** is a good deal? Explain.



|                 |               | Small   | Medium  | Large   | Extra Large |
|-----------------|---------------|---------|---------|---------|-------------|
| Create Your Own | Base Price    | \$8.29  | \$11.39 | \$12.49 | \$14.59     |
|                 | Add'l Topping | \$0.99  | \$1.39  | \$1.59  | \$1.79      |
| Specialty Pizza | Total         | \$11.29 | \$14.39 | \$16.49 | \$18.59     |

- 2 For each size, calculate the number of toppings you'd need to order for a specialty pizza to be worth the price. Based on this, which specialty size seems to be the best deal...and is this what you'd expect?
- 3 Choose three Papa John's specialty pizzas, and calculate how much you're saving two ways: in dollars *and* as a percent. Which specialty pizza (including size) is the best deal? The worst?

## Act Two: Coupons

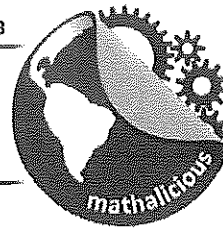


- 4 Papa John's also offers coupons. The **Three Large** coupon lets you order three large pizzas with *up to* three toppings for \$30. As a percent, what's the most you can save with this coupon? The least?
  
- 5 Imagine you only wanted two large pizzas. Would it still be worth using the **Three Large** coupon? Explain.
  
- 6 Of all the coupons, calculate which one saves you the greatest percent. Then, which offer would *you* choose? (Note: cheesesticks = \$4.99, wings = \$6.99, chickenstrips = \$6.99, and a 20-oz. soda = \$1.59.)

# GO BIG, PAPA?

Are Papa John's specialty pizzas a good deal?

## lesson guide



In addition to the regular build-your-own pizzas, Papa John's also offers a number of specialty pizzas, from The Works to Garden Fresh to Hawaiian BBQ Chicken. They sound delicious, but are they actually a good deal?

In this lesson students **evaluate expressions** to calculate how much it would cost to build each specialty pizza topping-by-topping. They then calculate the savings two ways—in dollars and as a **percent**—to determine whether specialty pizzas are really worth it. Is it smart to always “go big?”

### Primary Objectives

- Use “Create Your Own” pizza pricing to evaluate a cost expression and compare prices
- Calculate savings when ordering pizza in terms of dollars (\$), percents (%), and number of toppings
- Given several money-saving options, decide which deal is the best (and why!)

### Content Standards (CCSS)

Grade 6 RP.3, EE.9  
Grade 7 EE.4.a

### Mathematical Practices (CCMP)

MP.3, MP.4

### Materials

- Student handout
- LCD projector
- Computer speakers

### Before Beginning...

Students should be able to convert part of a whole into a percent (e.g. \$5 is 25% of \$20).

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## Preview & Guiding Questions

Students watch a commercial for Papa John's specialty Italian Meats Trio pizza. The pizza is advertised at a price of \$11.99. But is this a good deal?

When students say yes or no, ask them what they're basing their opinion on. After all, we don't have any additional information – what should we compare the \$11.99 to? Indeed, the real question isn't whether it's a good deal or not, but *how we'd determine* whether it is.

If students have trouble articulating how they can determine whether the pizza is a good deal, ask them a more general question: how do you know when a "sale" price is a deal or not? Of course, it's only a deal if it saves you money. Within the context of Papa John's, this means that the pizza in the ad is only a good deal if it's cheaper than the cost to build the pizza without the special offer, i.e. topping-by-topping.

So, to make a fair comparison, what will students need to know? That's right, the prices when you "Create Your Own" pizza. Once they realize this, they'll be ready for Act One.

- *Do you think the Italian Meats Trio pizza is a good deal?*
  - *What makes you think it's a good deal or a bad deal?*
  - *Can you think of any "deals" you've been offered that actually weren't very good deals?*
  - *How would you determine whether something is a good deal?*
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## Act One

Prices in hand, students begin Act One by determining whether or not the specialty pizzas offered by Papa John's are ever a good deal. They do this by comparing the price for a specialty pizza to the amount it would cost to recreate the same pie by using the "Create Your Own" ordering option. Students will explore how savings can vary by the type of pizza and its size. They will also quantify the savings in terms of dollars, percentages, and the number of extra toppings required to make a custom pie cost the same as one of the specialties.

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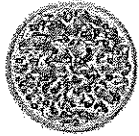
## Act Two

Analyzing the menu is certainly one way to scout for savings. Another popular approach is to look for coupons. In Act Two, students will explore how different coupons affect their potential savings. After calculating the savings provided by several different coupons, the lesson ends with students deciding for themselves which coupon they'd be most likely to use.

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## Act One: Isn't that Special?

- 1 When you order from Papa John's, you can either create your own pizza or order a specialty kind. For example, **The Works** includes pepperoni, ham, sausage, onions, green peppers, mushrooms and black olives. Look at the pricing chart below. Do you think **The Works** is a good deal? Explain.



|                 |               | Small   | Medium  | Large   | Extra Large |
|-----------------|---------------|---------|---------|---------|-------------|
| Create Your Own | Base Price    | \$8.29  | \$11.39 | \$12.49 | \$14.59     |
|                 | Add'l Topping | \$0.99  | \$1.39  | \$1.59  | \$1.79      |
| Specialty Pizza | Total         | \$11.29 | \$14.39 | \$16.49 | \$18.59     |

If someone created this from scratch, it would cost:

|              |                             |                         |
|--------------|-----------------------------|-------------------------|
| Small:       | $8.29 + 0.99(7) = \$15.22$  | Savings = \$3.93 or 26% |
| Medium:      | $11.39 + 1.39(7) = \$21.12$ | Savings = \$6.73 or 32% |
| Large:       | $12.49 + 1.59(7) = \$23.62$ | Savings = \$7.13 or 30% |
| Extra-Large: | $14.59 + 1.79(7) = \$27.12$ | Savings = \$8.53 or 31% |

Ordering **The Works** saves money in every size.

### Explanation & Guiding Questions

Students first need to realize that, when you buy a pizza, you're really paying for two things: the pizza itself, and then any additional toppings. The base price of the pizza is fixed for each size, but the cost of toppings depends on *how many* toppings you order. Begin by having students calculate the cost for a single additional topping, which only involves addition, and then they can generalize to the case of multiple toppings, which involves one addition for each topping – in other words, multiplication.

- What are the two components you pay for when you buy a pizza?
- How much does **just** the pizza cost in each size?
- How much would it cost to add a single topping to a small pizza?
- How many toppings are on **The Works** pizza?
- How much would it cost to add three toppings to a small pizza? To add seven toppings?
- How much would it cost, in total, for a small pizza with seven toppings?
- Do you think **The Works** seems like a good deal?

### Deeper Understanding

- How much would a medium build-your-own pizza with  $t$  toppings cost? ( $11.39 + 1.39t$  dollars)
- How does the percent increase in base price compare to the percent increase in topping price as you move from a medium to a large pizza? (The increase in base price is only about 9.7%, while the increase in topping price is over 14%.)
- Which size is the best deal? (The extra-large saves the most money, not surprisingly, but the medium actually offers the highest percent savings. See sample answer above.)

- 2 For each size, calculate the number of toppings you'd need to order for a specialty pizza to be worth the price. Based on this, which specialty size seems to be the best deal...and is this what you'd expect?

|              |  |          |
|--------------|--|----------|
| Small:       | $(\$11.29 - \$8.29) \div \$0.99 \approx 3.03$  | toppings |
| Medium:      | $(\$14.39 - \$11.39) \div \$1.39 \approx 2.16$ | toppings |
| Large        | $(\$16.49 - \$12.49) \div \$1.59 \approx 2.52$ | toppings |
| Extra Large: | $(\$18.59 - \$14.59) \div \$1.79 \approx 2.23$ | toppings |

Since the medium requires the fewest toppings to justify the price, it seems like this size is the best deal.

### Explanation & Guiding Questions

Students have seen that The Works is always a good deal, but what about the other specialty pies? After all, specialty pizzas cost more than a *plain* pizza, but less than a seven-topping pizza (like The Works) in every size. So there must be a point – a number of toppings – at which a specialty pizza starts becoming a good deal.

While it's straightforward to calculate the price difference between a specialty pie and a plain pie of the same size, the key understanding for students is that they can then represent that difference in terms of number of toppings. Begin by having students compute the price difference between specialty and build-your-own pizzas in a particular size, and then calculate how many toppings it would take to make up that difference.

For example, a small specialty pie costs \$3 more than a plain pie; how many toppings does it take to make up that difference. Some students might simply keep a running total with each additional topping. For the small pizza, one topping (\$0.99) isn't enough. Neither are two toppings (\$1.98). Three toppings still aren't enough (\$3.97). But the fourth topping makes up the difference, so that is the point at which the specialty pie becomes a good deal.

Alternatively, students may simply choose to divide the price difference by the cost of a single topping in order to get the number of required toppings. Since small toppings cost \$.099 each, you would need to order  $\$3 \div \$0.99 = 3.03$  toppings for the specialty pizza to be worth the additional cost. Since we're talking about whole numbers of toppings, that really means you need at least 4 toppings to justify the specialty price. The calculations for the rest of the sizes can be carried out in the same way. Overall, you'd need to order at least 3 toppings to make the specialty pie a good deal, and 4 toppings in the case of the small.

- How much does a small specialty pizza cost?
- How much does a small regular (plain) pizza cost?
- How much **more** does a small specialty pizza cost?
- How much does a single additional topping cost for a small pizza?
- How many toppings would you have to order to make up for that cost difference?
- So, at what point is the specialty pizza a better deal for the small?
- What about the other sizes?

### Deeper Understanding

- Why do you think that the small pizza takes more toppings to justify buying a specialty pizza? (There probably isn't a right answer, but it may be that the small pizza is so inexpensive, in general, that the company has to make the small specialty a slightly worse deal to make a profit.)

- 3 Choose three Papa John's specialty pizzas, and calculate how much you're saving two ways: in dollars *and* as a percent. Which specialty pizza (including size) is the best deal? The worst?

| Specialty Pizza | Add'l Toppings              | Size | Price, Create Your Own         | Savings (\$) | Savings (%) |
|-----------------|-----------------------------|------|--------------------------------|--------------|-------------|
| The Works       | see above                   | M    | $11.39 + 1.39(7) = 21.12$      | \$6.73       | 31.9%       |
| Spicy Italian   | pepperoni, double sausage   | XL   | $14.59 + 1.79(3) =$<br>\$19.96 | \$1.37       | 6.9%        |
| Spinach Alfredo | spinach (sauce not counted) | S    | $8.29 + 0.99(1) = \$9.28$      | -\$1.92      | -20.7%      |

A medium The Works saves the greatest percent. A small Spinach Alfredo actually loses you money. (This assumes that the Alfredo sauce isn't counted as an "add'l" topping, since it takes the place of tomato sauce.)

### Explanation & Guiding Questions

Have students begin by predicting which specialty pizza they think will end up being the best deal. The Works seems like a reasonable candidate: since it includes the most toppings, it would be the most expensive as a build-your-own pie. In other words, it has the most "room" for savings. In fact, it turns out that the medium The Works is the best deal, saving you almost 32% over the build-your-own price.

Students need to understand that "percent savings" is calculated based on the difference between the build-your-own price and the specialty price, so they will need those values to start with. The specialty price is already listed, so they just need to calculate the prices for the build-your-own versions of the specialty pies. Getting the absolute difference simply involves subtraction, but they may have difficulty turning that into a percent. Here you can use fractions as an intermediate step, if that helps your students make the transition. Remind them that the build-your-own price is the baseline we're using for comparison, so *it* needs to be in the denominator of their fraction/percent calculations, and *not* the specialty price. For example, a small pie with The Works would cost \$21.12 as a build-your-own pizza, which is \$6.73 more than the specialty version. That's  $\$6.73 / \$21.12 \approx 32\%$  savings.

As a final note, it's possible that a specialty pizza is actually a *worse* deal! If you don't count Alfredo sauce as a "topping," for instance (because it replaces the tomato sauce), the small Spinach Alfredo is better off as a build-your-own pizza. The questions below are based on The Works pizza, as an example.

- Which specialty pizza do you **predict** will offer the best deal?
- How much does a medium pizza with The Works cost (as a specialty pizza)?
- How much would it cost to build a medium pizza with The Works, topping by topping?
- How much are you saving, in dollars, by buying the specialty pizza?
- How would you write this savings as a **fraction** of the build-your-own cost?
- How would you write this savings as a **percent** of the build-your-own cost?

### Deeper Understanding

- What does it mean to have negative savings? (A negative savings means that the build-your-own price is actually **better** than the specialty price, as in the small Spinach Alfredo example above.)

## Act Two: Coupons



- 4 Papa John's also offers coupons. The **Three Large** coupon lets you order three large pizzas with *up to* three toppings for \$30. As a percent, what's the most you can save with this coupon? The least?

*A person will save the greatest percent by ordering the maximum number of toppings (3). A person will save the least percent by ordering the fewest number of toppings (0).*

| Large 3-Topping Pizza            |         | Large 0-Topping Pizza            |         |
|----------------------------------|---------|----------------------------------|---------|
| Price per Pizza, Create Your Own | \$17.26 | Price per Pizza, Create Your Own | \$12.49 |
| Price per Pizza, Coupon          | \$10.00 | Price per Pizza, Coupon          | \$10.00 |
| Savings (\$)                     | \$7.26  | Savings (\$)                     | \$2.49  |
| Savings (%)                      | 42.1%   | Savings (%)                      | 19.9%   |

## Explanation &amp; Guiding Questions

Now that students have looked at specialty pizza prices, they're going to look at some other deals in the form of coupons. First, students need to understand what the coupon is actually offering. It's not as simple as a three-pizza, three-topping deal; you're actually allowed to use it for "up to 3 toppings." While the wording might be a little ambiguous (does "up to 3" *include* 3?), customers can use the coupon for pizzas with 0, 1, 2, or 3 toppings. Students have already seen how, *without* a coupon, adding toppings to a pizza increases its price, so it stands to reason that the most savings occurs when the regular price is as high as possible – in this case, pizzas with three toppings – and the least savings occurs when the regular price is as low as possible – in this case, pizzas with zero toppings.

With the coupon, the pizzas end up costing \$10 each, so students can just compare the per-pizza regular price to \$10 in order to calculate the savings and, ultimately, the percent savings.

- What does "up to three" mean, mathematically?
- What number of toppings will give you the minimum savings? The maximum savings?
- How much does a large, zero-topping (plain) pizza cost?
- How much does a large, three-topping pizza cost?
- What is the cost per pizza if you *don't* use the coupon? What if you *do* use it?
- How much money are you saving on each pizza with the coupon?
- What is that savings as a fraction of the build-your-own price? As a percent?

## Deeper Understanding

- Is your percent savings *per pizza* the same as your percent savings *total*? Why or why not? (Because of the *Distributive Property*, it doesn't matter whether you add up the percent savings from each individual pizza, or calculate the percent savings from the total purchase.)



- 5 Imagine you only wanted two large pizzas. Would it still be worth using the Three Large coupon? Explain.

*If someone uses the Three Large coupon but only wants two pizzas, then each pizza now really “costs” \$15 (instead of \$10). Using the build-your-own method, a large 3-topping pizza would cost \$17.26. A large 2-topping pizza would cost \$15.56. A large 1-topping pizza would cost \$14.08. And a large 0-topping pizza would cost \$12.49.*

*Based on this, the Three Large coupon is still a deal if someone orders two pizzas with two or more toppings. For only one or no toppings, though, the create-your-own option is the way to go.*

### Explanation & Guiding Questions

If someone wants to use the Three Large coupon, but only wants *two* pizzas, then each pizza effectively costs \$15 (instead of the \$10 each, as in the previous question). Students have already done some calculations, so they can refer to their earlier work to get a feel for whether this strategy would be a good idea. For example, they know that a large, plain pizza costs \$12.49, so using the coupon would actually cost *more* money. That same pizza with three toppings, though, costs \$17.26, so now the coupon saves you money. It seems as though whether or not the coupon is a good deal depends on the number of toppings you plan to buy.

After students reason about the zero- and three-topping cases, have them look at one- and two-topping pizzas as well. They'll see that the coupon is a good deal if you order at least two toppings, and a bad deal otherwise.

- *If you use the coupon, but only want two pizzas, how much are you paying **per pizza**?*
- *How much would a large, build-your-own pizza cost with three toppings?*
- *How about a two-topping pizza? A one-topping pizza? Plain?*
- *Which pizzas cost less than \$15? Which cost more?*
- *So, when would you use the coupon? When **wouldn't** you use it?*

### Deeper Understanding

- *What do you think a One Large coupon should offer? (The Three Large and Two Large coupons offer savings between about 36% and 42%, so any discount in about that range would seem reasonable.)*

- 6 Of all the coupons, calculate which one saves you the greatest percent. Then, which offer would you choose? (Note: cheesesticks = \$4.99, wings = \$6.99, chickenstrips = \$6.99, and a 20-oz. soda = \$1.59.)

| Coupon         | Price   | Details                             | Regular | Savings (\$) | Savings (%) |
|----------------|---------|-------------------------------------|---------|--------------|-------------|
| Papa's Sides   | \$9.50  | Wings + Cheesesticks                | \$11.98 | \$2.48       | 20.7%       |
|                |         | Chickenstrips + Cheesesticks        | \$11.98 | \$2.48       | 20.7%       |
| Two Large      | \$22.00 | Two Large 2-Topping Pizzas          | \$31.34 | \$11.34      | 36.2%       |
| Carryout Only! | \$4.99  | Small 1-Topping Pizza               | \$9.28  | \$4.29       | 46.2%       |
|                | \$5.99  | Small 1-Topping Pizza + 20-oz. Coke | \$10.87 | \$4.88       | 44.9%       |

### Explanation & Guiding Questions

Students have already looked at the Three Large coupon in some depth, so there are really only three more to compare in this question. Also, since the chickenstrips and wings have the same regular price, both deals in the Papa's Sides coupons are exactly the same, from a savings standpoint (wings are obviously superior). The Two Large coupon involves essentially the same mathematics as the Three Large coupon, so no surprises there. The Carryout Only! deal for a small, one-topping pizza is straightforward, and it ends up being a great deal – in fact, it's easily the best bargain of the bunch.

There's an interesting wrinkle with this last coupon, though: adding the drink actually makes the deal *worse*! To see why, students can focus on the percent savings for the drink compared to the pizza alone. The savings from just the pizza is about 46%, which is pretty great. The drink only costs \$1, compared to its regular price of \$1.59, which is good – but not quite *as good* – since 59 cents is less than 46% savings on \$1.59. Because the percent savings from the drink is worse, the combined savings *with* the drink must be worse than the savings from the pizza alone.

- How much would the items in the Papa's Sides deal cost without the coupon?
- What does that tell you about the two possible deals in the Papa's Sides coupon?
- What coupon ends up saving you the most money?
- What coupon ends up saving you the biggest percent?
- Does the best deal surprise you? Why or why not?

### Deeper Understanding

- Without calculating anything, how do you know that the Carryout Only! deal is worse *with* the beverage than without it? (See explanation in notes above.)
- How much would the discounted soda have to cost for both Carryout Only! options to be equally good? (Since, again, the pizza savings is 46.2%, the savings on the drink would *also* have to be 46.2% for both deals to be equally good. That would correspond to a discounted price of about \$0.86.)