NEW-TRITIONAL INFO

How long does it take to burn off food from McDonald's?

name

date

Act One: Burn It

1 When you exercise, the number of calories you burn depends on two things: the type of exercise and your weight. Playing basketball for one minute, for example, burns 0.063 calories for every pound of body weight.

Complete the table below to find out how many calories each celebrity will burn in **one minute of exercise**.

cal. burned in one min.	Selena Gomez 125 lb	Justin Timberlake 160 lb	Abby Wambach 178 lb	LeBron James 250 lb
Basketball 0.063 cal/lb				
Soccer 0.076 cal/lb				
Walking 0.019 cal/lb				

2 If someone wanted to double the number of calories they burned while exercising, what could they do?

3 An NBA game is 48 minutes long. If LeBron James ate a Big Mac Extra Value Meal (1360 calories) before a game, would he burn off all the calories by the end of the game? If not, how much longer would he have to play?

Act Two: Supersize?

4 Different types of exercise burn different numbers of calories. Choose one of the celebrities from before and three types of exercise. For each activity, how long would it take to burn off the McDonald's items below?

Calories Burned in One Minute of Exercise				
Sitting 0.009 cal/lb	Walking 0.019 cal/lb	Bowling 0.023 cal/lb	Biking, slow 0.029 cal/lb	Golf 0.033 cal/lb
Soft-Baseball 0.038 cal/lb	Weight Training 0.039 cal/lb	Biking, fast 0.045 cal/lb	Ice Skating 0.053 cal/lb	Tennis 0.061 cal/lb
Basketball 0.063 cal/lb	Jogging 0.063 cal/lb	Swimming 0.064 cal/lb	Soccer 0.076 cal/lb	Jump Rope 0.083 cal/lb

	Big Mac 550 calories	Large Fries 500 calories	Large Coca-Cola 310 calories	Salad (no dressing) 20 calories

5 In September 2012, McDonald's began posting calorie information in all of its restaurants in the United States. Listen to the NPR clip about this decision, and use it to answer the following.

a. Does publishing calories affect what people order? Why do you think this is?	b. What do you think would happen if McDonald's rewrote its menu in terms of *exercise*?

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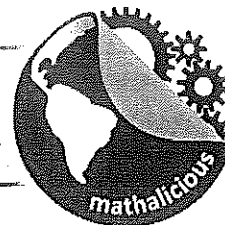
Many restaurants are required to post nutritional information for their foods, including the number of calories. But what does "550 calories" really mean? Instead of calories, what if McDonald's rewrote its menu in terms of exercise?

In this lesson, students will use unit rates and proportional reasoning to determine how long they'd have to exercise to burn off different McDonald's menu items. For instance, a 160-pound person would have to run for 50 minutes to burn off a Big Mac. So...want fries with that?!

Primary Objectives

- Calculate the number of calories burned per minute for different types of exercise and body weights
- Correctly write units (e.g. calories, cal/min, etc.) and simplify equations using them
- Calculate how long it would take to burn off menu items from McDonald's
- Discuss effects of posting calorie counts, and what might happen if exercise information were posted instead

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Content Standards (CCSS)	Mathematical Practices (CCMP)	Materials
Grade 6 RP.3d, NS.3	MP.3, MP.6	• Student handout • LCD projector • Computer speakers

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Before Beginning...

Students should understand what a unit rate is; if they have experience calculating and using unit rates to solve problems, even better.

Preview & Guiding Questions

Students watch a McDonald's commercial in which NBA superstars LeBron James and Dwight Howard play one-on-one to determine who will win a Big Mac Extra Value Meal. When it's done, ask students, "How long do you think LeBron James would have to play basketball to burn off all the calories in a Big Mac?"

The goal isn't for students to come up with an exact answer. Instead, it's to get them thinking about the various factors that determine how many calories someone burns when he/she exercises. People burn calories at a faster rate when they do more strenuous exercise. Also, larger people burn more calories doing the same activity than smaller people. We don't expect students to know these things for sure, but they might conjecture that easier activities burn fewer calories, and that different people doing the same activity burn calories at a different rate.

- *How long do you think LeBron James would have to play basketball to burn off the calories in a Big Mac?*
- *What are some factors that might determine how long it would take someone to burn off calories?*
- *Do you think everyone burns the same number of calories when they exercise? Why or why not?*

Act One

After students have discussed some possible factors affecting how quickly someone burns calories, they will learn in Act One that there are three essential things to consider: their body, the type of exercise, and the duration of exercise. Students will first calculate how many calories people with different body types (including LeBron) will burn per minute while performing a variety of activities. Based on this, they'll be able to answer the question in the preview: LeBron would have to play basketball for about 86 minutes in order to burn off a Big Mac Extra Value Meal. Even if he played for an entire game, he wouldn't be able to burn off his lunch!

Act Two

Act Two broadens the scope even further by considering a wider assortment of exercises and different McDonald's items. Students will determine how long someone would have to do different activities to burn off each menu item. Then, they will listen to an NPR clip about the fact that McDonald's now posts calorie information for all of its items on the menu. Students will discuss whether or not this seems like an effective way to change people's behavior. We end with the following question: what might happen if McDonald's rewrote its menu in terms of *exercise*?

ct One: Burn It

1 When you exercise, the number of calories you burn depends on two things: the type of exercise and your weight. Playing basketball for one minute, for example, burns 0.063 calories for every pound of body weight.

Complete the table below to find out how many calories each celebrity will burn in **one minute of exercise.**

cal. burned in one min.	Selena Gomez 125 lb	Justin Timberlake 160 lb	Abby Wambach 178 lb	LeBron James 250 lb
Basketball 0.063 cal/lb	7.88 calories per minute	10.08 calories per minute	11.21 calories per minute	15.75 calories per minute
Soccer 0.076 cal/lb	9.50 calories per minute	12.16 calories per minute	13.53 calories per minute	19.00 calories per minute
Walking 0.019 cal/lb	2.38 calories per minute	3.04 calories per minute	3.38 calories per minute	4.75 calories per minute

Explanation & Guiding Questions

The math in this question is fairly straightforward. However, students might get confused by all the different units, and it may be worth demonstrating how they simplify. For instance, when LeBron James plays basketball, he burns 0.063 calories for every pound of body weight *each minute*. Since he weighs 250 pounds, he will burn

$$\left(\frac{0.063 \text{ cal}}{1 \text{ lb}} \times 250 \text{ lb} \right) \text{ per minute} = \frac{0.063 \text{ cal}}{1 \text{ lb}} \times \frac{250 \text{ lb}}{1} \text{ per minute} = 15.75 \text{ calories in one minute.}$$

Of course, not all students will be this intentional with their units, and it would be cumbersome to repeat this process for all twelve boxes. Still, it may be worth pointing out how the units simplify, lest "calories per minute" seem to come out of left field. However students calculate their unit rates, they should be able to explain what they mean in their own words, e.g. "Every minute that LeBron plays basketball, he burns 15.75 calories."

- *For a given exercise, who do you think will burn more calories in a minute – LeBron or Selena – and why?*
- *What does the unit rate, "0.063 calories per pound," mean?*
- *What does the unit rate, "15.75 calories per minute," mean?*

Deeper Understanding

- *Why do you think Selena Gomez burns so many fewer calories than LeBron does? (All your cells consume energy, i.e. burn calories, and LeBron, being so much heavier, has many more cells.)*
- *Why does playing soccer burn so many more calories per minute than walking does? (In soccer, a player runs, jumps, and kicks. These require more energy than walking. A calorie is a measure of energy.)*
- *How long would someone have to walk to burn the same number of calories as a minute of soccer? (Since walking burns 1/4 the calories of soccer, a person would have to walk 4 times as long, or 4 minutes.)*

2 If someone wanted to double the number of calories he burned while exercising, what could they do?

If someone wanted to double the number of calories he burned, he could do three things. He could exercise for twice as long. He could switch to an exercise that burned twice as many calories. Or he could somehow weigh twice as much...though this is unlikely.

Explanation & Guiding Questions

From the LeBron-James-playing-basketball example from before, we know he burns

$$15.75 \text{ calories} = \left(\frac{0.063 \text{ cal}}{1 \text{ lb}} \times 250 \text{ lb} \right) \text{ in one minute.}$$

More generally, total calories (T) = calories per pound (c) × weight (w) × number of minutes (n). If someone wants to double the number of calories he burns, he can double any of the terms above: he can choose an exercise that burns twice as many calories; he can weigh twice as much; or he can exercise for twice as long. (Of course, students will probably realize that the second option – weighing twice as much – is pretty unlikely.)

Mathematically, this is a nice example of the commutative property: 2T = 2c × w × m = c × 2w × m = c × w × 2m. Since all the terms are being multiplied together, doubling one of them will cause the entire expression to double.

- *Which of these options – exercise harder, gain weight, or exercise longer – do you think is the easiest?*
- *Why does doubling one of the terms – c, w, or m – cause T to double?*

Deeper Understanding

- *What would have a bigger effect on the total number of calories LeBron burned: if he gained a pound, or if he played basketball for one more minute? (Each additional pound increases the number of calories burned by 0.063. On the other hand, every additional minute increases the number of calories burned by 15.75. If he played for more than 15.75/0.063 = 250 minutes, the extra pound would matter more.)*
- *What would happen if we could double all of the factors (work out twice as long, twice as hard, in a body that weighed twice as much)? (We would burn 8 times as many calories, since we'd be multiplying by 2^3.)*
- *Instead of doubling a single term, how else could we double the total number of calories burned? (Assuming weight is fixed, we could change both the calories per pound and the exercise duration. For instance, we could choose an exercise that burns four times as many calories, and do it for half as long.)*

3 An NBA game is 48 minutes long. If LeBron James ate a Big Mac Extra Value Meal (1360 calories) before a game, would he burn off all the calories by the end of the game? If not, how much longer would he have to play?

Calories burned in 1 minute: *15.75 cal/min × 1 min = 15.75 calories*
Calories burned in 12 minutes (1 quarter): *15.75 cal/min × 12 min = 189 calories*
Calories burned in 48 minutes: *15.75 cal/min × 48 min = 756 calories*

Even if he played an entire NBA game, LeBron James wouldn't burn off a Big Mac Extra Value Meal. To burn off 1360 calories, he's need to play for 1360 cal ÷ 15.75 cal/min = 86 minutes, or 38 minutes more. That's almost a whole other game!

Explanation & Guiding Questions

Some students may have a relatively easy time with this. For students who are struggling, consider helping them create a ratio table to show how the number of calories LeBron burns changes over time:

Minutes	1	2	3	4	...	12	...	48
Calories	15.75	31.5	47.25	63	...	189	...	756

From this, we see that LeBron burns 756 calories in a 48-minute game. However, there are 1360 calories in a Big Mac Extra Value Meal, and students may naturally wonder how long he'd have to exercise to burn them all off. Some may have a relatively easy time determining this by dividing 1360 calories ÷ 15.75 calories/minute, or

$$\frac{1360 \text{ calories}}{\frac{15.75 \text{ calories}}{1 \text{ minute}}} = \frac{1360 \text{ calories}}{1} \times \frac{1 \text{ minute}}{15.75 \text{ calories}} = 86.35 \text{ minutes.}$$

Meanwhile, struggling students can use their ratio tables. They already know that LeBron burns 756 calories in 48 minutes. At this rate, he'd burn 1512 calories in 96 minutes. Since he only needs to burn 1360 calories, though, students can subtract minutes: 1496.25 calories in 95 minutes, 1480.5 calories in 94 minutes, etc. They'll eventually find that 1360 calories "happens" between 87 minutes (1370.25 calories) and 86 minutes (1354.5 calories). Thus, LeBron would need to play for another 86 minutes – 48 minutes = 38 minutes.

- *If LeBron burns 15.75 calories in one minute, how many calories will he burn in two minutes? 12 minutes?*
- *How many calories will LeBron burn in 48 minutes?*
- *Will LeBron burn 1360 calories in 48 minutes?*

Deeper Understanding

- *An NBA game includes a 15-minute halftime. Should we include that? (No, since players are resting.)*
- *Will LeBron's teammates also burn 756 calories in a game? (Not necessarily. The number of calories they burn depends on how heavy they are, and how long they're on the court.)*
- *Is it possible that LeBron actually burns more than 15.75 calories each minute when he plays basketball? (Since an NBA game is more physical than a regular game, his unit rate may be higher than 0.063 cal/lb.)*

Act Two: Supersize?

4 Different types of exercise burn different numbers of calories. Choose one of the celebrities from before and three types of exercise. For each activity, how long would it take to burn off the McDonald's items below?

Answers will vary. Sample response:

Calories Burned in One Minute of Exercise

Sitting 0.009 cal/lb	Walking 0.019 cal/lb	Bowling 0.023 cal/lb	Biking, slow 0.029 cal/lb	Golf 0.033 cal/lb
Soft-Baseball 0.038 cal/lb	Weight Training 0.039 cal/lb	Biking, fast 0.045 cal/lb	Ice Skating 0.053 cal/lb	Tennis 0.061 cal/lb
Basketball 0.063 cal/lb	Jogging 0.063 cal/lb	Swimming 0.064 cal/lb	Soccer 0.076 cal/lb	Jump Rope 0.083 cal/lb

Selena Gomez 125 pounds	Big Mac 550 calories	Large Fries 500 calories	Large Coca-Cola 310 calories	Salad (no dressing) 20 calories
Sitting (1.125 cal/min)	489 minutes	444 minutes	276 minutes	18 minutes
Biking, fast (5.625 cal/min)	98 minutes	89 minutes	55 minutes	4 minutes
Jump Rope (10.375 cal/min)	53 minutes	48 minutes	30 minutes	2 minutes

Explanation & Guiding Questions

This question requires multiple steps. Fortunately, students have already seen them all.

1. Pick celebrity (e.g. Selena)	2. Pick exercise (e.g. sitting)	3. Calculate calories burned in one minute of exercise	4. Choose food (e.g. Big Mac), and calculate time to burn off
125 lb	0.009 cal/lb	125 lb × 0.009 cal/lb = 1.125 cal/min	550 cal ÷ 1.125 cal/min = 489 min

Once students have calculated the times needed to burn off the various menu items, they can discuss takeaways. For instance, the fewer calories a food has, the less time it takes to burn off; this was to be expected. But did students expect it to take 25 times as long to burn off fries than a salad? (Note: fries have 25 times as many calories as a salad. According to the table, though, they only take 444 min ÷ 18 min = 24.67 times as long to burn off. The difference is due to rounding.)

- *Which foods do you think will take the most time to burn off? The least time?*
- *How many times longer does it take to burn off fries than a salad?*

Deeper Understanding

- *Why do you think the body burns calories while sitting? (Heart rate, breathing, etc.)*
- *What celebrity + exercise combination would burn the most calories per minute? (LeBron + jump rope)*
- *Do you think people should be able to substitute a salad for French fries in an Extra Value Meal?*
- *If you wanted dressing with your salad, how many calories do you think that would add? (150!)*

5   In September 2012, McDonald's began posting calorie information in all of its restaurants in the United States. Listen to the NPR clip about this decision, and use it to answer the following.

a. Does publishing calories affect what people order? Why do you think this is?	b. What do you think would happen if McDonald's rewrote its menu in terms of *exercise*?
According to the researchers in the radio clip, publishing calorie information does not affect the foods people order. Maybe this is because people don't know what the calories really mean. A Big Mac may have 550 calories, but if a customer doesn't know how many calories he/she burns in a day, it won't mean much!	*Perhaps knowing how long it would take to burn off a Big Mac would convince people to order healthier (lower calorie) items. Then again, maybe not. Maybe people would just decide to eat fewer calories elsewhere – a lighter breakfast, perhaps – or maybe they're at McDonald's to satisfy a craving and don't care about calories...or exercise!*

Explanation & Guiding Questions

In the NPR clip, an NYU professor describes a surprising research finding: that posting calorie information has absolutely no effect on what foods people order. Why is this? According to the clip, one possibility is that people go to fast food restaurants to satisfy a craving. As explained by one McDonald's customer, "If I'm at McDonald's, I'm not worried about calories. If I want a salad, I don't go to McDonald's or any other fast food restaurant." Another possibility is that people don't know how to contextualize calories. 85% of Americans don't know how many calories they're supposed to eat in a day. In this case, a Big Mac's "550 calories" won't mean much.

But what if McDonald's rewrote its menu in terms of exercise? Instead of "550 calories," what if a Big Mac were advertised as requiring "98 minutes of biking fast?" Would this have an effect on what foods people order?

- *(Before listening to the clip) Do you think posting calories will have an effect on the foods people order?*
- *According to the clip, what are some reasons that posting calories might not affect people's food choices?*
- *When you go to a fast food restaurant, do you pay attention to how many calories the foods contain?*
- *Do you know how many calories you're supposed to eat in a day?*
- *Would rewriting nutritional information in terms of exercise have an effect on what you order?*

Deeper Understanding

- *Which McDonald's menu item do you think has the most calories? (Big Breakfast with Hotcakes = 1150 cal)*
- *Which menu item do you think has the fewest calories? (Water, Diet Coke, etc. = 0 calories)*
- *If McDonald's rewrote its menu in terms of exercise, would this be good for customers? (Answers may vary.)*
- *If McDonald's rewrote its menu in terms of exercise, would this be good for McDonald's? (It depends. McDonald's has a number of healthy options, e.g. oatmeal, salads, etc. If it makes more profit on these than it does, say, a Big Mac, then McDonald's might actually do better if people ordered healthier foods.)*