

REAL-WORLD TAKEAWAYS

- Physical forms of money cost money to make. Some coins cost more to produce than they're worth.
- Money does not have inherent value. Currency has value because people in society agree to give it value.
- The United States could follow other countries in abolishing the penny. This would have advantages and disadvantages.

MATHEMATICAL OBJECTIVES

- Add, subtract, and multiply positive and negative numbers to answer real-world questions
- Operate fluently with decimals in a real-world context

LESSON AT A GLANCE
90 MIN.

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LAUNCH		Watch a video about the history of money.	5 min.
PART ONE	1	Given information about how many pennies, nickels, dimes, and quarters the U.S. Mint produced in a year, determine which coin accounted for the most/least money in total.	15 min.
	2	Given the cost to produce each coin, calculate the “seigniorage” (the amount the government loses/gains) for each coin; debate which coin is the worst deal for the government.	20 min.
PART TWO	3	For a sampling of common grocery items, calculate how much a shopper paying in cash would spend if the government got rid of various coins (in which case prices would be rounded).	20 min.
	4	For the previous situations, calculate how much the shopper would lose/gain if the government got rid of the coins; debate how much of an impact this would have on people.	20 min.
	5	Discuss the pros and cons of getting rid of coins and imagine interesting uses for retired coins.	10 min.

- L Students watch a video about the origins of money. It describes how in early history humans relied on a barter system to exchange goods. While this allowed people to trade for items they wanted – for instance, if a farmer needed wood and a lumberjack needed eggs – it had a weakness; it had a hard time managing lots of people with different needs. (What if the farmer needed wood, the lumberjack needed apples, and the apple farmer needed eggs?)

To make trading easier, humans invented money: a “medium of exchange” that represents a certain amount of value and which we can use to buy items. Throughout human history, money has taken many forms, including shells, tobacco, coins, and paper currency.

DISCUSSIONS QUESTION

1. What was the barter system? Have you ever bartered for anything?
2. What are some of the downsides of the barter system?
3. What is “money,” and how does it correct for the weakness of the barter system?
4. Have humans always used coins and bills as money? What are some other objects that we’ve used?

KEY TAKEAWAYS

- Throughout human history, we’ve wanted to sell goods that we have and buy goods that we don’t.
- For a long time, we used a barter/trading system to do this. But the barter system is not well equipped to handle lots of people.
- To make exchanging items easier, humans created money.
- Money has taken lots of forms. In ancient times, shells were used as money. Eventually, money took the form of coins and bills. Today, we use digital forms of money. For the most part, the forms of money that we use don’t have value in and of themselves. Instead, money has value because we *agree* that it does.

1 The United States Mint is the government agency that produces physical money. Watch the video about how quarters are made. Then, the table below shows how many pennies, nickels, dimes, and quarters the Mint produced in 2023. Which coin accounted for the greatest amount of money in total?



	PENNY	NICKEL	DIME	QUARTER
VALUE	1¢	5¢	10¢	25¢
NO. PRODUCED	4,136,000,000	1,416,000,000	2,666,000,000	2,274,000,000

METHOD 1: CALCULATE VALUE IN CENTS	$1¢ \cdot 4,136,020,000$ $= 4,136,020,000¢$ #4 (least amount)	$5¢ \cdot 1,416,280,000$ $= 7,080,000,000¢$ #3	$10¢ \cdot 2,666,000,000$ $= 26,660,000,000¢$ #2	$25¢ \cdot 2,274,000,000$ $= 56,850,000,000¢$ #1 (greatest amount)
METHOD 2: CALCULATE VALUE IN DOLLARS	$\$0.01 \cdot 4,136,020,000$ $= \$41,360,200$ #4	$\$0.05 \cdot 1,416,280,000$ $= \$70,800,000$ #3	$\$0.10 \cdot 2,666,000,000$ $= \$266,600,000$ #2	$\$0.25 \cdot 2,274,000,000$ $= \$568,500,000$ #1
METHOD 3: REASON PROPORTIONALLY	<p><u>Penny vs. Nickel</u> Approx. 3x more pennies produced than nickels. But each nickel is worth 5x as much. $\text{Nickel Total} > \text{Penny Total}$</p> <p><u>Nickel vs. Dime</u> More dimes produced than nickels. And each dime is worth 2x as much. $\text{Dime Total} > \text{Nickel Total}$</p> <p><u>Dime vs. Quarter</u> Roughly same number of dimes and quarters produced. Each quarter is worth 2.5x as much. $\text{Quarter Total} > \text{Dime Total}$</p> <p><u>Penny vs. Dime</u> Roughly 2x as many pennies produced than dimes. But dimes are worth 10x as much. $\text{Dime Total} > \text{Penny Total}$</p> <p>$\text{Quarter Total} > \text{Dime Total} > \text{Nickel Total} > \text{Penny Total}$</p>			

2 After the Mint produces coins, it sells them to banks around the country for the amount that they’re worth (e.g. banks pay \$0.01 for a penny). If a coin is worth more than it costs to produce, the Mint earns money. If a coin is worth less, the Mint loses money. The term “seigniorage” refers to the difference between how much a coin is worth and how much it costs to produce.

The following table shows how much it cost the Mint to produce each type of coin in 2023. Calculate the seigniorage for each coin. Based on this, which coin would you say was the worst deal for the Mint and why?

	PENNY	NICKEL	DIME	QUARTER
COST TO PRODUCE	3.1¢	11.5¢	5.3¢	11.6¢
SEIGNIORAGE	$1¢ - 3.1¢ =$ <u>-2.1¢ per penny</u>	$5¢ - 11.5¢ =$ <u>-6.5¢ per nickel</u>	$10¢ - 5.3¢ =$ <u>+4.7¢ per dime</u>	$25¢ - 11.6¢ =$ <u>+13.4¢ per quarter</u>

Students’ responses will vary about which coin they interpret to be the “worst deal.” Approaches include:

METHOD 1:
CALCULATE LOSS
PER COIN

The government loses 2.1 cents on every penny.
The government loses 6.5 cents on every nickel.

The nickel is the worst deal.

METHOD 2:
CALCULATE LOSS PER
\$1 OF VALUE

There are 100 pennies in \$1. For every \$1 of value, the gov’t loses $100 \cdot 2.1¢ = 210¢ = \2.10 .
There are 20 nickels in \$1. For every \$1 of value, the gov’t loses $20 \cdot 6.5¢ = 130¢ = \$1.30$.

The penny is the worst deal.

METHOD 3:
CALCULATE TOTAL
SEIGNIORAGE

Total Seigniorage, Penny: $-2.1¢ \cdot 4,136,020,000 = -8,685,600,000¢ = -\$86,856,420$
Total Seigniorage, Nickel: $-6.5¢ \cdot 1,416,280,000 = -9,205,820,000¢ = -\$92,058,200$

The nickel is the worst deal.

- 3 Just because a country has a coin doesn't mean it needs to keep it forever. In 2013, Canada got rid of its penny. When a shopper bought something and paid in cash, the store would round the price up or down to the nearest \$0.05. Watch the video about this.

Then, imagine the U.S. got rid of the penny and rounded like Canada does. If a shopper bought each of the following items *separately* and paid in cash, how much would each item cost? What if the Mint stopped producing another coin, as well? (You can pick the coin.)



		BREAD	MILK	EGGS	COFFEE	BANANAS	DETERG.
CURRENT PRICE		\$2.50	\$4.03	\$3.07	\$1.89	\$0.63	\$14.21
CASH NEEDED		\$2.50	\$4.05	\$3.05	\$1.90	\$0.65	\$14.25
		\$2.50	\$4.00	\$3.10	\$1.90	\$0.60	\$14.20
		\$2.50	\$4.00	\$3.00	\$2.00	\$0.75	\$14.25
		\$3.00	\$4.00	\$3.00	\$2.00	\$1.00	\$14.00

TEACHING TIP

When Canada got rid of the penny, it didn't get rid of the *cent*. When a shopper buys a \$4.03 gallon of milk using a credit or debit card, they still pay the original \$4.03. The rounding only happens when someone is paying in cash. It may be helpful to clarify this for students. A cent is a unit of value. A penny is the *physical object* that represents a cent.

- 4 For each scenario above – no more penny, and no more coin-of-your-choosing – calculate how much the shopper would lose/save if they purchased all the items separately. If the country got rid of these coins, do you think it would have a big impact on people?



		BREAD	MILK	EGGS	COFFEE	BANANAS	DETERG.
ORIGINAL PRICE		\$2.50	\$4.03	\$3.07	\$1.89	\$0.63	\$14.41
CASH NEEDED		\$2.50 no diff.	\$4.05 -\$0.02	\$3.05 +\$0.02	\$1.90 -\$0.01	\$0.65 -\$0.02	\$14.40 +\$0.01
		\$2.50 no diff.	\$4.00 +\$0.03	\$3.10 -\$0.03	\$1.90 -\$0.01	\$0.60 +\$0.03	\$14.40 +\$0.01
		\$2.50 no diff.	\$4.00 +\$0.03	\$3.00 +\$0.07	\$2.00 -\$0.11	\$0.75 -\$0.12	\$14.50 -\$0.09
		\$3.00 -\$0.50	\$4.00 +\$0.03	\$3.00 +\$0.07	\$2.00 -\$0.11	\$1.00 -\$0.37	\$14.00 +\$0.41

shopper Loss/Savings	No Penny (round to nearest \$0.05)	$\$0.00 - \$0.02 + \$0.02 - \$0.01 - \$0.02 + \$0.01 = -\$0.02$
	No Nickel (round to nearest \$0.10)	$\$0.00 + \$0.03 - \$0.03 - \$0.01 + \$0.03 + \$0.01 = +\$0.03$
	No Dime (round to nearest \$0.25)	$\$0.00 + \$0.03 + \$0.07 - \$0.11 - \$0.12 - \$0.09 = -\$0.22$
	No Quarter (round to nearest \$1)	$-\$0.50 + \$0.03 + \$0.07 - \$0.11 - \$0.37 + \$0.41 = -\$0.47$

Answers will vary about whether getting rid of the coin(s) would have a big impact on people. Sample response:

If the government got rid of the penny, a shopper who bought each of the items separately and paid in cash would spend \$0.02 more than they would have otherwise; in other words, they'd lose 2 cents. On the other hand, if the government got rid of the nickel, the shopper would save \$0.03. Because these amounts are fairly small, I don't think most people would notice the difference. Even if the government got rid of higher-value coins like quarters – where the differences are greater – I still expect that over time the losses and savings would more or less cancel one another out (especially since people buy more than just the sample items above).

There's a second reason I think most people wouldn't notice it much if the government got rid of coins. In real life, shoppers don't buy all of their items separately; they buy them together. This would limit the effect of the rounding since it would happen less often.

- 5 Many people think the United States government should stop producing the penny (and maybe other coins, as well). If it did, what might be some consequences, both positive and negative? If the government does decide to stop producing certain coins, what do you think would be the best/most interesting uses for the coins that currently exist?

Responses will vary. Sample response:

If the U.S. government followed Canada's (and other countries') lead and abolished the penny, I don't think it would have much of an impact on people's lives. Years ago, people could buy things like candy and gum with pennies. Now, though, it's hard to think of anything that costs less than \$0.05...or really, that costs less than \$0.50. As a form of money, the penny is fairly worthless: literally, it doesn't have much *value*. Even for items that are relatively inexpensive, more and more people these days are paying for them with credit cards and apps like Venmo and Zelle. In fact, some stores no longer accept physical currency at all, including paper bills.

Instead of using pennies to buy things – which is what money was created for, after all – I expect that most people put whatever pennies they have in jars and forget about them. Some people might even throw their pennies away. The same might be true for nickels and maybe even dimes (but probably not quarters, as people can still use those for vending machines and parking meters).

In 2023, the U.S. Mint produced more than 4 million pennies and lost 2.1 cents on each. If the government got rid of the penny, it would save almost \$90 million each year. If the government got rid of the nickel, too, it would save another roughly \$90 million. Instead of spending \$180 million to produce those coins, the government could spend it on national parks or public education or lots of other things that would improve people's lives. I don't think people would notice it much if the government stopped producing pennies and nickels. But if the government used that money to improve highways or national parks, people would notice that a lot!

In terms of the coins that currently exist, there are lots of things that people could do with them. These include:

- Going to the bank and exchanging coins for cash
- Turning coins into art, e.g. using coins to create a mosaic on the wall or as tiles on the floor
- Donating coins to charity
- Making *lots* of wishes

TEACHING TIP

Students may ask what would happen to old coins if the government stopped producing new coins. In particular, they may wonder whether old coins would suddenly be useless. You can assure them that they would not; the coins would still have value, at least for a time.

There are lots of examples of countries deciding to no longer *produce* a certain denomination of currency, such as Canada and the penny. There are even examples of countries deciding to no longer *honor* certain denominations; in 2016, the Indian government announced that it would no longer accept 500 and 1,000 rupee notes due to concerns over corruption. (Higher-denomination bank notes are more efficient to store and transport than small- denomination ones, so they tend to be popular among criminals/organized crime.) In such cases, though, the government gives people a certain amount of time to exchange their old coins and bills for new currency. Because of this, you could argue that, if the U.S. government got rid of the penny, then people might actually end up using them more than they do now. If people knew that they needed to trade in their old pennies, they might have a reason to dig them out of their sofa cushions!