

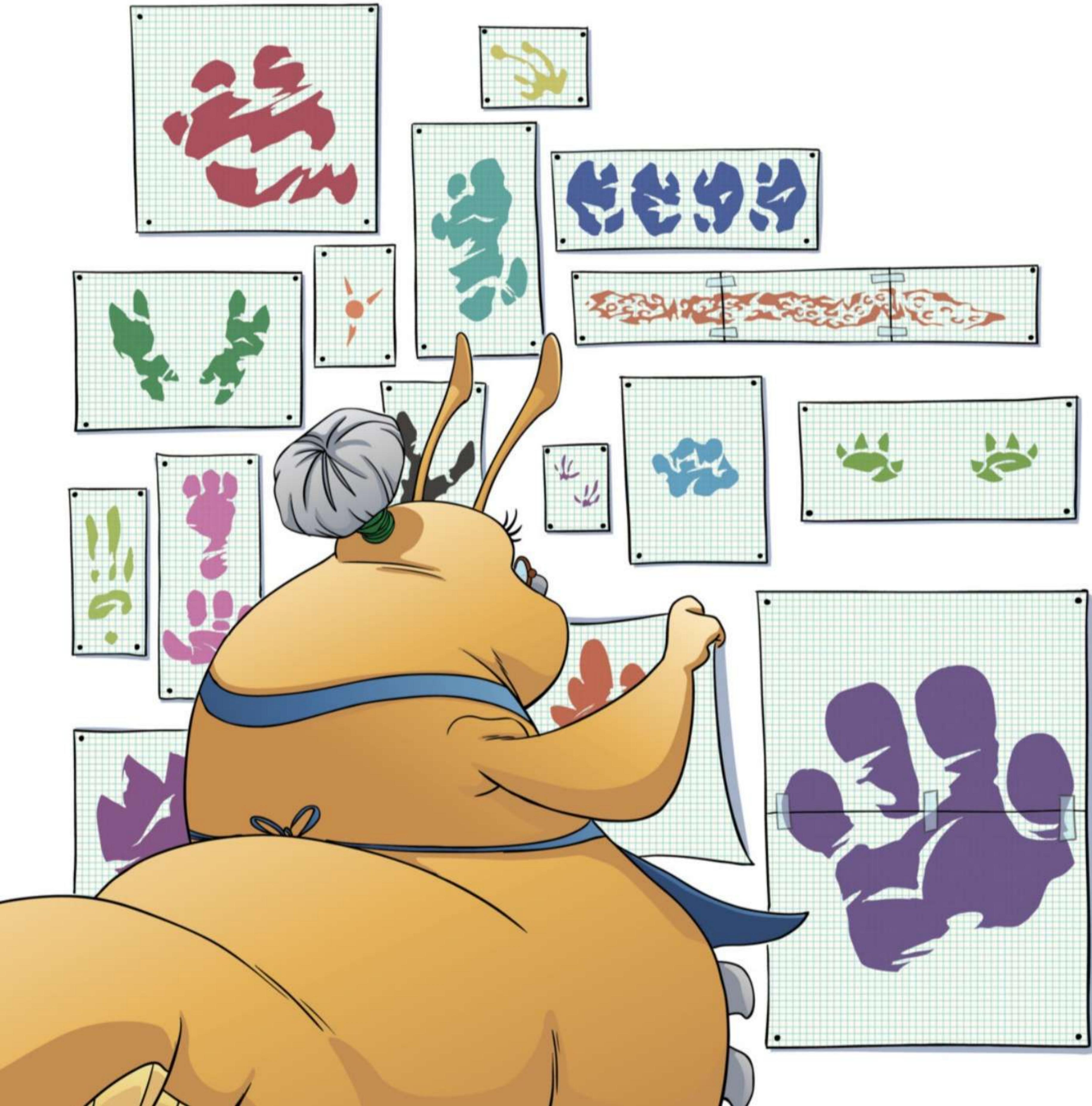
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Chapter 11:

Estimation





How many monsters are there on Beast Island?

Sure.

Right now?



Do we count as one monster or two?

Monsters come and go all the time. I don't think I could count them all.

You might not know the **exact** number, but you could **estimate**.

Huh?



Estimating means using what you know to make a good guess.

You want me to guess?

Right, but put some thought into it.



Okay, then, I figure there are about 503,702 beasts on the island.

How'd you come up with **that** number?



TO ESTIMATE MEANS TO FIND A NUMBER THAT IS CLOSE TO EXACT. AN ESTIMATE IS A NUMBER THAT IS CLOSE TO AN EXACT AMOUNT.

I added!
There are
about 140,000
reptosaurs...

...130,000
terraquatics...

...maybe
120,000
woolies...

...around
70,000
mythicas...

...and
40,000
pods.



That's 500,000.
What about the
other 3,702?

$$\begin{array}{r} 140,000 \\ 130,000 \\ 120,000 \\ 70,000 \\ + \quad 40,000 \\ \hline 500,000 \end{array}$$

There are
about 3,000
avians...

...700
cybots...

...and
us!

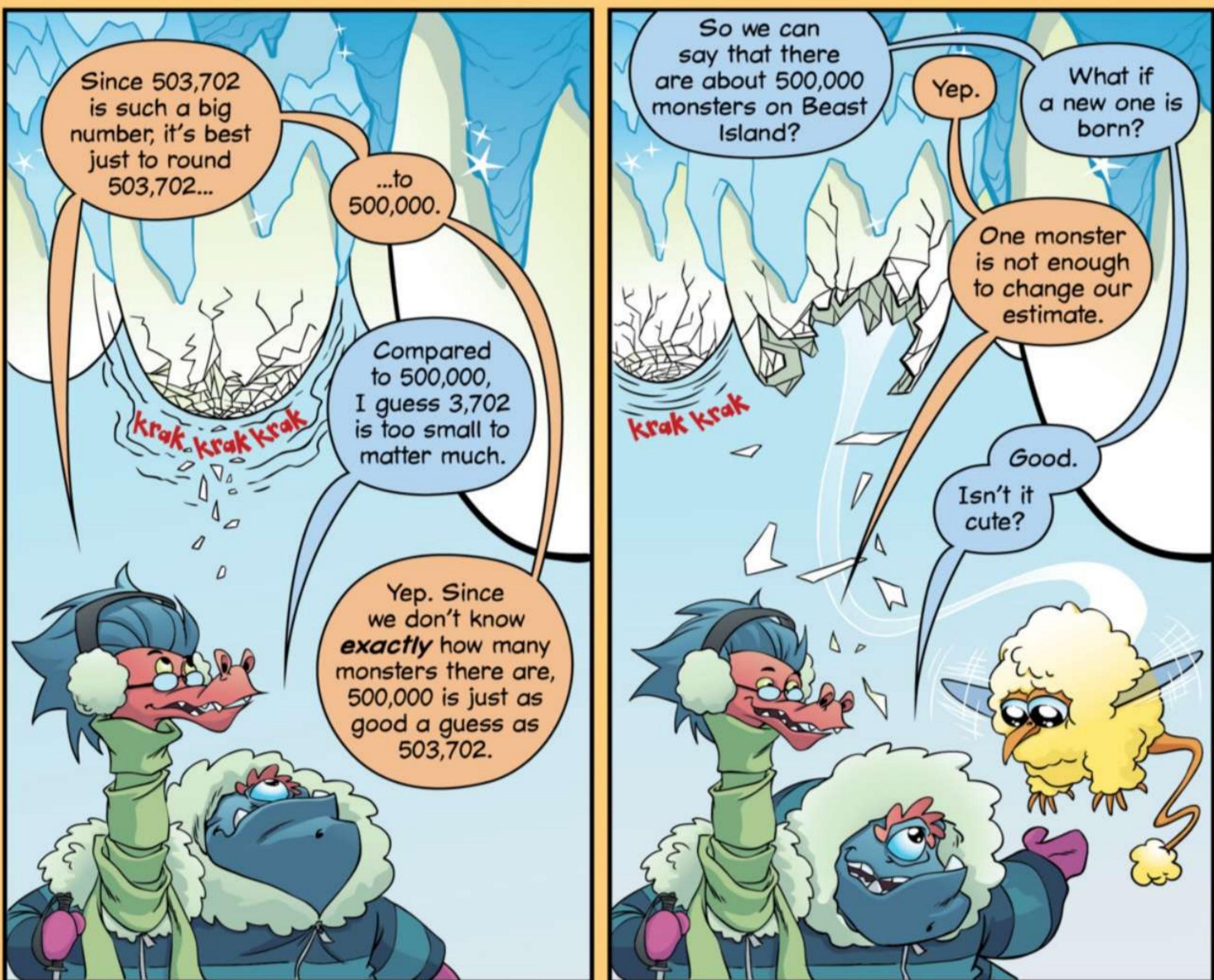
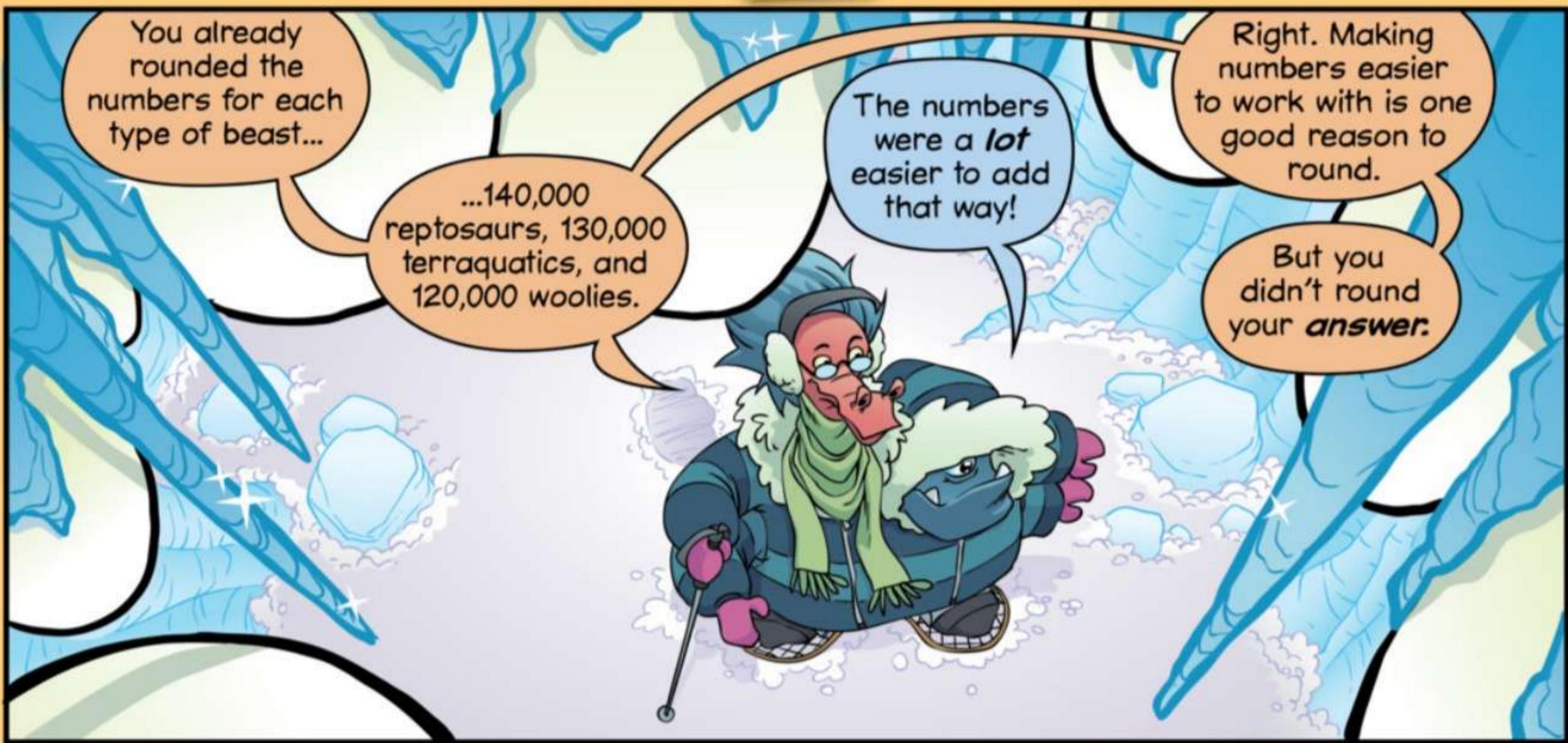
That
makes
503,702
beasts.

That's pretty
good, but when
you **estimate**,
you usually
round your
answer.

???
A rounded
answer usually
ends in one or
more zeroes.

That makes
sense. Zero **is**
the roundest
number.

WE'LL EXPLAIN HOW TO ROUND IN THE NEXT SECTION.



Ms. Q.

Rounding

When do we estimate?

When we don't need an exact answer.

Or to make a prediction.

Or, when an exact answer is impossible to find.

Like the number of planets in the universe.

Or how many licks it takes to get to the center of a Tootsie Pop.

The world may never know.



POPCORN

Sometimes we estimate by rounding.

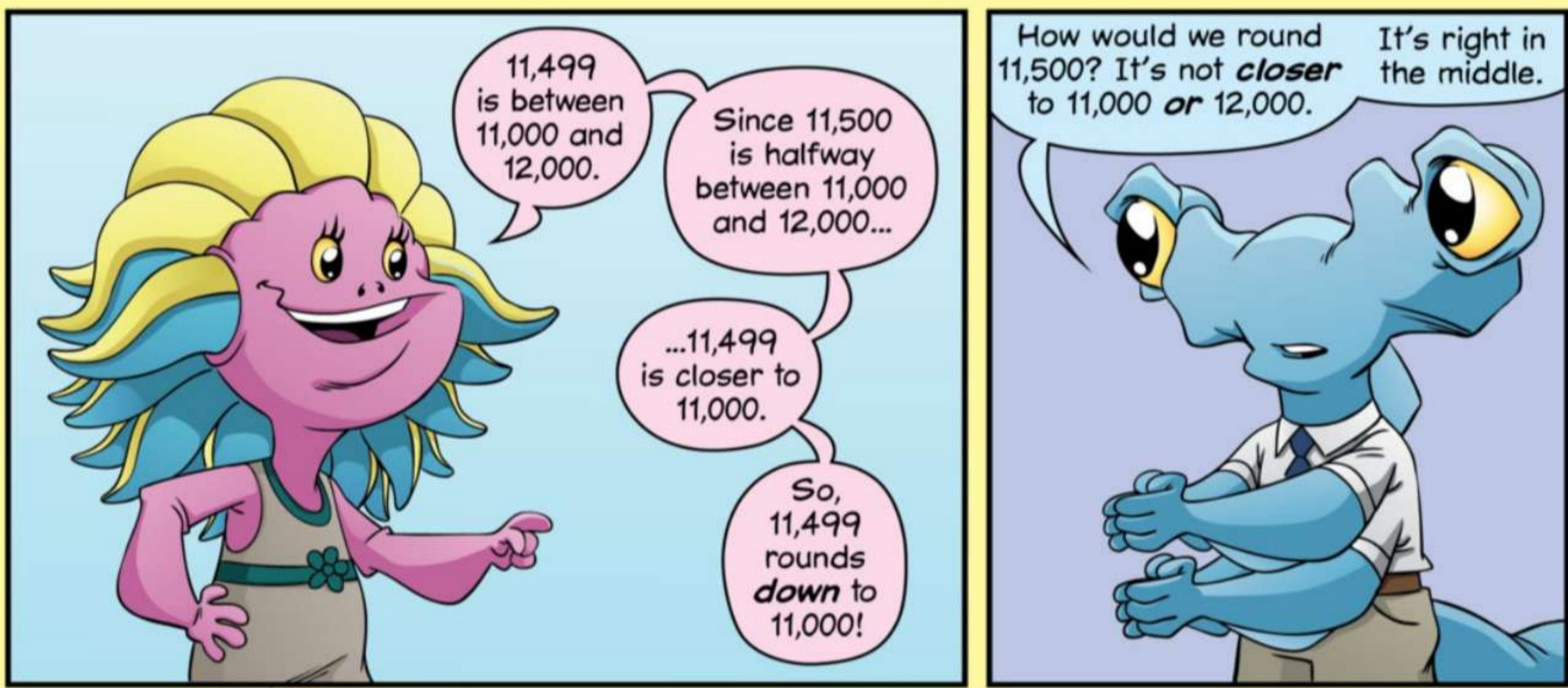
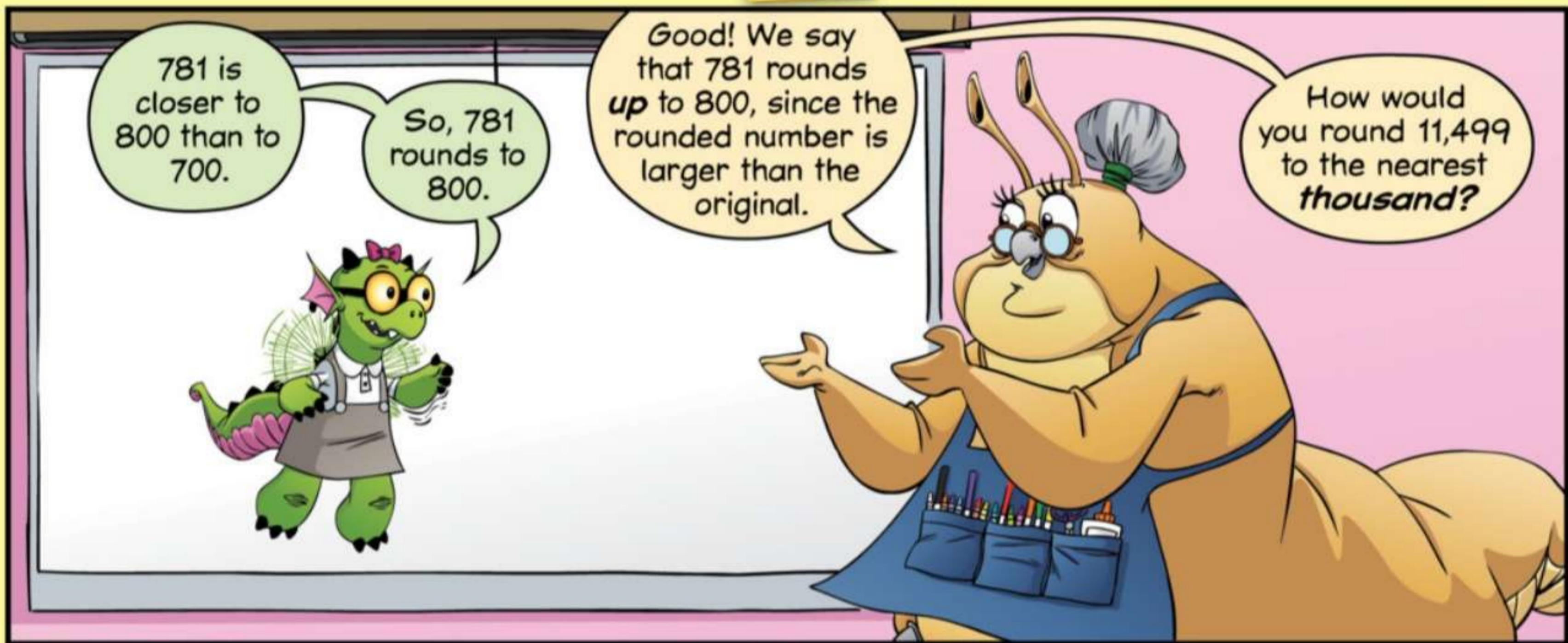
We can round to the nearest ten, hundred, thousand, million...

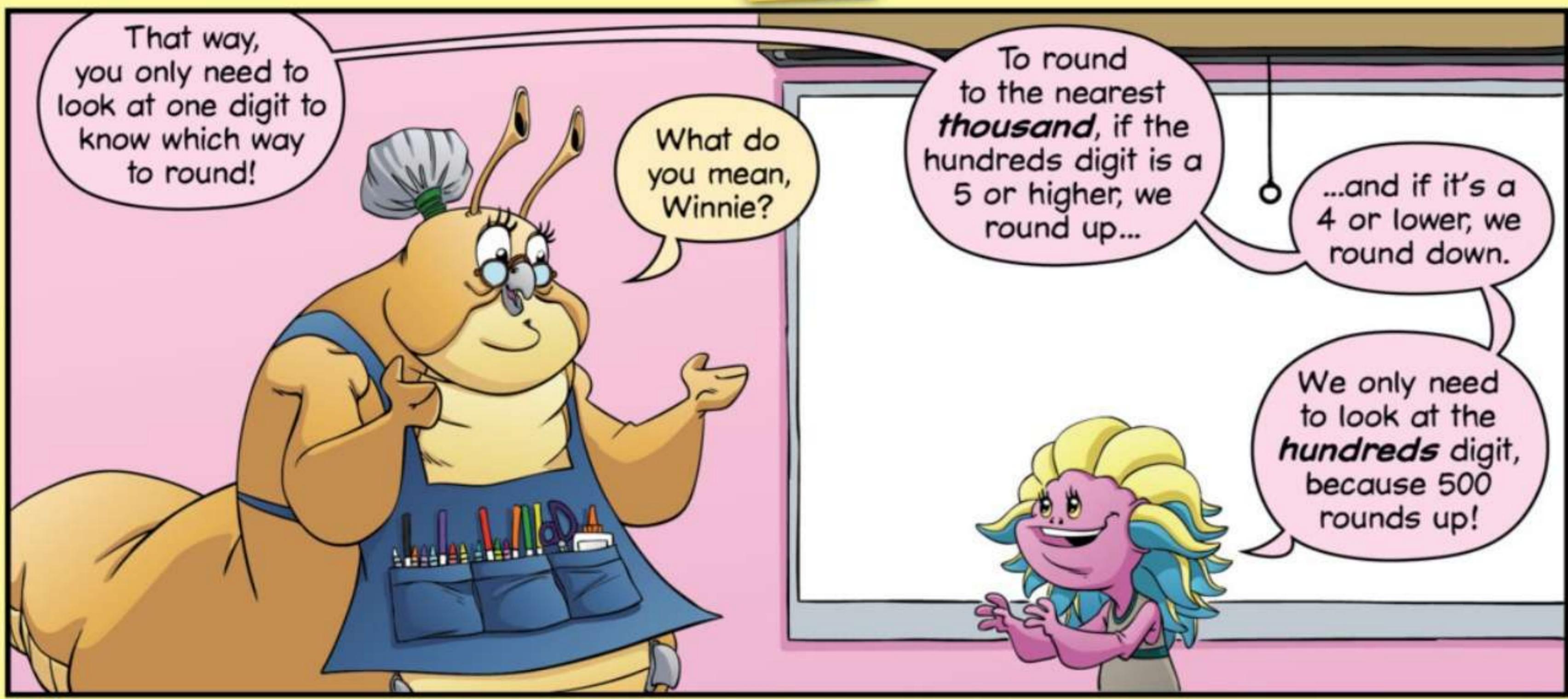
...or any other place value.

That's right. How would you round 781 to the nearest hundred?

How do we estimate?

Try it.





To round to the nearest **hundred**, we only need to look at the **tens** digit.

If the tens digit is a 5 or higher, we round up to the next hundred.

But if the tens digit is a 4 or lower, we round down.

| | rounds to |
|-----|-----------|
| 693 | 700 |
| 267 | 300 |
| 950 | 1000 |

| | rounds to |
|-----|-----------|
| 607 | 600 |
| 221 | 200 |
| 949 | 900 |

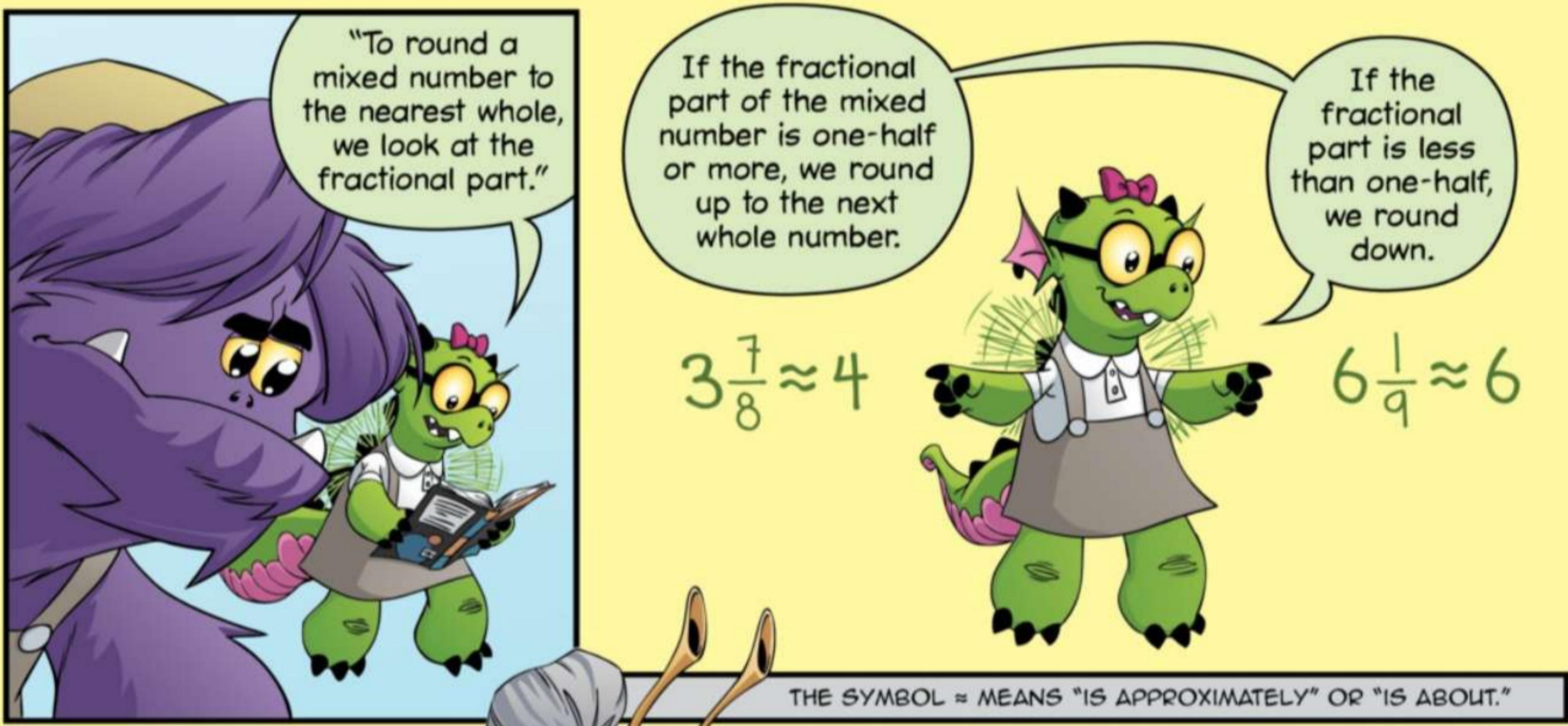
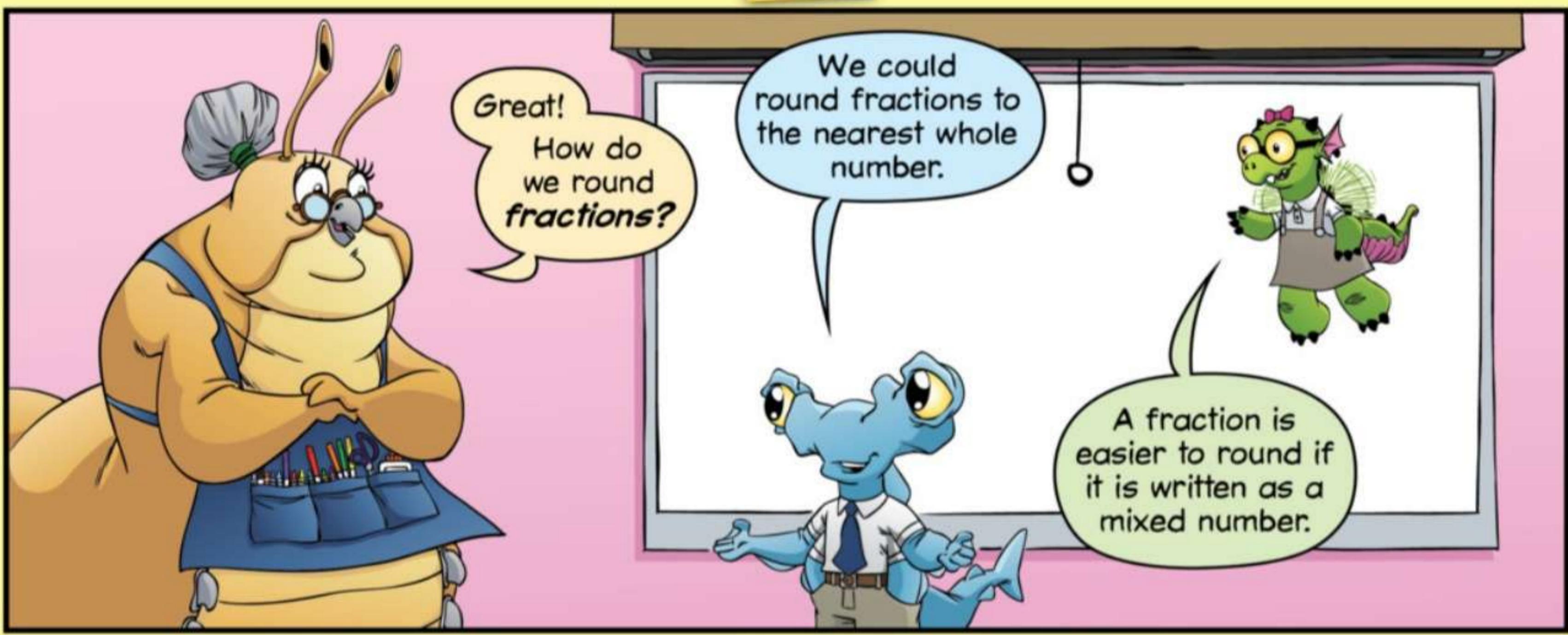
To round to the nearest **ten**, we look at the **ones** digit.

To round to the nearest **hundred**, we look at the **tens** digit.

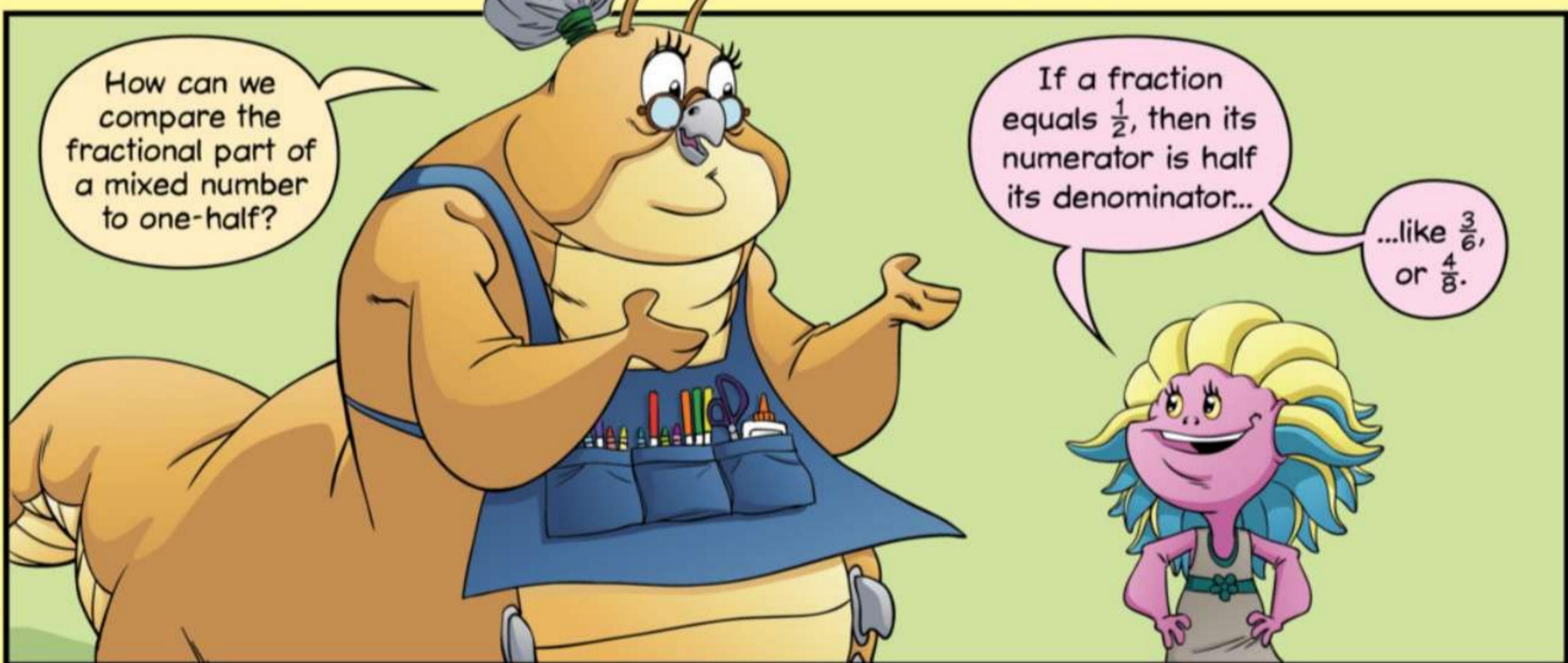
And to round to the nearest **thousand**, we look at the **hundreds** digit.

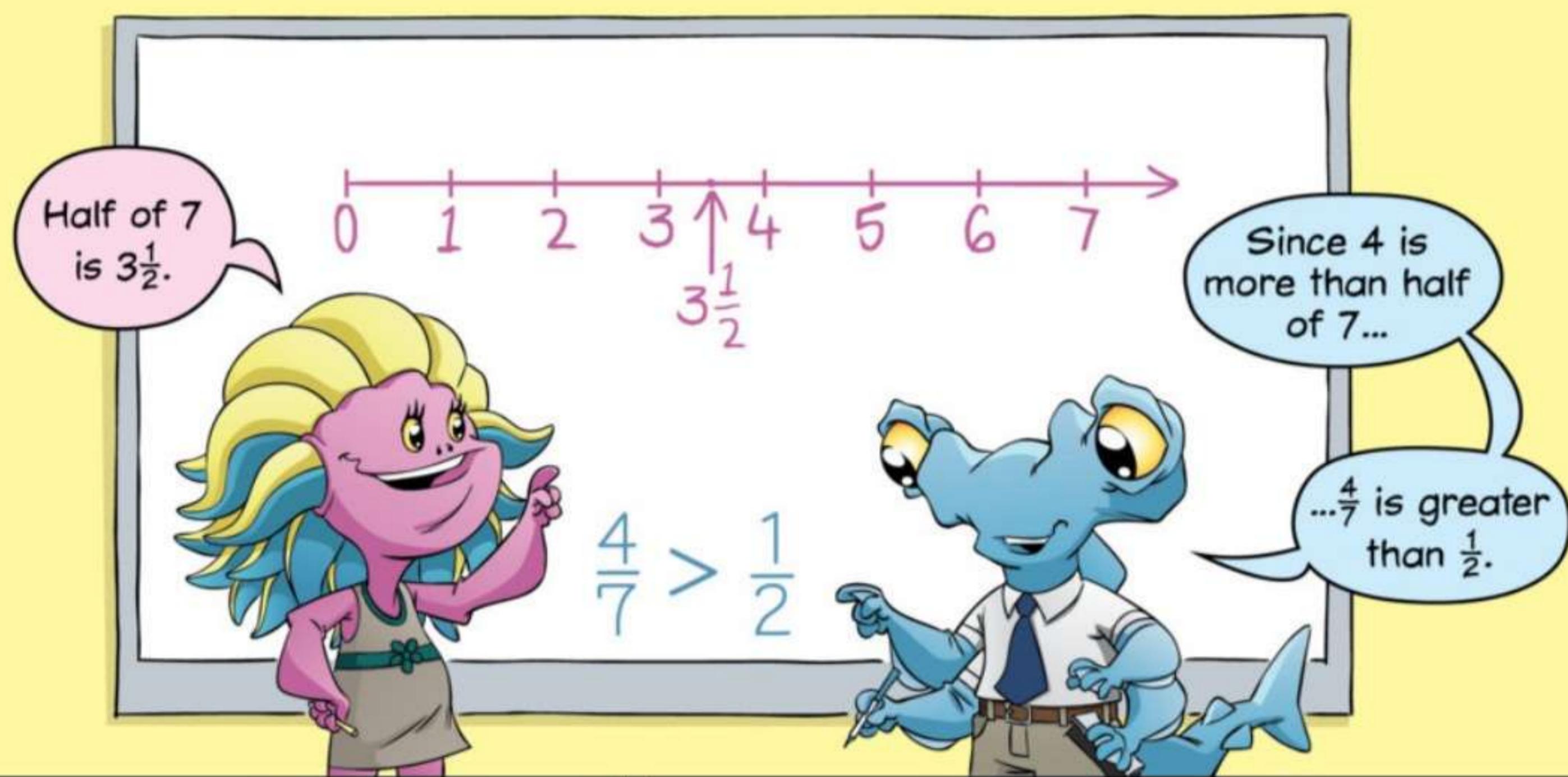
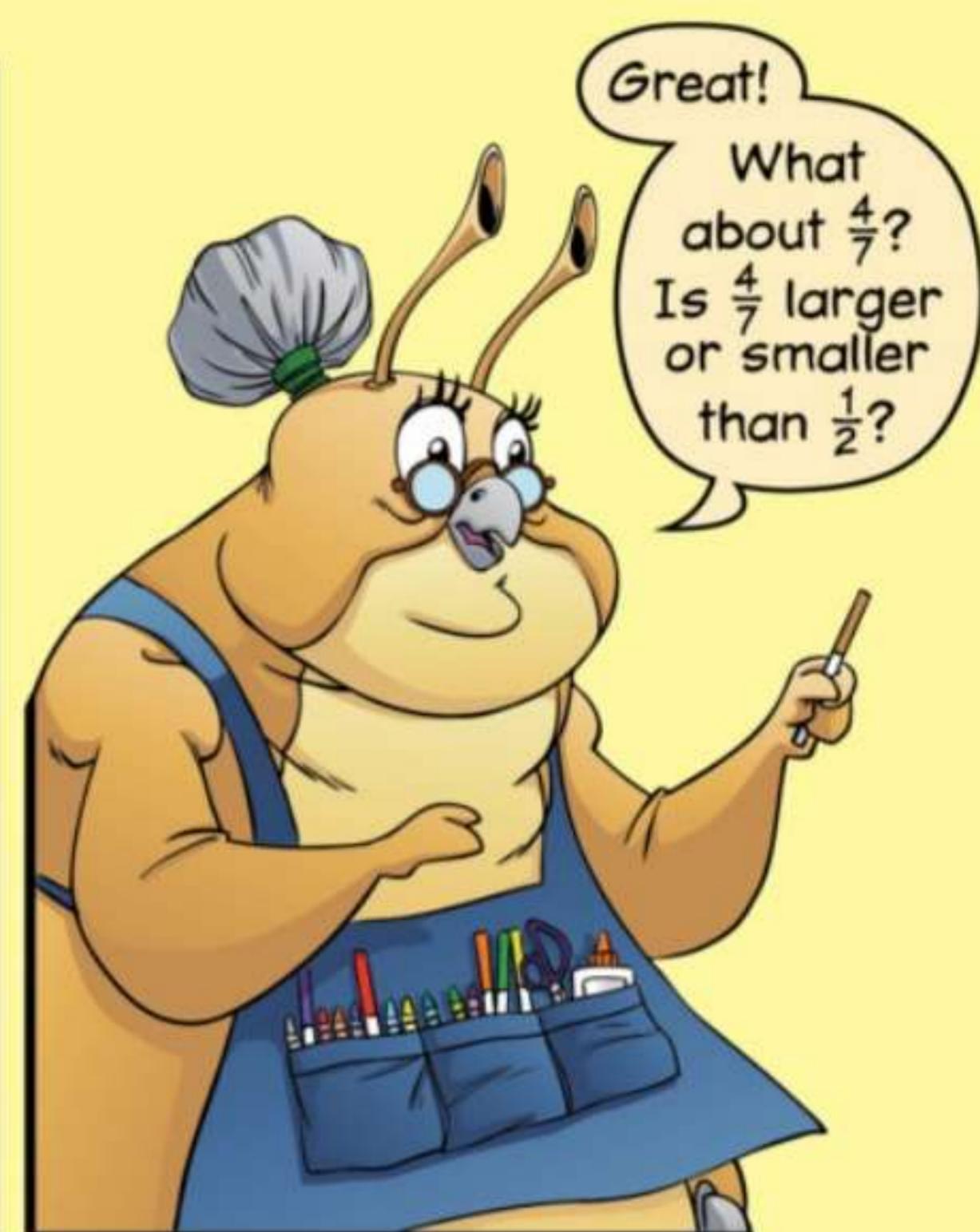
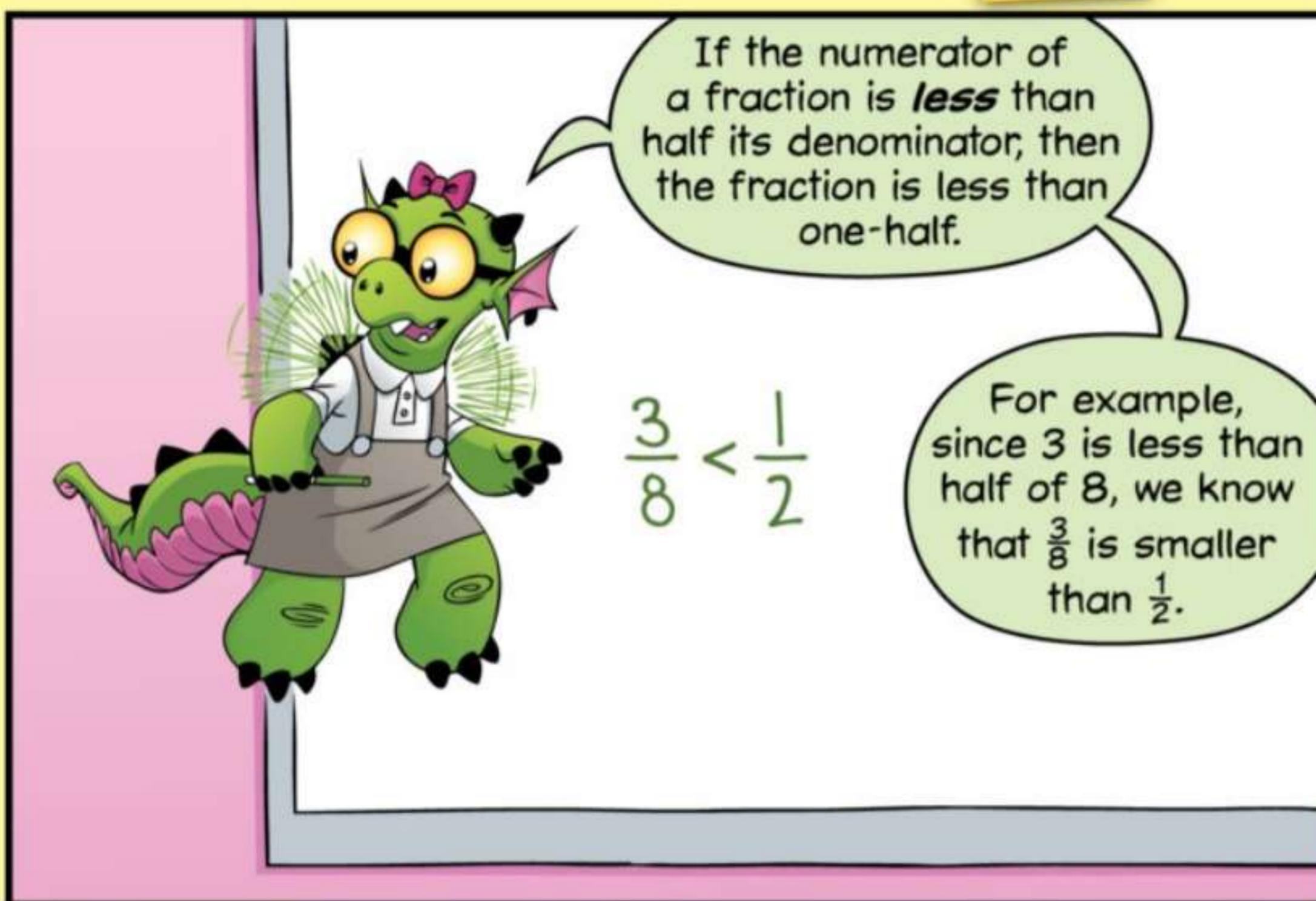
Whatever place value we are rounding to...
...the digit to the right tells us whether to round up or down.

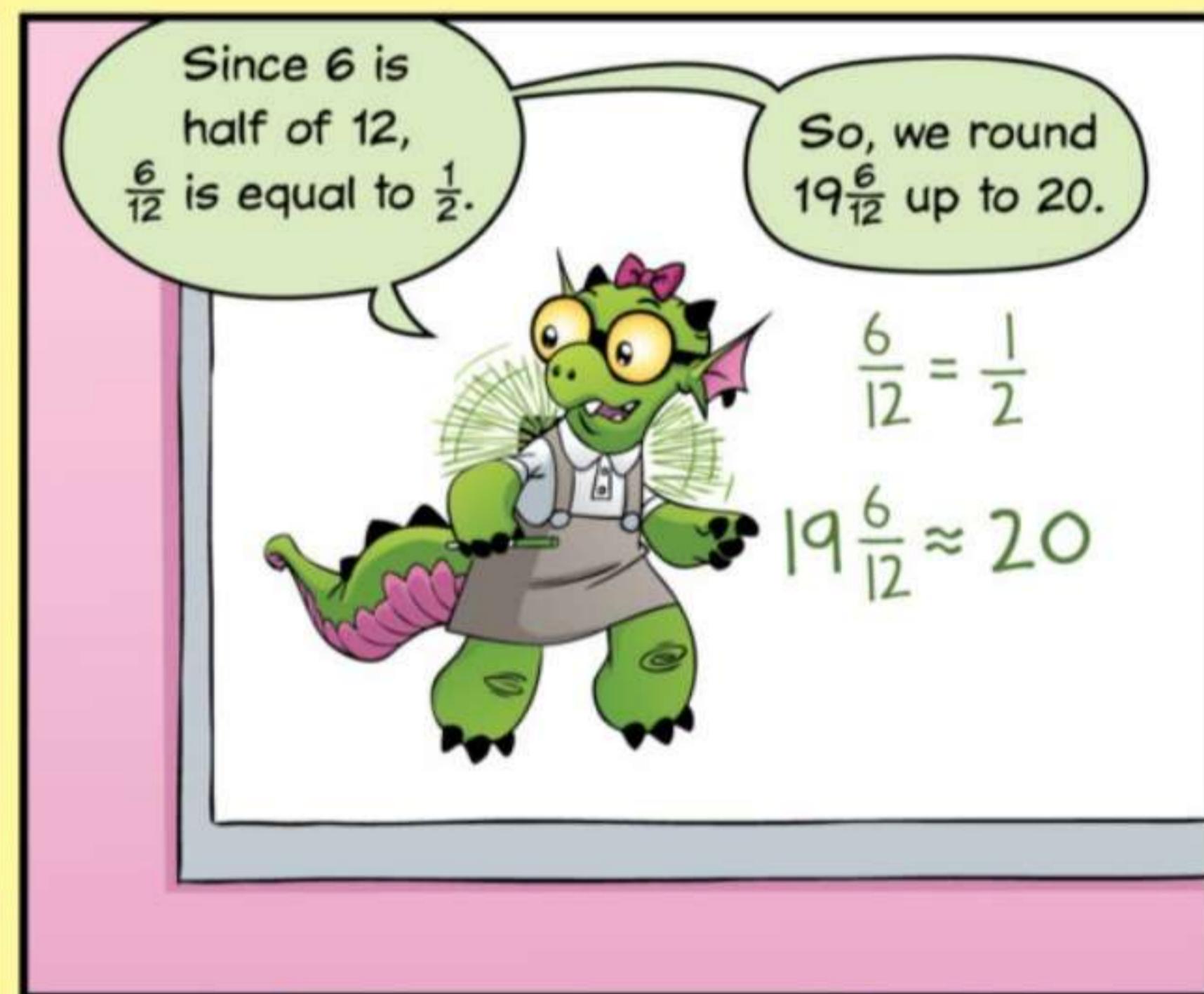
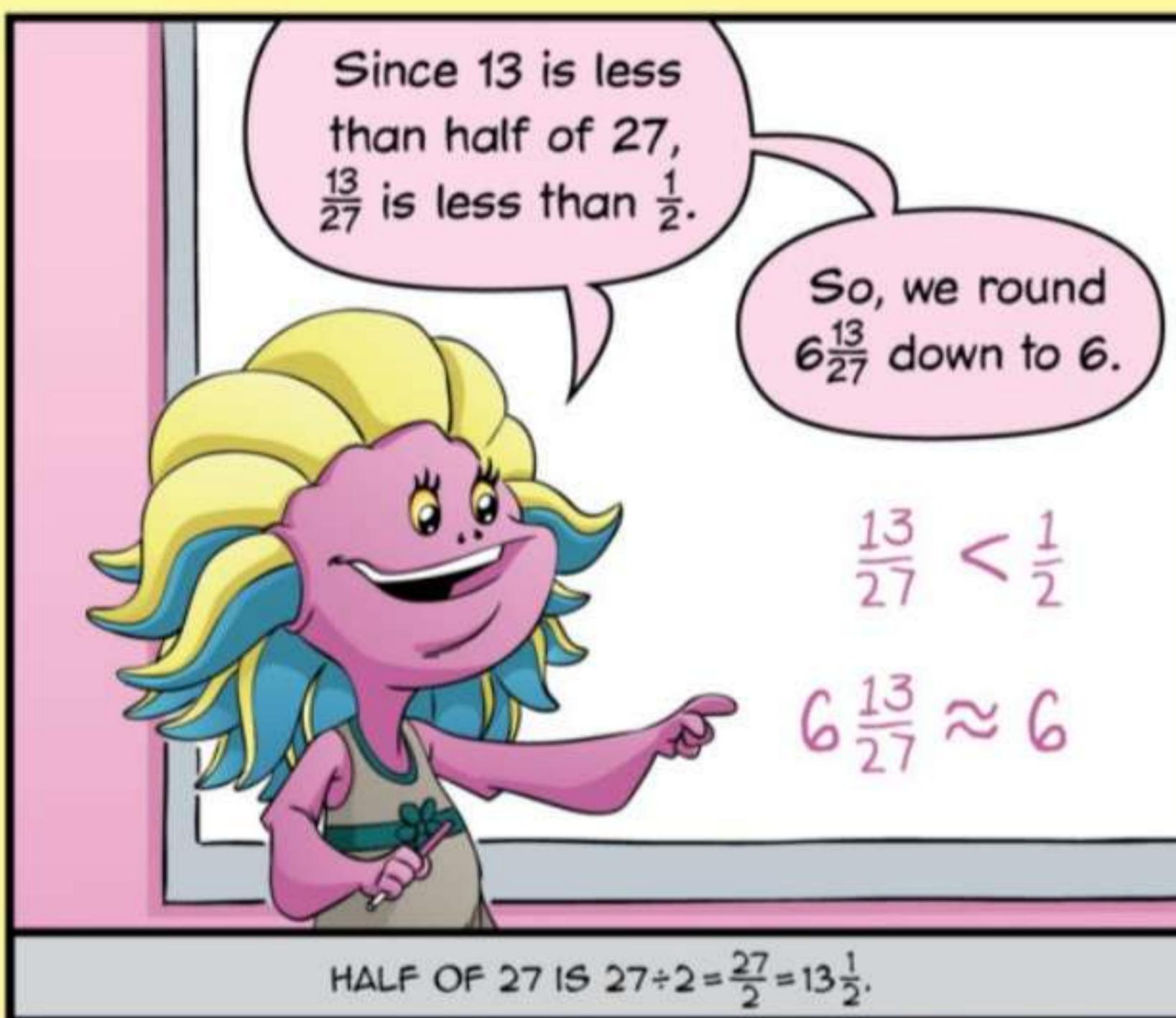
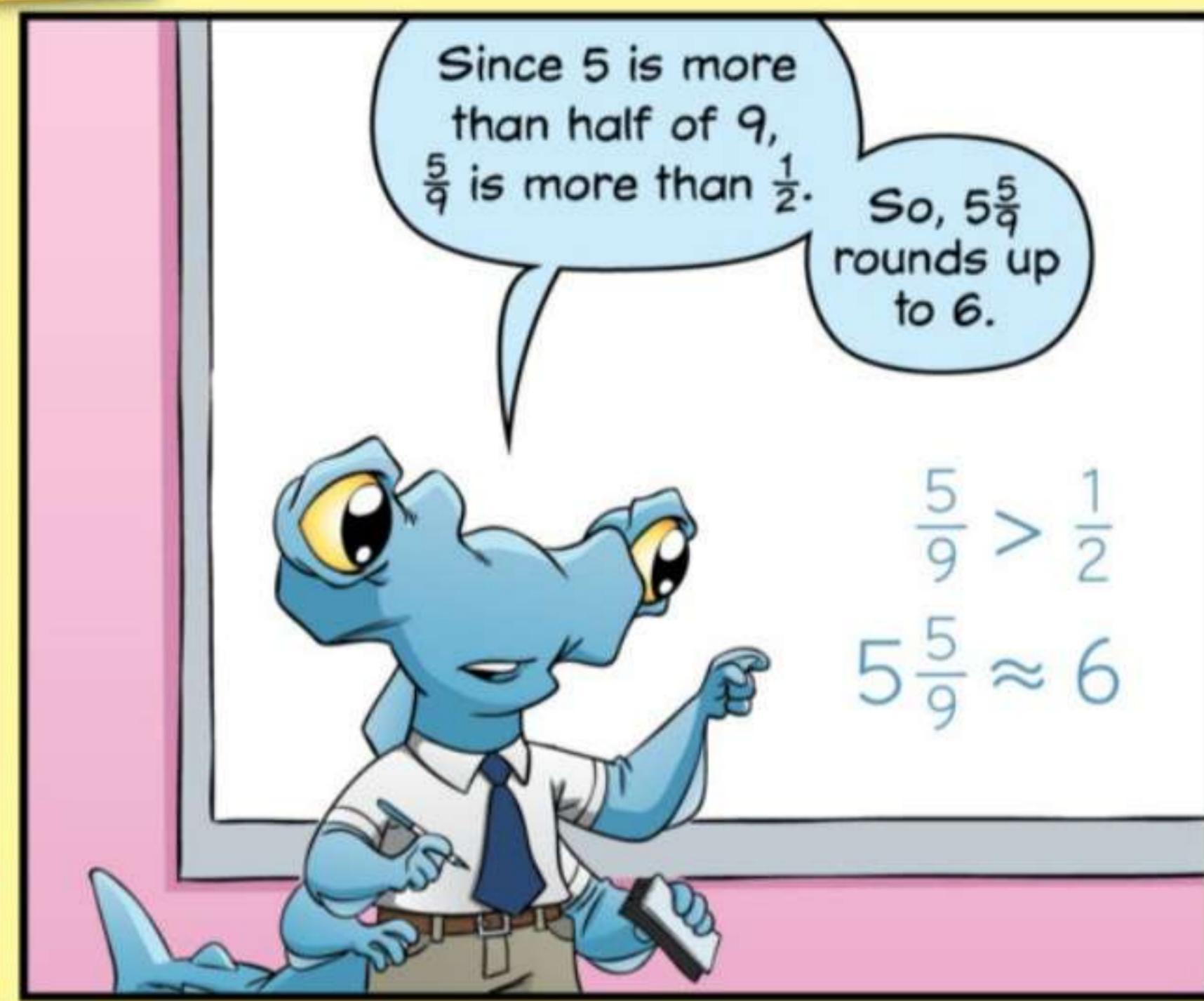
| | | |
|-----------------------|-------------------------|---------------------------|
| 92 rounds to 90 | 437 rounds to 400 | 5782 rounds to 6000 |
|-----------------------|-------------------------|---------------------------|



THE SYMBOL \approx MEANS "IS APPROXIMATELY" OR "IS ABOUT."







HALF OF 27 IS $27 \div 2 = \frac{27}{2} = 13\frac{1}{2}$.



I was thinking that
maybe you could round
all of my scores to the
nearest 100.



MATH TEAM

Over and Underestimating

It is often useful to know whether an estimate is bigger or smaller than the actual value.

Let's begin by estimating this sum and this product.

$$4\frac{7}{9} + 1\frac{5}{6}$$

$$613 \times 41$$

$4\frac{7}{9}$ is about 5...

...and $1\frac{5}{6}$ is about 2...

613 is a little more than 600...

...and 41 is just over 40...

$$4\frac{7}{9} + 1\frac{5}{6} \approx 5+2$$

$$5+2 = 7$$

...so $4\frac{7}{9} + 1\frac{5}{6}$ is about $5+2=7$.

$$613 \times 41 \approx 600 \times 40$$

$$600 \times 40 = 24,000$$

...so
613×41 is about $600 \times 40 = 24,000$.

Good work.
Are these estimates larger or smaller than the actual answers?

$$4\frac{7}{9} + 1\frac{5}{6} \approx 5+2$$

$$5+2 = 7$$

$$613 \times 41 \approx 600 \times 40$$

$$600 \times 40 = 24,000$$

Which estimate is larger than the actual value?
Which is smaller?

Grogg rounded both numbers he was adding **up**.

This made his estimate larger than the real answer.



$$4\frac{7}{9} + 1\frac{5}{6} \approx 5+2$$
$$5+2 = 7$$



Right!

When an estimate is larger than the actual value, it is called an **overestimate**.

But Alex rounded both numbers **down**.

So his estimate was smaller than the real answer.



$$613 \times 41 \approx 600 \times 40$$
$$600 \times 40 = 24,000$$



Perfect!

When an estimate is smaller than the actual value, it is called an **underestimate**.

When you add or multiply two numbers, rounding them up makes the estimate larger than the real answer.



And rounding them both down makes the estimate smaller than the real answer.

Real Answer
Over-estimate

$$4\frac{7}{9} + 1\frac{5}{6} = 6\frac{11}{18}$$
$$5+2=7$$

Real Answer
Under-estimate

$$613 \times 41 = 25,133$$
$$600 \times 40 = 24,000$$

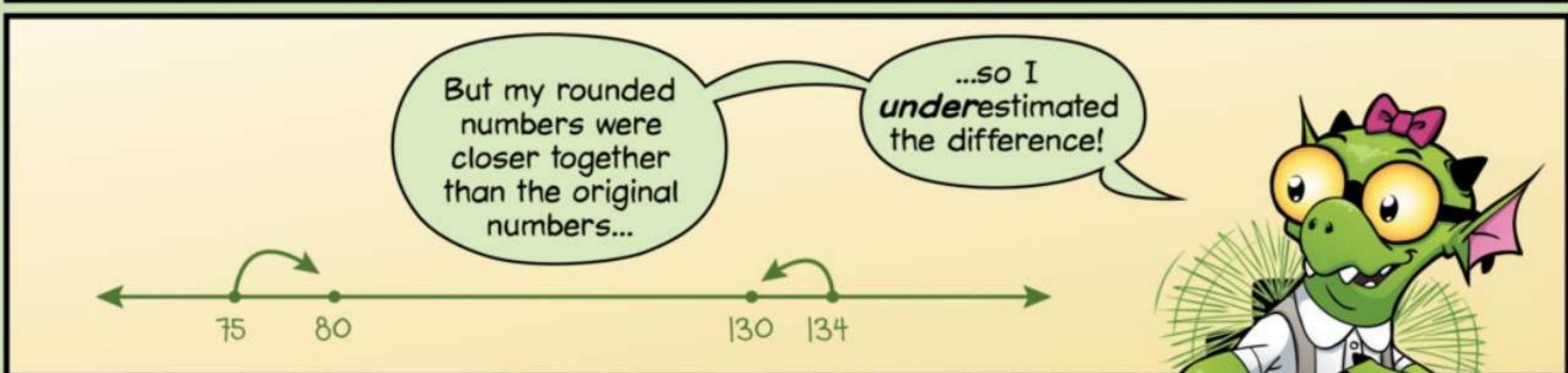
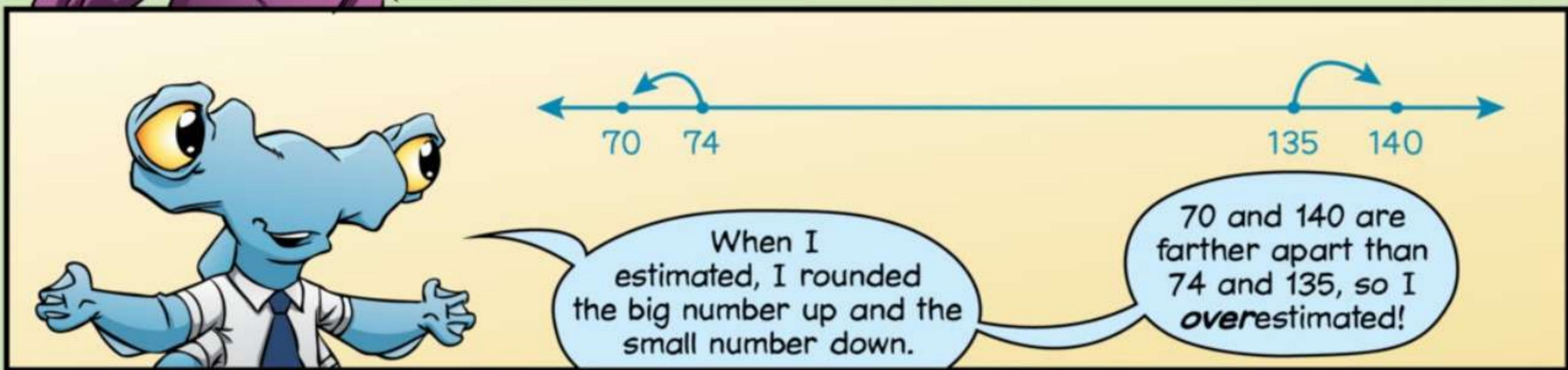
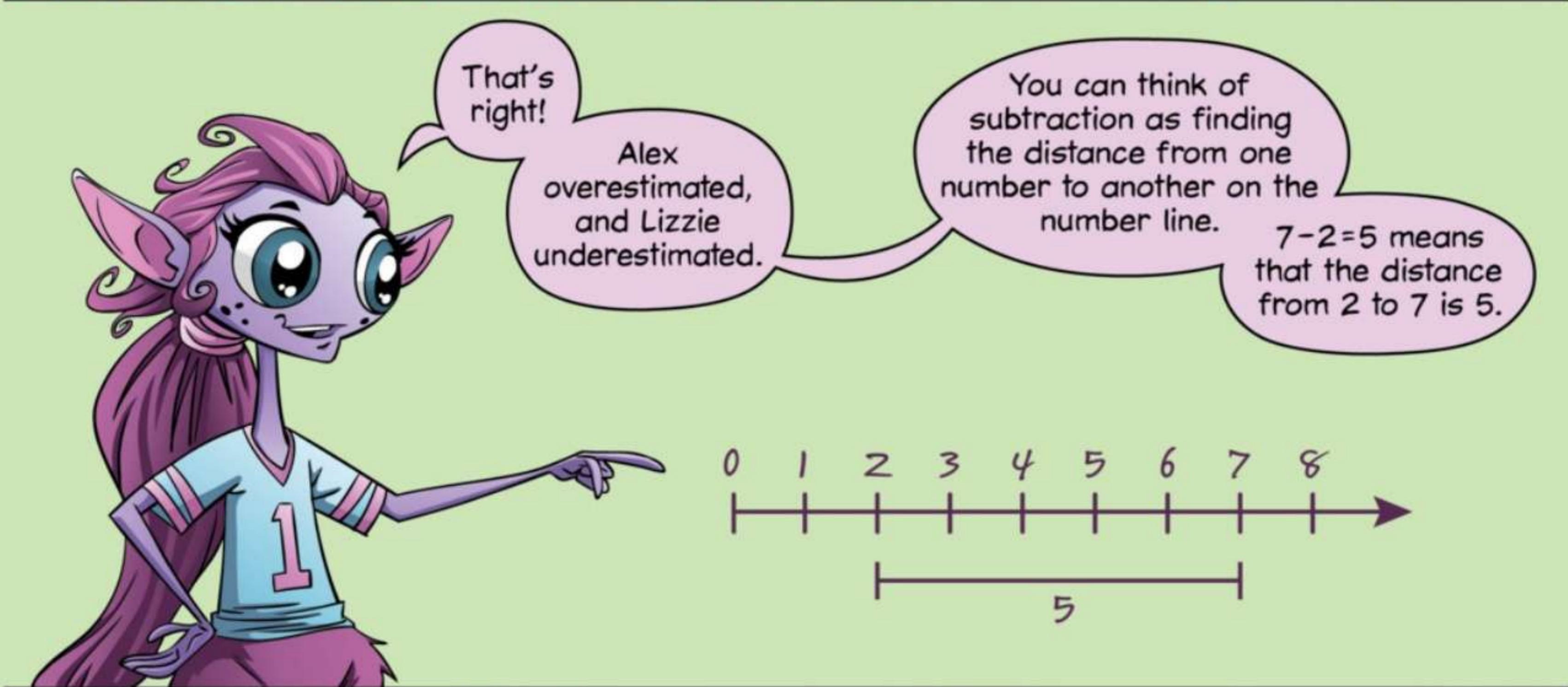
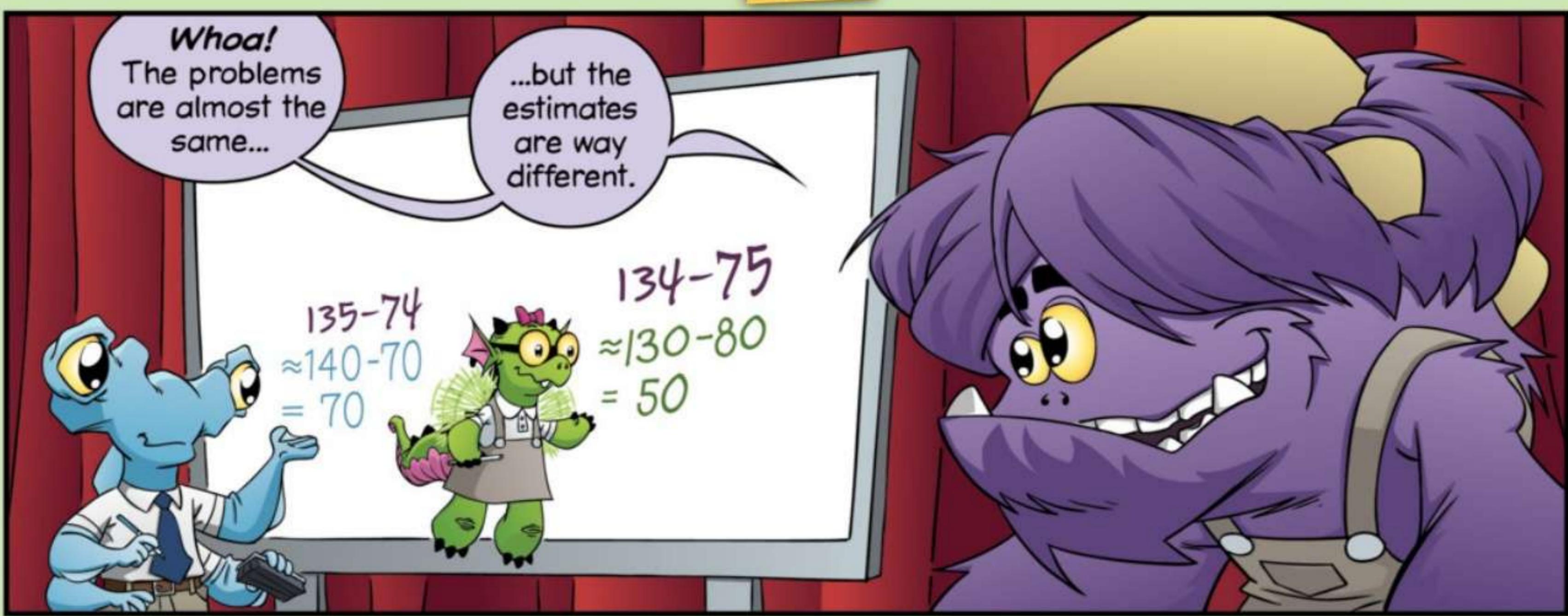


Next, try estimating these differences:

$$135 - 74$$

$$134 - 75$$

REMEMBER: WHEN YOU SUBTRACT TWO NUMBERS, THE RESULT IS CALLED A DIFFERENCE.



When you subtract...

...if you round the numbers towards each other, you get an underestimate.

$$\begin{aligned}1,937 - 465 \\ \approx 1,900 - 500 \\ = 1,400\end{aligned}$$

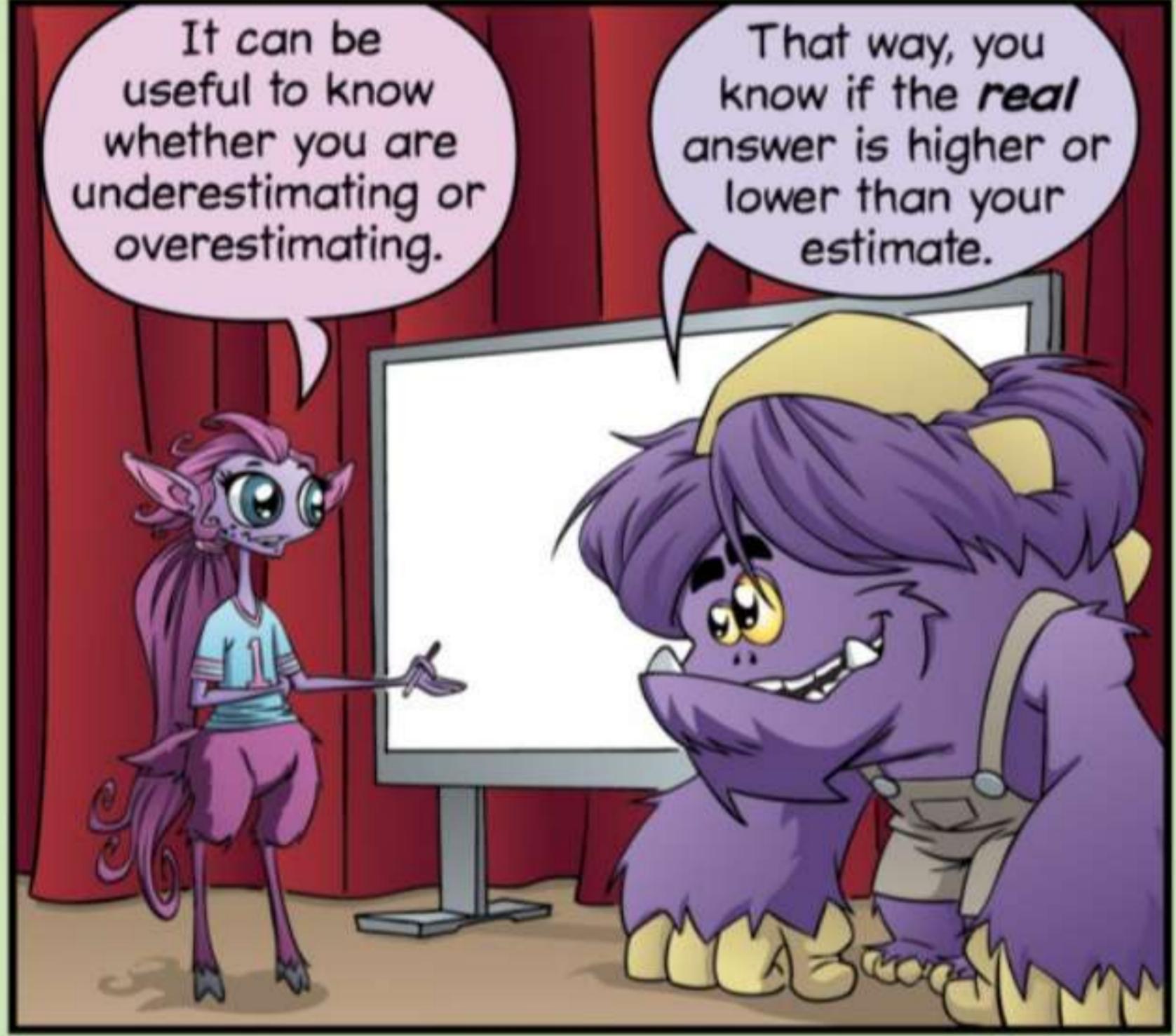
And if you round them away from each other, you get an overestimate.

$$\begin{aligned}1,967 - 435 \\ \approx 2,000 - 400 \\ = 1,600\end{aligned}$$



It can be useful to know whether you are underestimating or overestimating.

That way, you know if the **real** answer is higher or lower than your estimate.



That's right!

Since $20 \times 40 = 800$ is an underestimate...

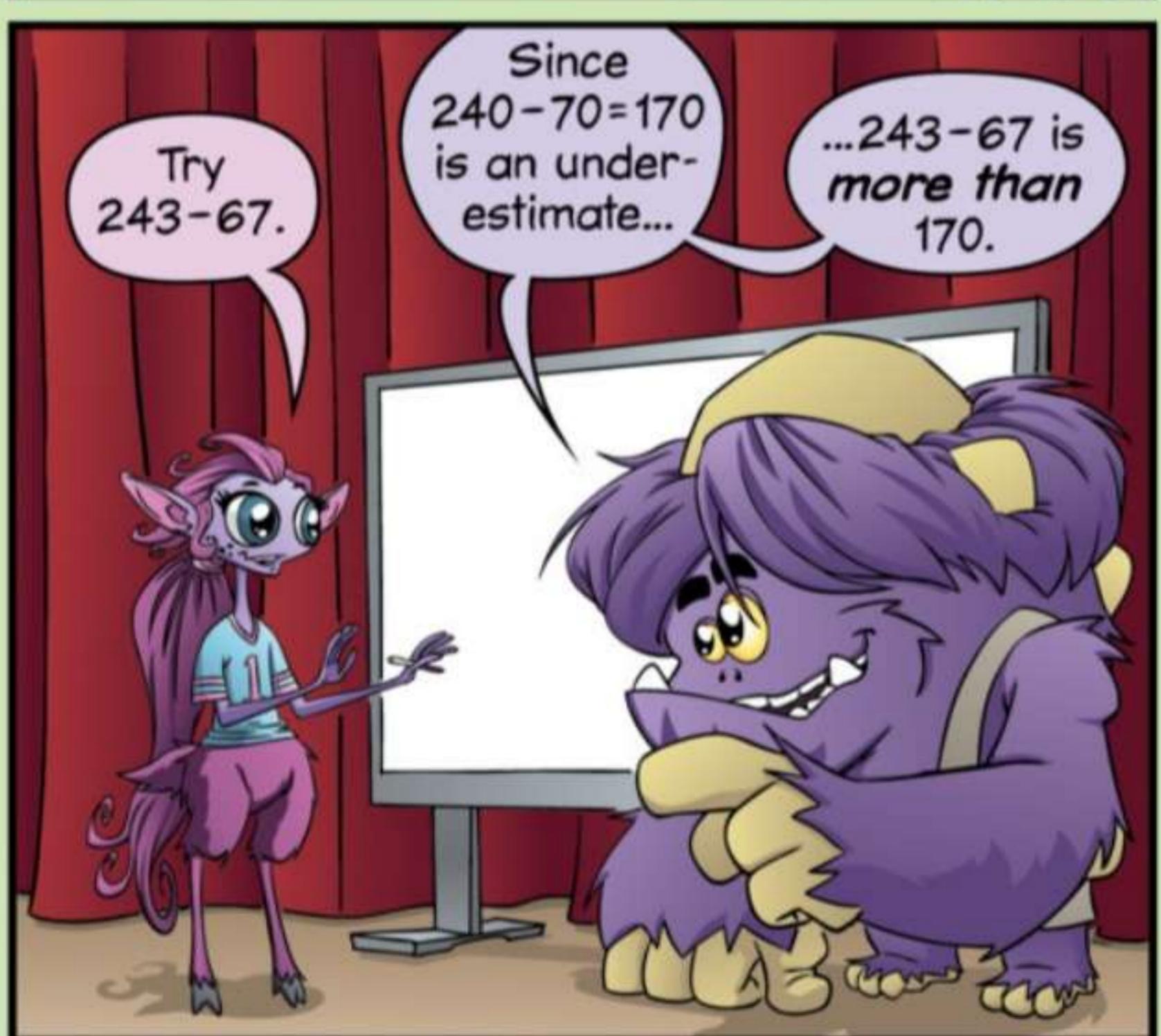
... 23×44 is more than 800.



Try 243-67.

Since $240 - 70 = 170$ is an underestimate...

... $243 - 67$ is more than 170.



I didn't know you had it in you, Grogg.

Never underestimate the mind of a great big purple furball.



Woochiee QUOTIENTS

Once in a blue moon, fortune be smilin' upon me.

Years ago, we discovered a booty so bountiful,

so massive,

so enormous,

so behemoth,

so immense,

so gigantic...

...so gargantuan, so colossal, so titanic, so Brobdingnagian, so...

Big?

Aye, 'twas big.

Too many coins to count.

If you couldn't count the coins, how could you split them into equal shares?

By estimatin'!

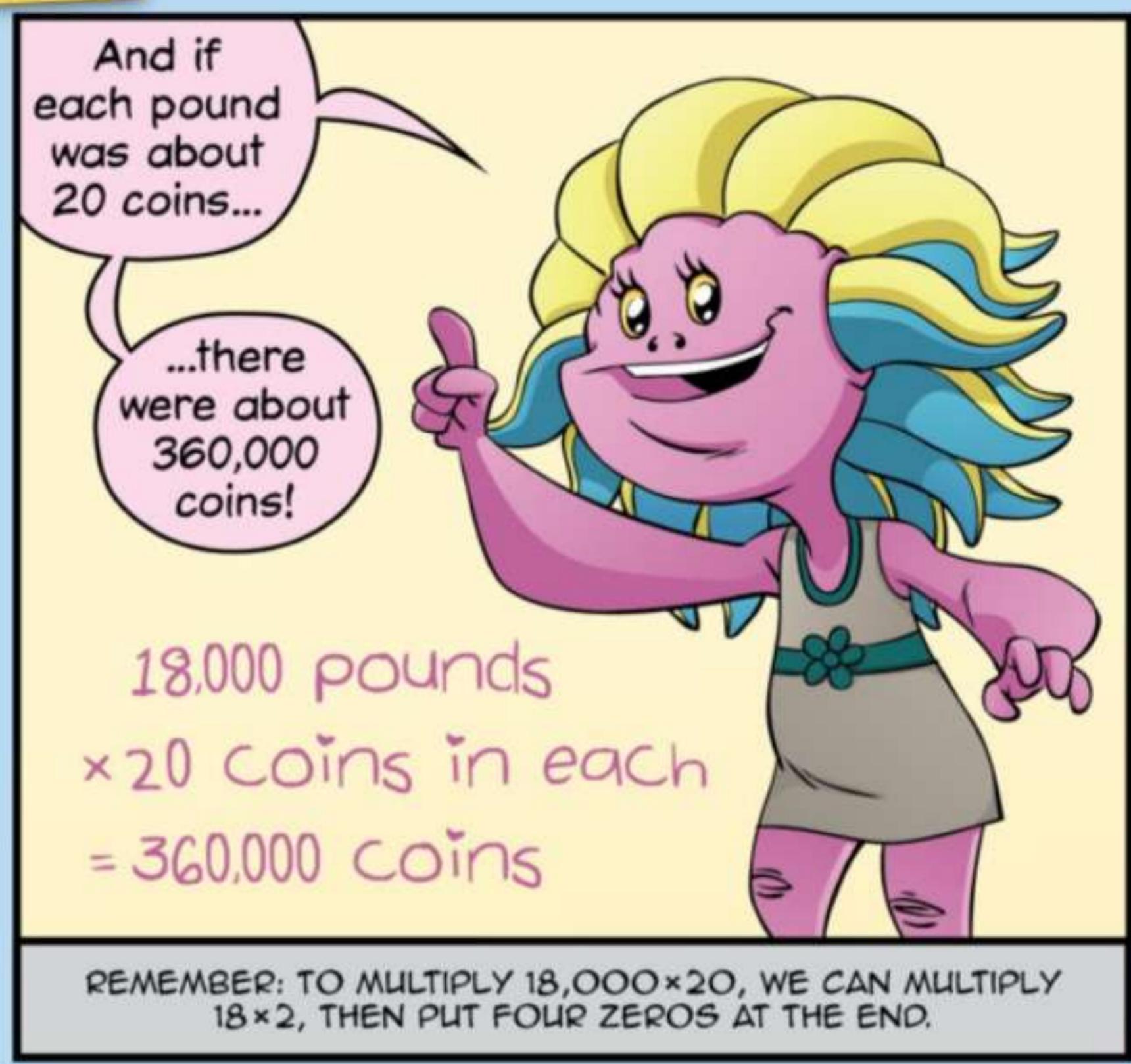
It took nearly 100 full wheelbarrows to transport the treasure to the hull o' me ship.

A full 'barrow holds about 180 pounds o' gold coins.

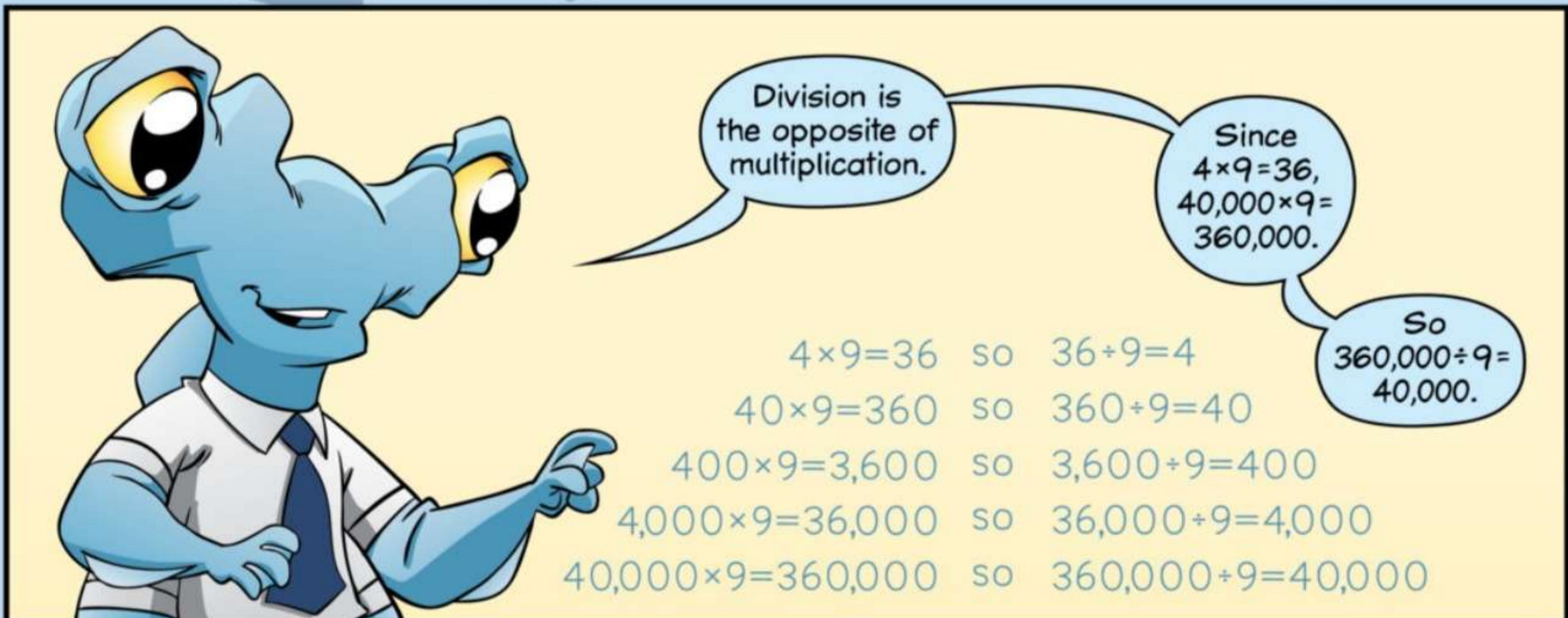
There be about 20 coins in a pound.

Who can estimate the number o' coins in the whole treasure?

Try it.



REMEMBER: TO MULTIPLY $18,000 \times 20$, WE CAN MULTIPLY 18×2 , THEN PUT FOUR ZEROS AT THE END.



Aye, each pirate
be gettin' about
40,000 coins.

Alas, no
pirate can be
countin' 40,000
coins.

With collectible
novelty beverage
cups!

How did
you divide the
coins, then?

???



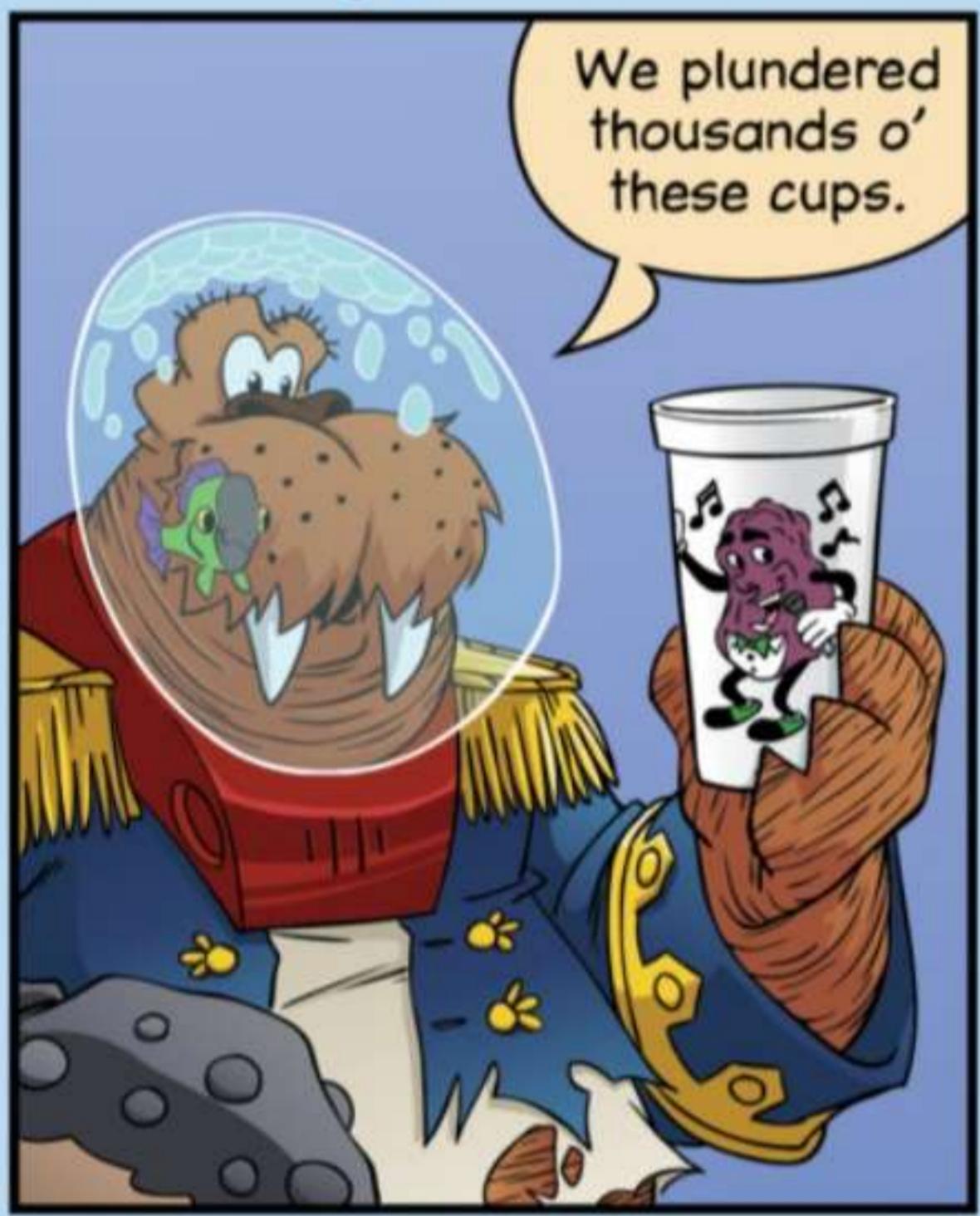
We plundered
thousands o'
these cups.

We filled
each cup full
o' coins...

...with
each cup
holdin' about
350 coins.

Who can
estimate the
number o' cups
needed to hold
all the coins?

Try it.



We have
to divide
360,000 by
350.

$360 \times 1,000$ is
360,000...

...so
 $360,000 \div 360$ is
1,000.

$$360 \times 1,000 = 360,000$$

$$360,000 \div 360 = 1,000$$

$$350 \approx 360$$

$$360,000 \div 350 \approx 1,000$$

And
350 is
pretty close
to 360,
so
 $360,000 \div 350$
is pretty close
to 1,000.





We need to estimate $700 \div 9$.

We can round 9 up to 10 and divide $700 \div 10$ to get 70.

Or, since 700 is close to 720, $720 \div 9 = 80$ is also a good estimate of $700 \div 9$.

So, each pirate got about 70 or 80 cups of coins.



$$\begin{aligned}700 \div 9 \\ \approx 700 \div 10 \\ = 70\end{aligned}$$

$$\begin{aligned}700 \div 9 \\ \approx 720 \div 9 \\ = 80\end{aligned}$$



After all the cups be divided equally, each pirate be gettin' 78 cups o' coins, with two left over.

Aye! Excellent estimatin'!

Of course, no pirate be content with just an estimate, so we had to be countin' all 704 cups o' coins.

How did you decide who got the last two cups of coins?

With a rock-paper-scissors tournament.



Did you win?

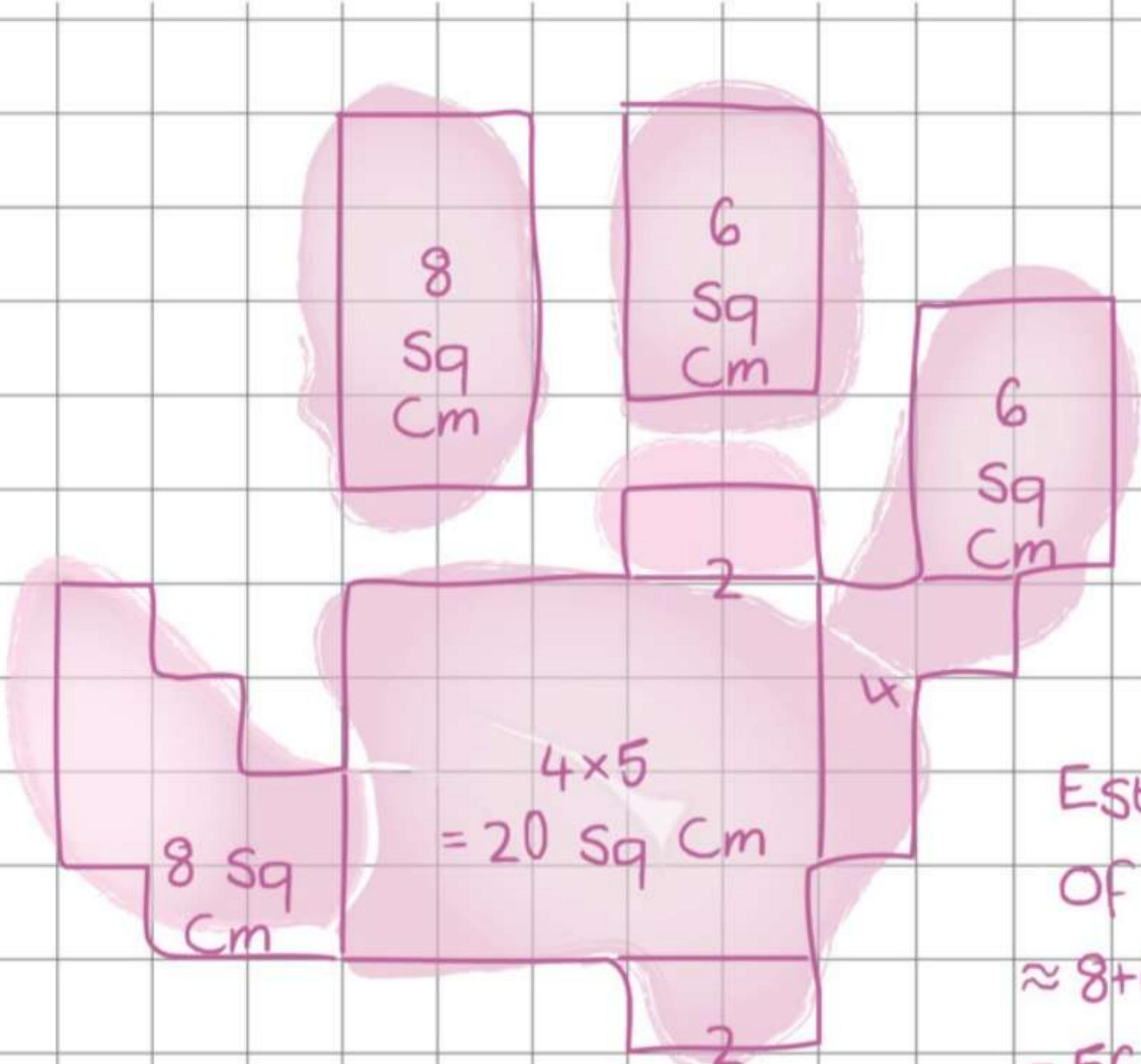
Arrr... I lost to Rocky in the third round.

'Twas probably a mistake to play with me right hand.



Centimeter Graph Paper

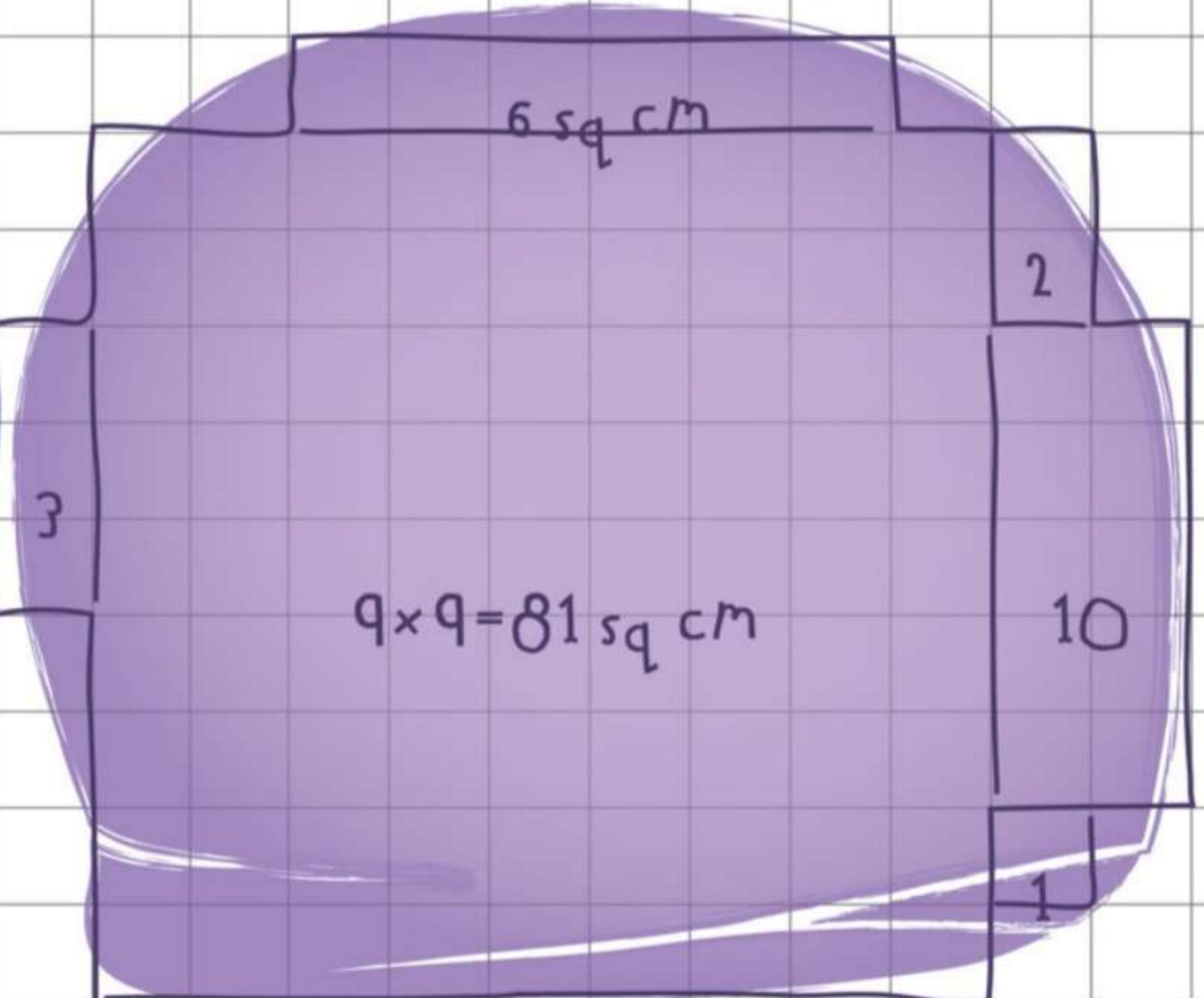
www.BeastAcademy.com



= 1 Square
centimeter
(sq Cm)

Estimated Area
of my handprint:
 $\approx 8+6+6+2+8+20+4+2$
 $= 56 \text{ Sq Cm}$

Estimated Area
of my fingerprint:
 $\approx 81+3+6+2+10+1$
 $= 103 \text{ sq cm}$



RECESS

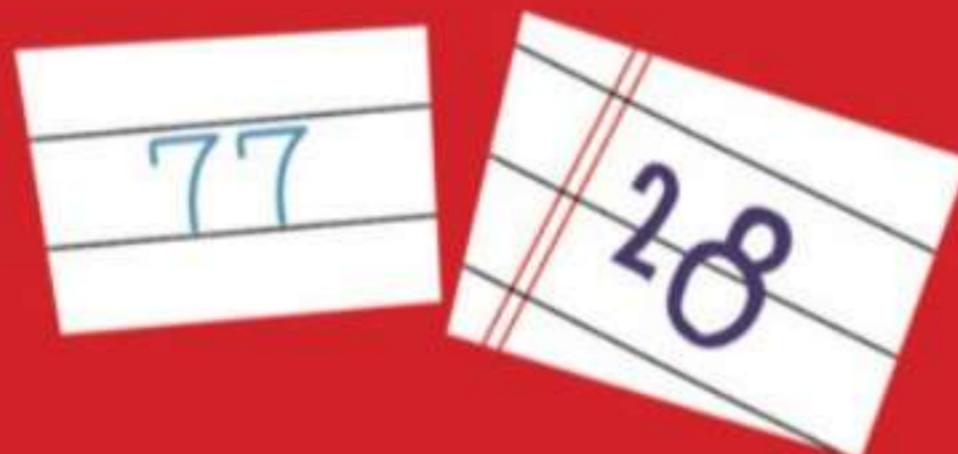
Materials:

About 40 small paper slips for each game.

A quarter or other coin.

A calculator.

A large, clear table.



Game Play:

1. Each player writes a 2-digit number on a slip of paper without showing the other player. The slips are placed face-down on a table.
2. In the first round, one player is the "spinner" and the other player is the "flipper." The flipper turns both slips of paper over at the same time that the spinner spins the coin.
3. Both players estimate the product of the two numbers. Each player must write his or her estimate on a new slip of paper, placing it face down on the table before the coin stops spinning.
4. A calculator is used to compute the actual product of the two numbers. The player whose guess is closest wins the round and gets a point.
5. If one player does not guess in time, the other player wins the round. If both players fail to guess in time, neither player gets a point. If the players tie, both get a point.

Each round, players switch roles between spinner and flipper. The first player to 3 points wins the game.

Variations:

- You can play Guesstimate with addition or subtraction instead of multiplication. Division is more complicated.
- You may eliminate the 2-digit number rule and allow larger numbers.
- If one or both players is not comfortable spinning a coin, you may set a time limit for each round instead of spinning a coin.
- For a longer game, increase the number of points needed to win. Or, play several games and see who can win the most.
- For a game with more than 2 players, rotate the roles of spinner and

Guesstimate

Sample Game:

Round 1

Grogg writes 28, Alex writes 77.

Grogg estimates 2,400.

Alex estimates 2,300.

Correct product: $28 \times 77 = 2,156$.

Alex gets a point.

Round 2

Grogg writes 61, Alex writes 44.

Grogg estimates 2,600.

Alex estimates 2,800.

Correct product: $61 \times 44 = 2,684$.

Grogg gets a point.

Round 3

Grogg writes 92, Alex writes 15.

Grogg estimates 1,350.

Alex estimates 1,400.

Correct product: $92 \times 15 = 1,380$.

Alex gets his second point.

Round 4

Grogg writes 36, Alex writes 21.

Grogg estimates 800.

Alex estimates 750.

Correct product: $36 \times 21 = 756$.

Alex gets his third point and wins the game.

Find a partner and