

Balance Scale Puzzles

How many Lizzies are needed to balance Alex?

We know from Example 3 that one Alex balances with a Lizzie and Winnie, so we can replace Alex in Example 1 with a Lizzie and a Winnie. This tells us that *one Grogg balances with two Lizzies and a Winnie*.

Next, we know from Example 2 that two Groggs balance with three Winnies. We can replace each Grogg with two Lizzies and a Winnie. This tells us that *four Lizzies and two Winnies balance with three Winnies*. That must mean that *four Lizzies balance with one Winnie*.

Finally, we know from Example 3 that a Lizzie and a Winnie balance with one Alex. We can replace Grogg with four Lizzies, so we know that **five Lizzies balance with one Alex**.

Extra challenge: Captain Kraken has discovered eight coins, but knows that one of them is a fake! It looks exactly like the others, but will be slightly heavier. Can he find the fake coin by using the balance scale only two times?

If you could only use the balance scale *one* time, you could easily figure out which of two coins was the fake: you would just put one coin on each side of the scale and see which one was heavier!

What if you had three coins? Could you figure out which one is fake using the balance scale only one time?

Yes, you can! Put one coin on each side of the balance scale. If one of those two coins is the fake, the scale will tip and you will know the heavier coin is the fake. If the two coins are the same, the scale will be level and you will know that the third one (the one you didn't put on the scale) is the fake.

What if you had four coins? Could you figure out which one is fake using the balance scale only one time?

No, you can't! The strategy you used for three coins wouldn't work unless you got lucky and chose the fake one to put in the scale. If you left the fake coin off of the scale, you wouldn't know which of the two leftovers was fake. It also wouldn't work to just split the four coins in half and compare the two sets of two: you could figure out which set was heavier, but that wouldn't narrow it down to just one coin.

So, our first attempt at using the balance scale needs to narrow it down to at most three possible coins. How can we do this?

Let's divide the coins into two groups of three coins and one group of two coins. First, we use the balance scale to compare the two groups of three coins. If one group of three is heavier, we know the fake is in that group. Then, we can use the strategy we described above to figure out which of the three is fake. That would be our second use of the balance scale. If the two groups of three balance, we know that one of the two leftover coins is the fake. Our second use of the scale will just be a comparison of those two to see which is heavier.