Panning for Gold

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San Francisco Math Circle at San Francisco State University
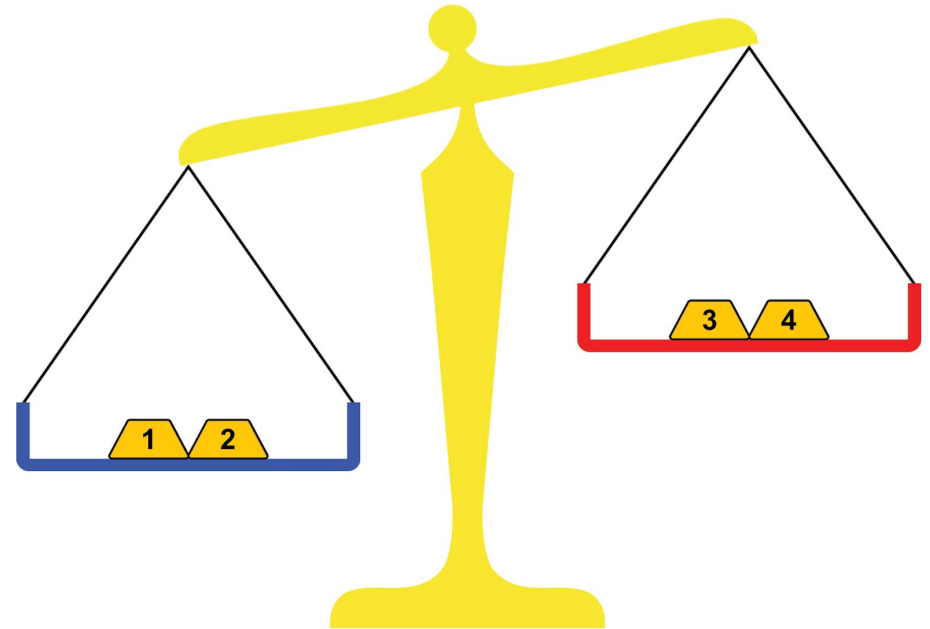
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Panning for Gold

Objective:
- Find the real gold bar.

Rules:
- Only one bar is gold, and all other bars are fakes.
- The real gold bar weighs more than the fakes.
- You can use a balance scale to compare the weights of two groups of bars.
- All fakes weigh the same.
- A pair of fakes together weigh more than the real gold bar.

Bars 1 and 2 are heavier than 3 and 4. How does this information help you find the gold bar?

1. If there are 8 bars, what is the fewest number of weighings you need to guarantee that you find the gold bar?


2. What if there are 9 bars? 10 bars? More?

3. If you can do at most 3 weighings, what is the largest number of bars you can start with and still find the gold bar? 4 weighings? More?
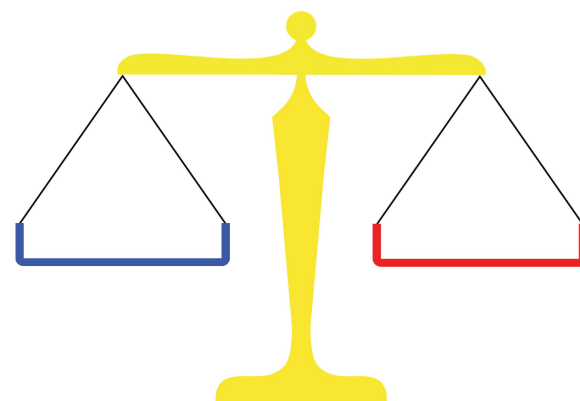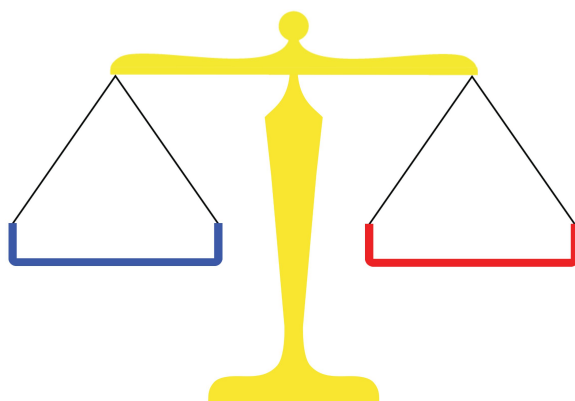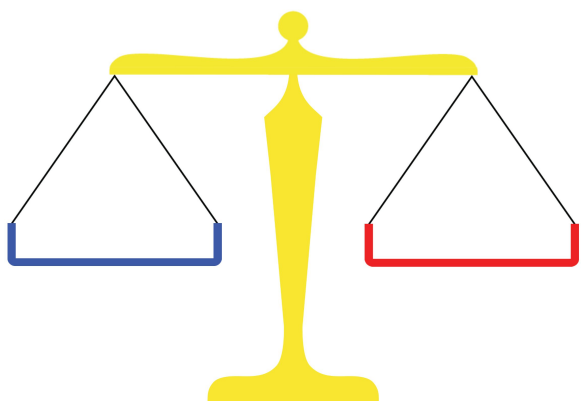
1. If the gold bar is a little **lighter** than each of the counterfeits, how do your answers to the explorations change?

2. If the gold bar is either **lighter or heavier** than each of the counterfeits, but you don't know which, how do your answers to the explorations change?

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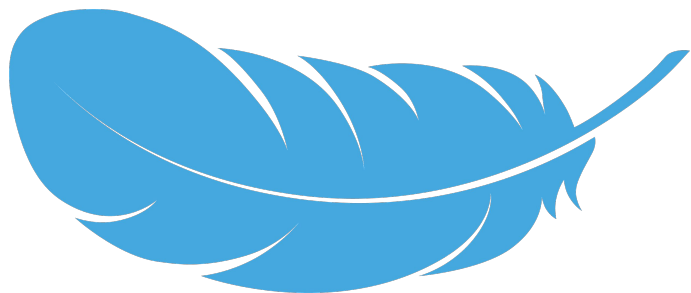
3. In question 2, if you need to determine both which bar is gold and whether it is heavier or lighter than the counterfeits, how do your answers change?

Two Is Better Than One

1. You can now use two scales at the same time. It takes 1 minute to use both scales. The gold bar is heavier than the others. If you only have 5 minutes, what is the largest number of bars you can start with and still guarantee that you'll find the gold bar?
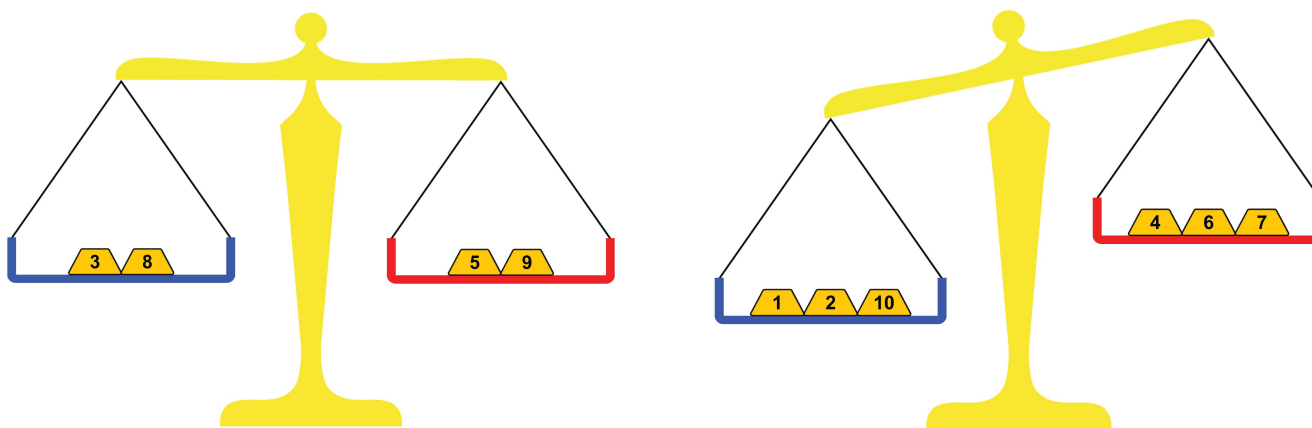
2. Answer question 1 for when the gold bar is **lighter**.

3. Answer question 1 for when the gold bar is **heavier or lighter**.

4. What if you had 6 minutes? 7 minutes? More?

5. How would your answers change if you could use 3 scales at the same time?