A Whole Lotta Lemons: The Power of Repeated Doubling

A more detailed explanation of the Exponential Growth of these Lemons

At the back of Double Puppy Trouble, we asked: What if you wanted to pick 1 lemon on the first day of the month, 2 lemons the next day, 4 lemons the following day, 8 lemons the day after that, and you kept going, doubling the number of lemons each day? Could you keep it up all month long?

Let's see how that would work!

Hm, if we're doubling, that means each day we multiply by 2, right? So day 2 we'd just pick 2 X 1 = 2 lemons, day 3 would be 2 X 2 = 4 lemons, day 4 would be 2 X 2 X 2 = 8 lemons, etc. See the repeated multiplication by 2? There's a shorter way to write repeated multiplication. We can use little numbers called **exponents**, which tell us *how many times* to multiply a number times itself.
So 2^3 means we multiply 2 by itself 3 times: $2^3 = 2 \text{ X } 2 \text{ X } 2$. See what I mean?

Back to our lemons, let's use exponents to show how many we'd pick each day:

Day 2: $2^1 = 2$
Day 3: $2^2 = 4$
Day 4: $2^3 = 8$
Day 5: $2^4 = 16$
Etc.
(Check out Chapter 15 in my book *Kiss My Math* for more on exponents!)

Do you see the pattern? Whichever day we're on in the month, the exponent will be 1 less than that number. In other words, on day 7, we'd pick 2^6 lemons = 64 lemons. (You'd read 2^6 like "two to the sixth power.") Not too bad, but that's a REALLY full shopping bag full of lemons.

But if that seems like a lot, at the end of the second week, on August 14, you'd have to pick $\mathbf{2^{13}}$ lemons, right? A calculator will tell you that's 8,192 lemons – holy cow! That's almost enough lemons to fill up your car!

At the end of week 3, that's day 21, so you'd have to pick 2^{20} lemons, which is another way of writing 1,048,576 lemons – that's over a million lemons! What?? Yes – it's a huge number. It's enough lemons to fill up a house!

And on the 31st day of the month, the amount of lemons you'd pick would be 2^{30} lemons = 1,073,741,824 lemons! Yep, that's over a *billion* lemons. That's enough lemons to fill a 30-story building!

So that's how we got all those numbers… but let's think about this even more:
Even if your entire class of 30 kids each picked 1 lemon every second of every day (and never even slept!), it would take *over a year* to pick that many lemons.

The good news is, if you could manage to make lemonade from them, it would last you a loooong time – you and your classmates could each have 1 glass of lemonade every minute for over 52 years, so you might want to share with some other people, too – like maybe the whole town you live in!

My goodness, all we did was double the number of lemons every day – wow, doubling numbers sure is powerful – those numbers get really big, really quickly. Exponential growth sure is amazing…and now you've seen how it works – with exponents!