Santa's Dirty Socks

A Computer Science Tale for the Holidays

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Santa's Dirty Socks

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COMPUTER SCIENCE Unplugged

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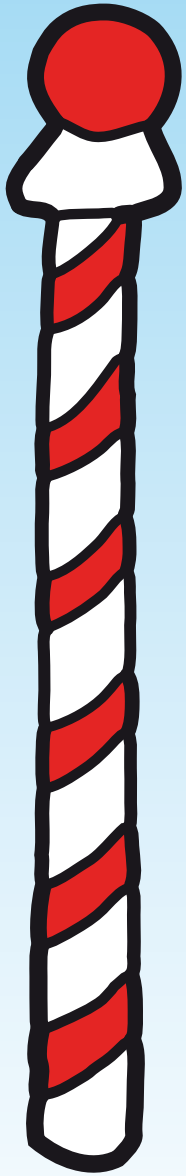
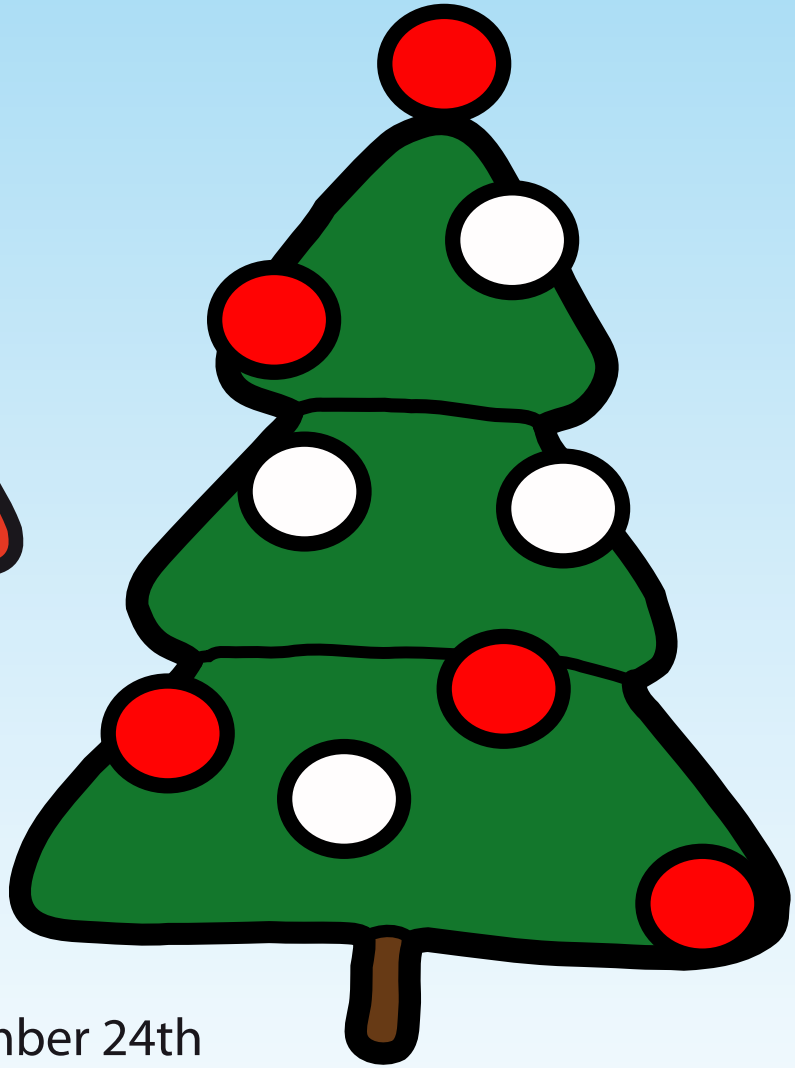




‘Twas ten to midnight on December 24th
and all was not well in the far, far North.

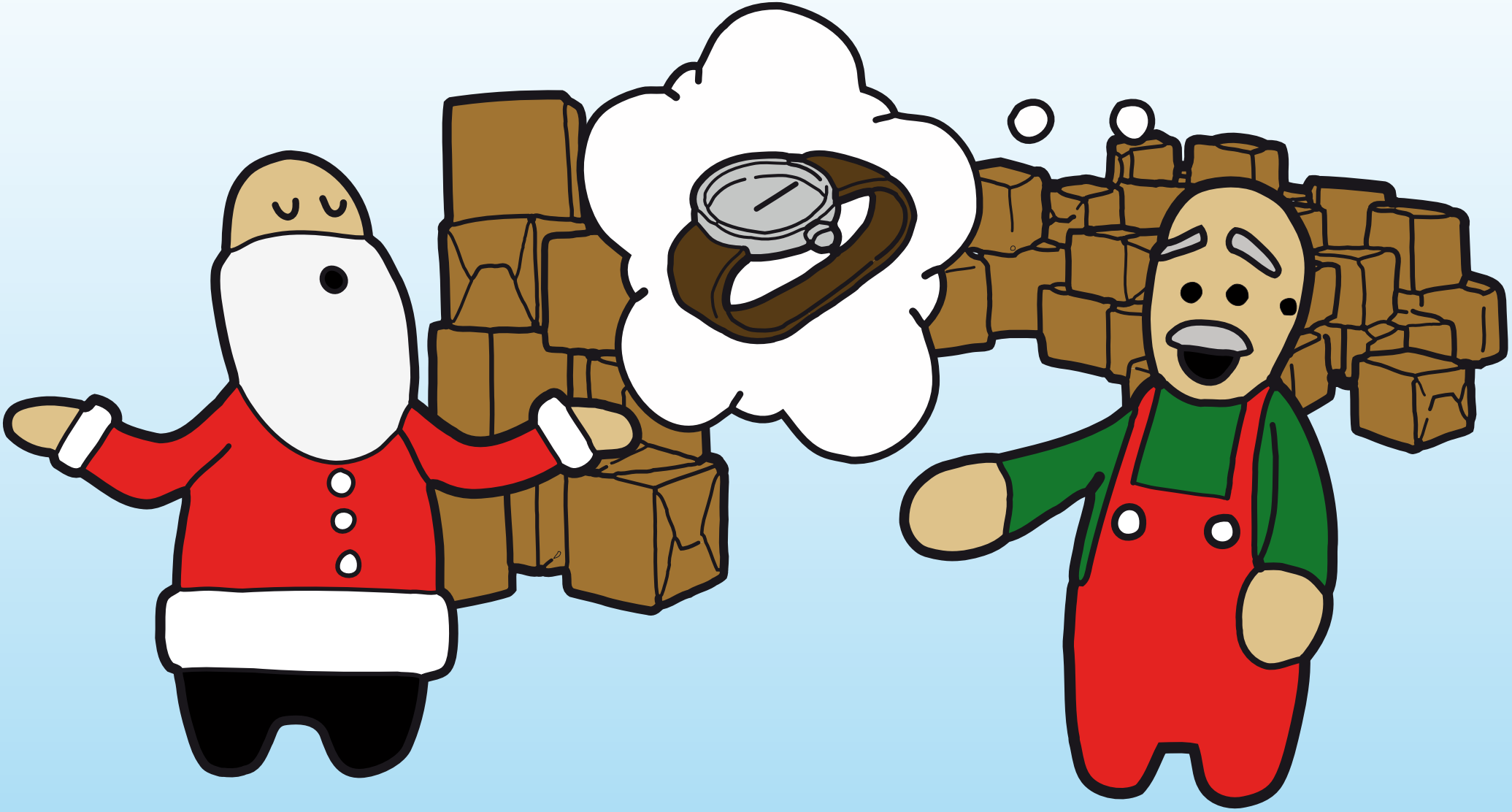
Some little elves were wrapping a thousand and twenty four toys,
roller skates for a thousand and twenty four good girls and boys.

At ten to midnight the elves called Saint Nick,
tonight, all the boxes had been filled extra quick.
Saint Nick was thrilled, “right then, fill up thesleigh,
a thousand and twenty four boxes and we’re on our way.”

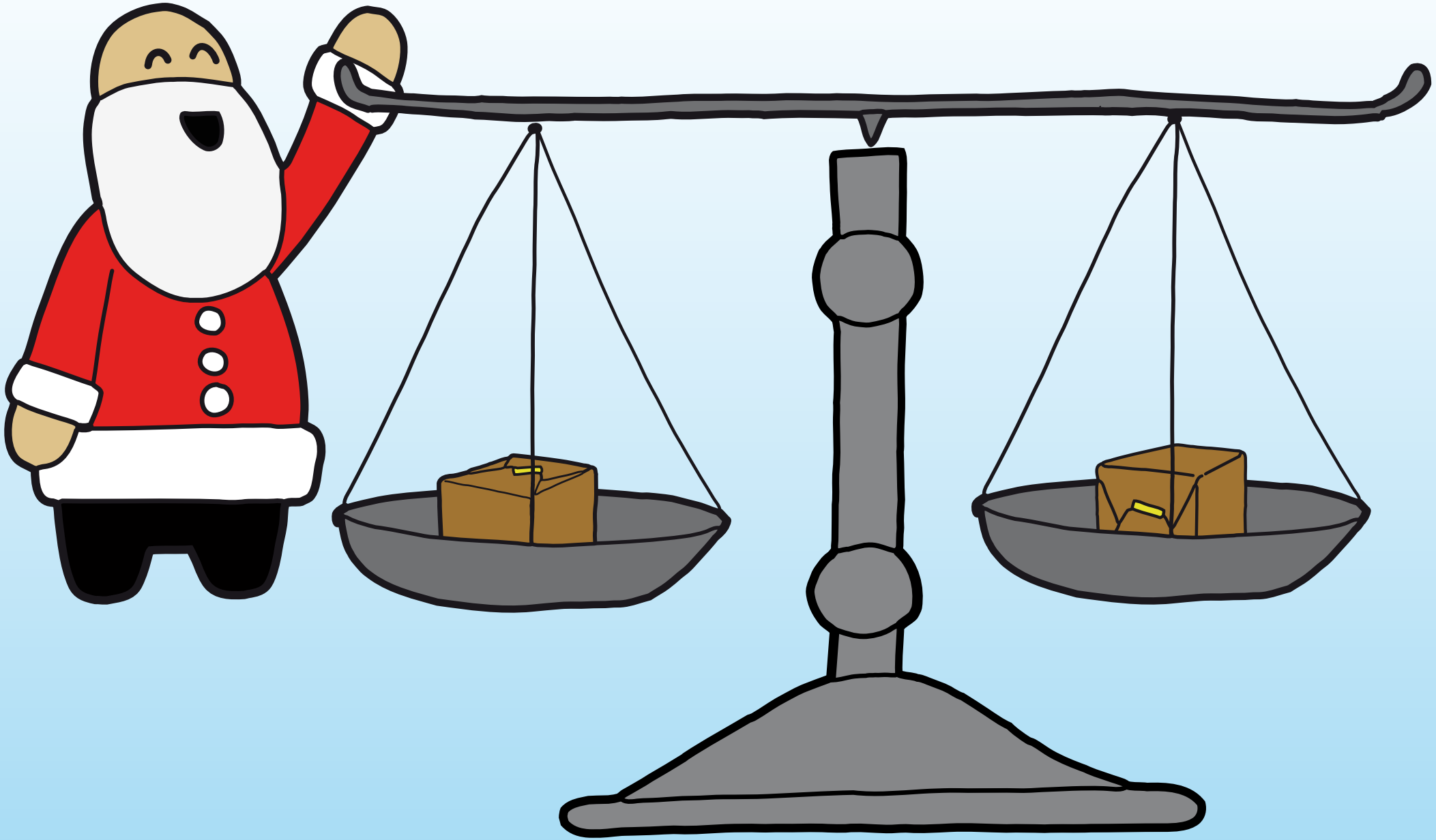
Then Mrs. Christmas burst in through the doors
“Where are your dirty socks, Santa Claus?”

A young elf cried, “Santa, I dropped your dirty sockses
in one of the thousand and twenty four boxes!”

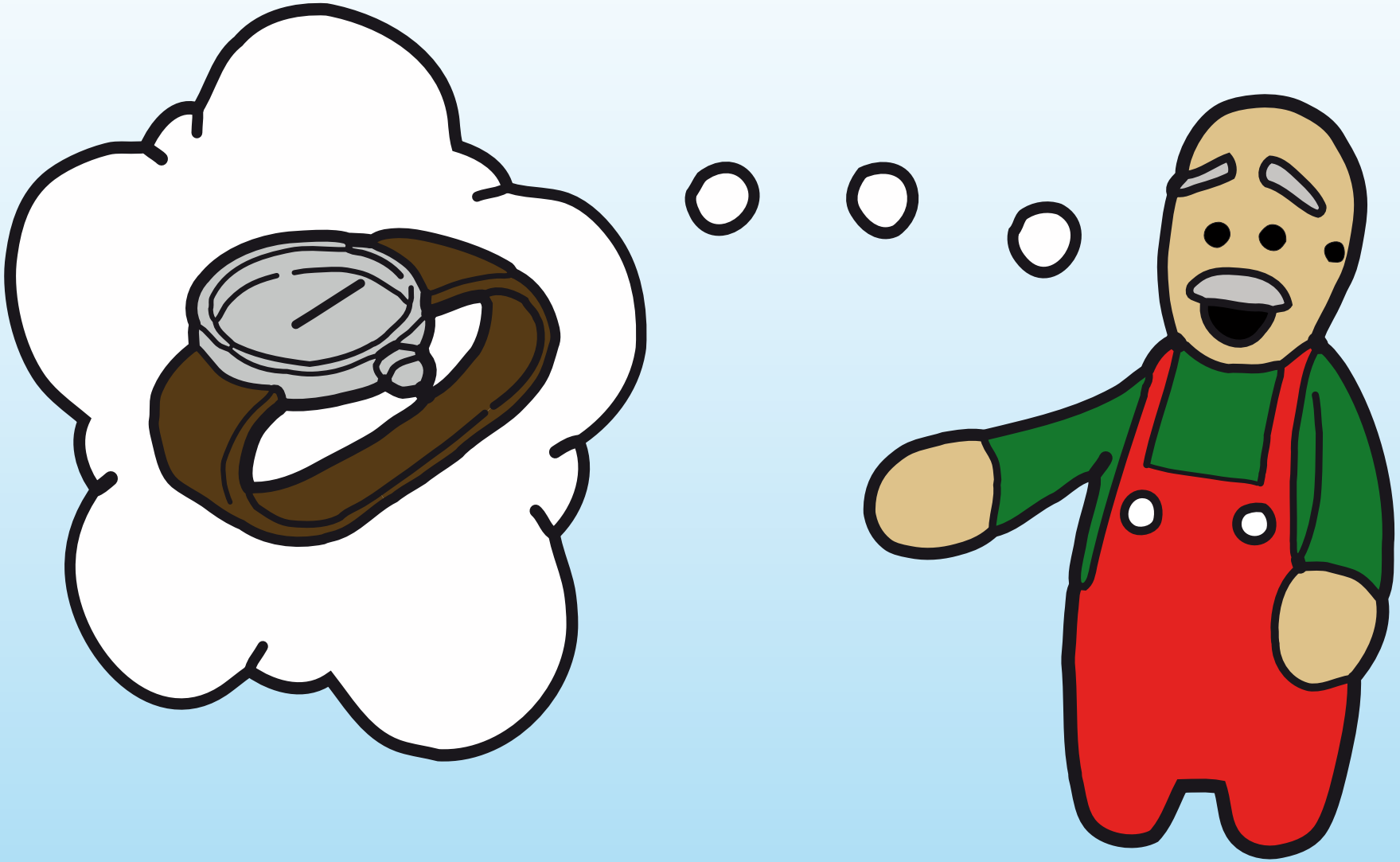
“Quick, unwrap every single box!
I’m not leaving ‘til you find those socks!”
“Sorry, Santa,” said the supervisor elve,
“us workers are all union, and we finish at twelve.”



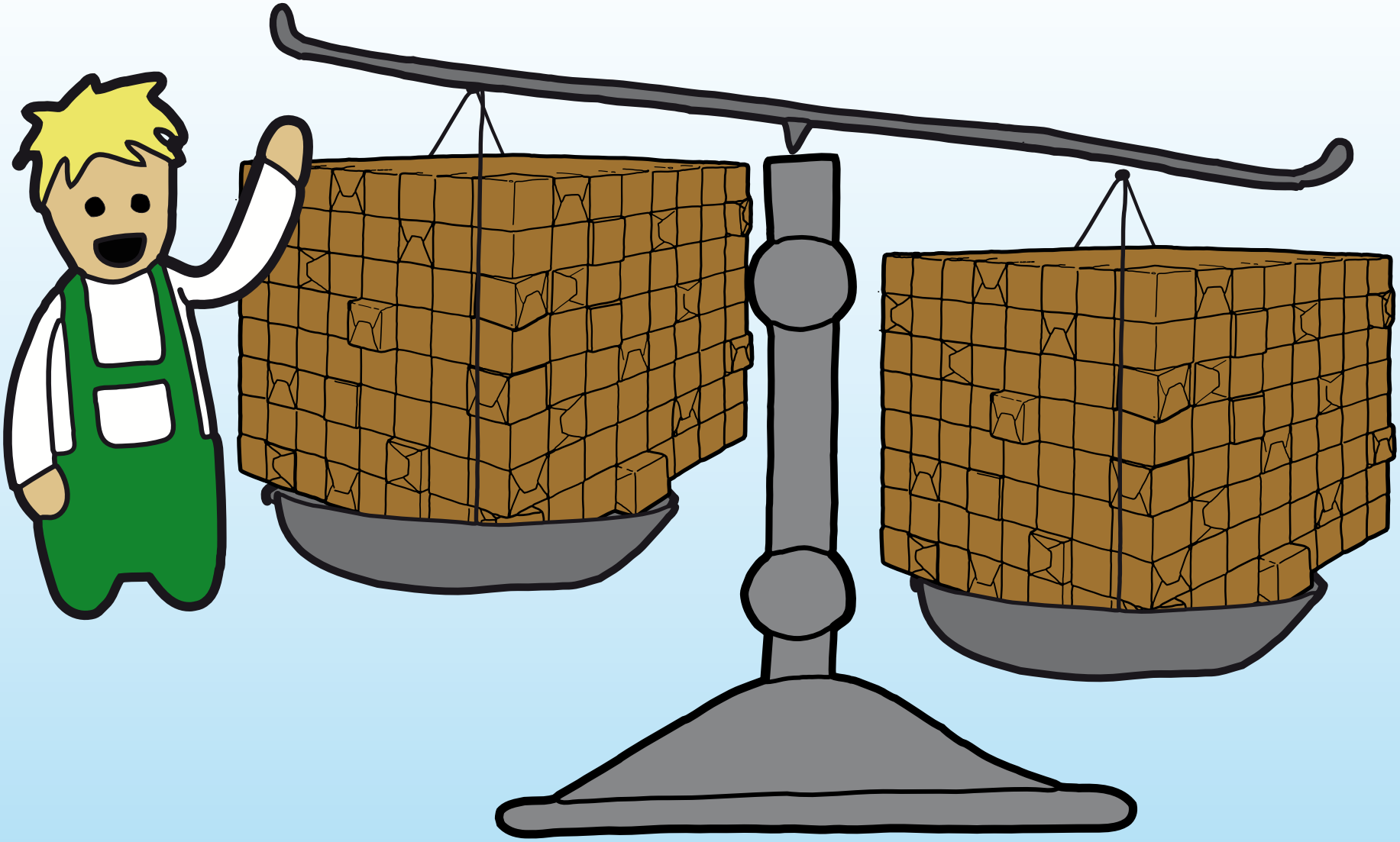
Said Santa, “No need to be unpleasant,
I’ve got a big pair of scales, just weigh each present.
They’ll all weigh the same when you put them in each bucket,
except for one, and that one’s the culprit!”



“With all due respect,” replied the supervisor elf,
“It’ll take a jolly long time, and you can do it yourself.
If we could make one comparison every second,
we’d be here ‘til twelve-oh-seven!”

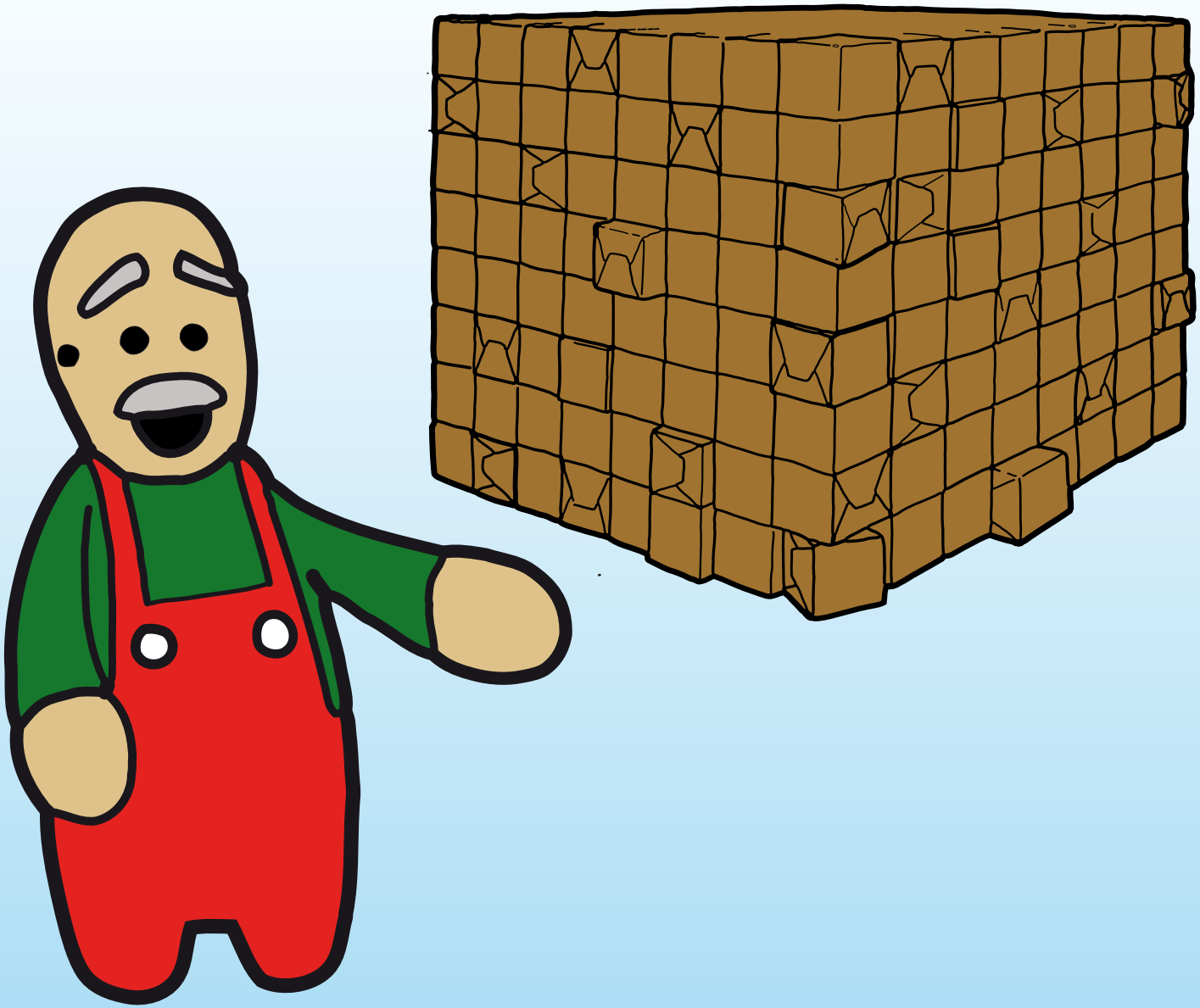


A little elf piped up: “I’ve got an idea!
We just need to use divide and conquer here.

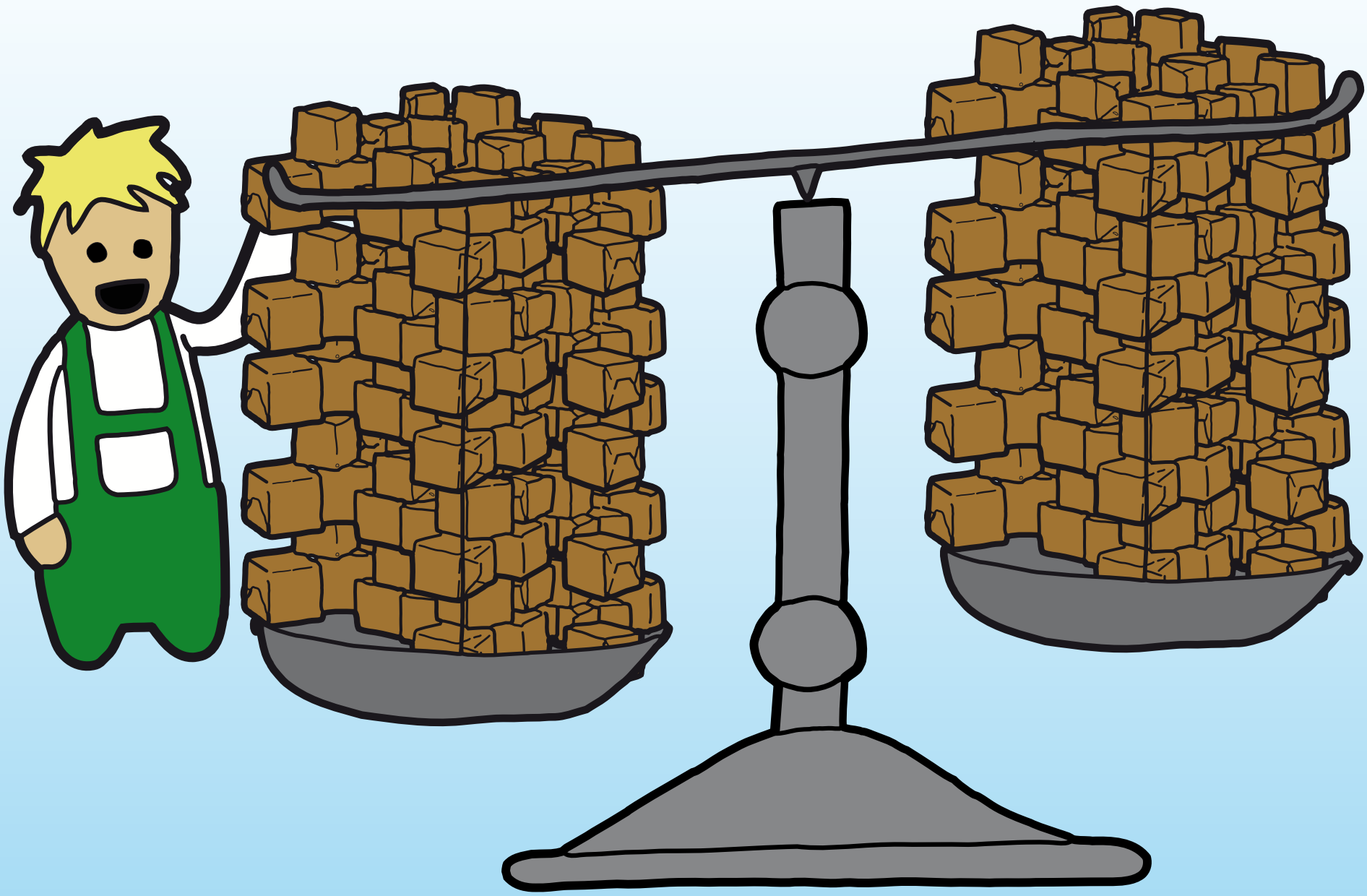


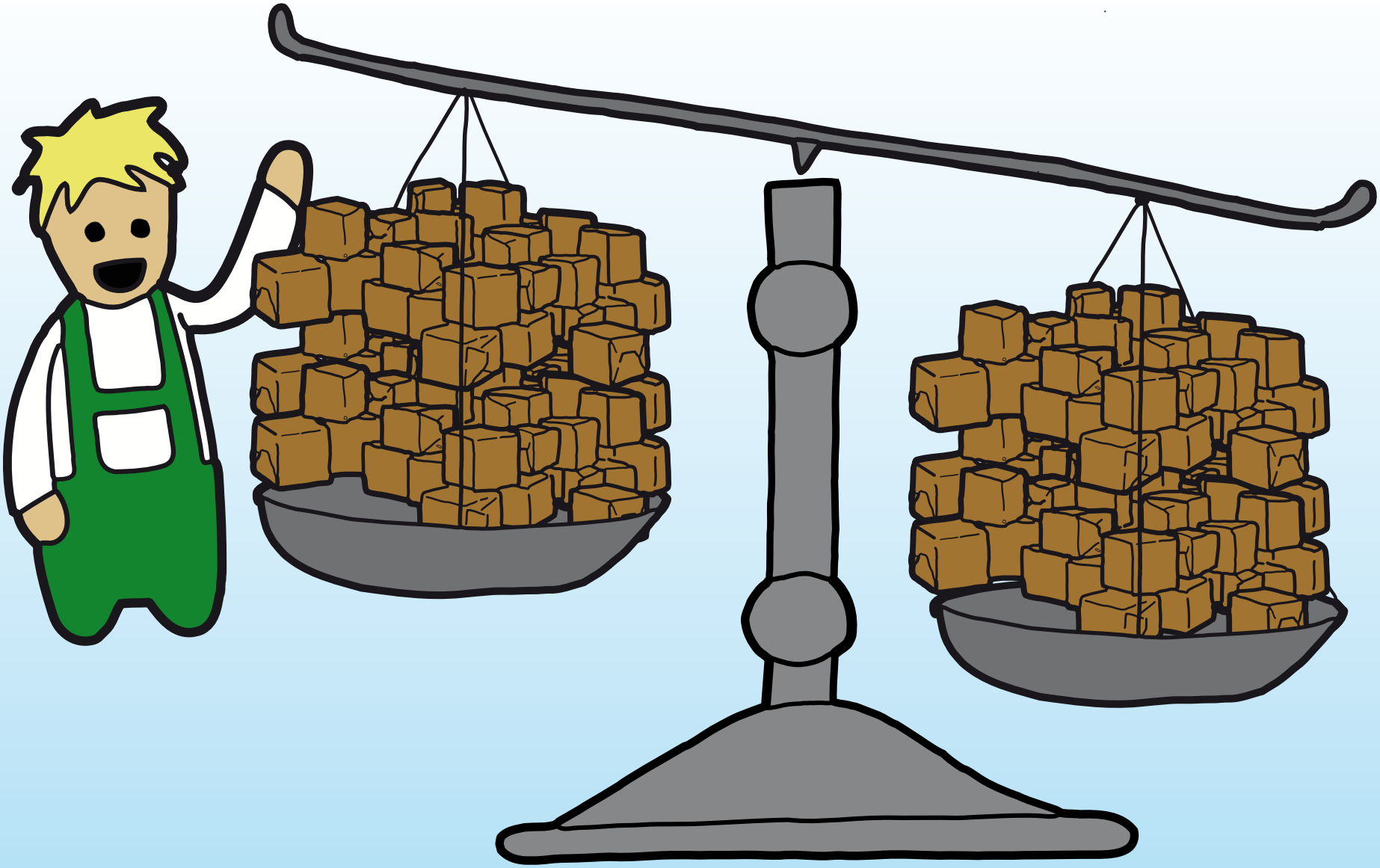
Put half the boxes on that scale, and half the boxes on this,
whichever side goes up, that pile we dismiss!”

The supervisor elf, with an unimpressed gaze,
pointed out, “we’ll still be here for days.
You’ve narrowed it down to five hundred twelve,
Hardly any help from this little elve.”

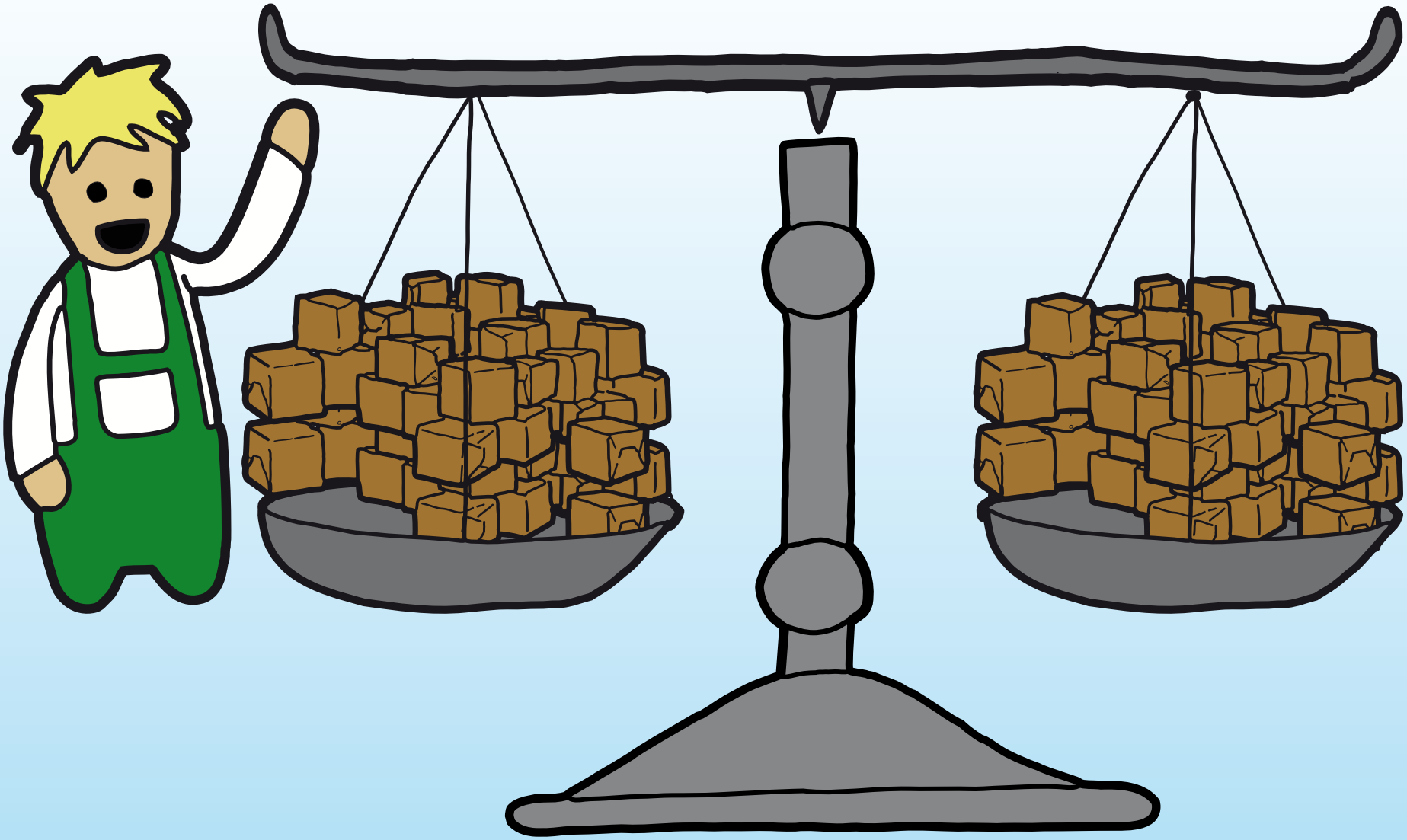


“Wait,” said the elf, only beginning his campaign,
“watch what happens when we halve it again.”
So they halved it again, and now their fix
was narrowed to two hundred and fifty six.



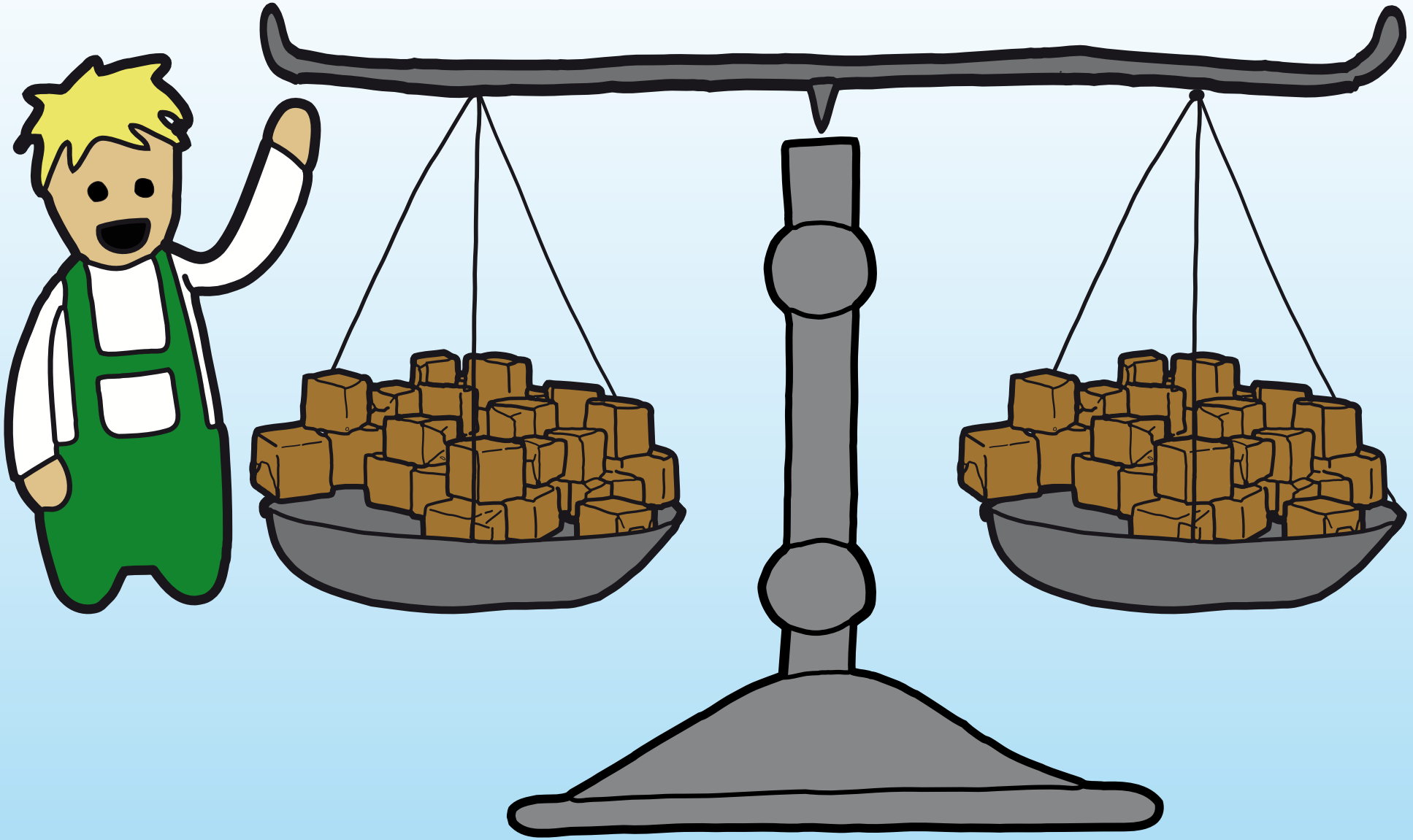


Then, after their third comparison of weight,
their problem was reduced to a hundred twenty eight.

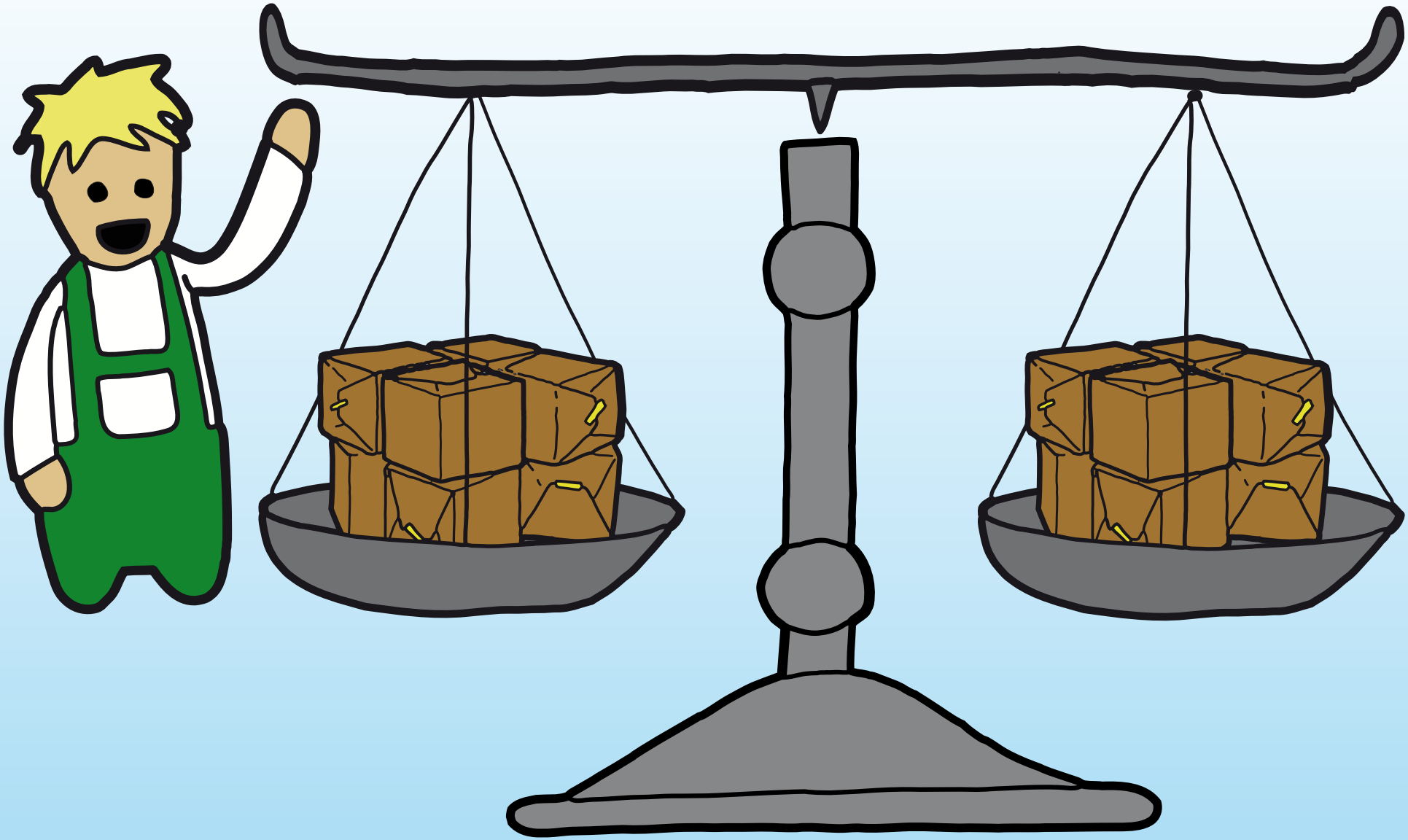


Then sixty four,

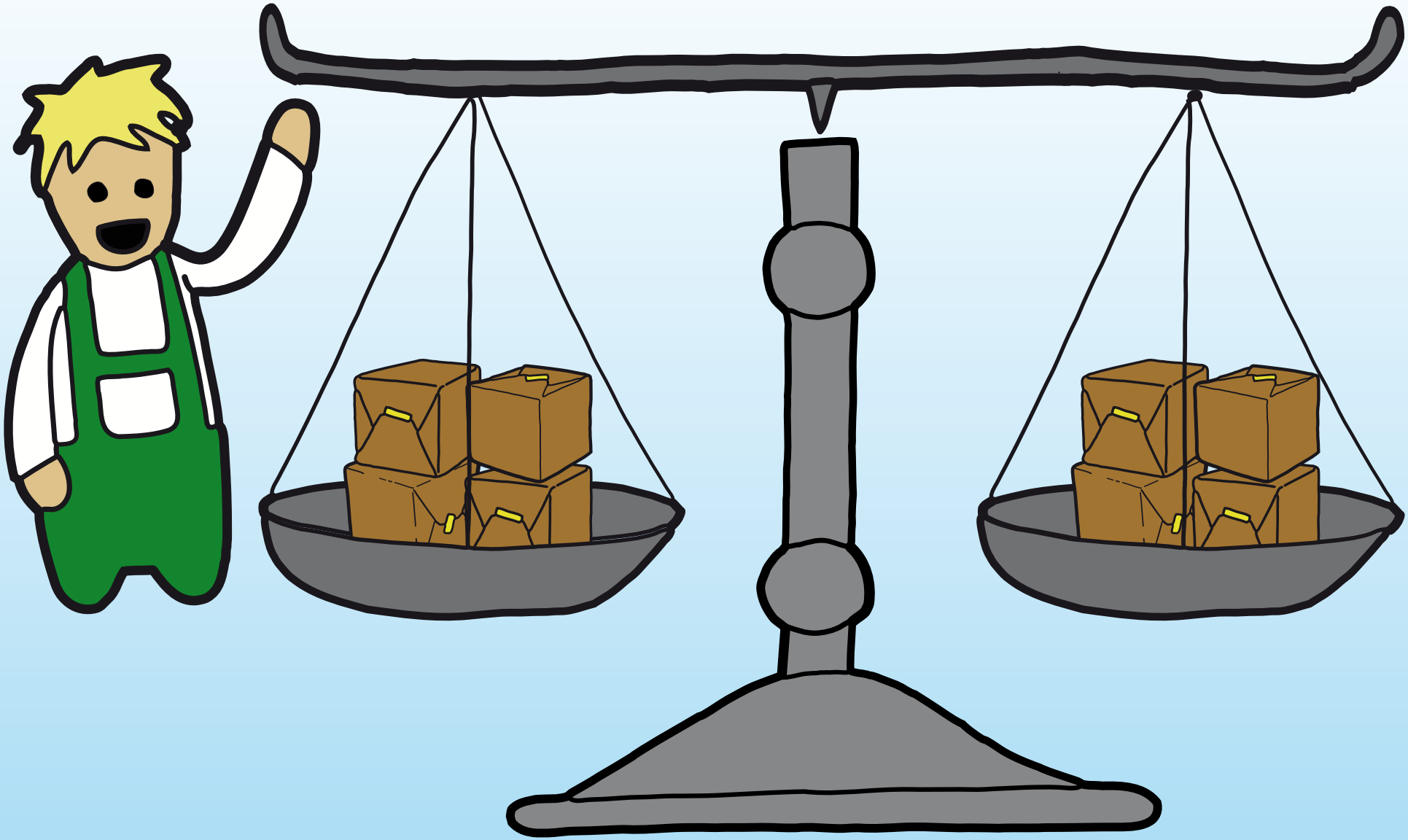
then thirty two...



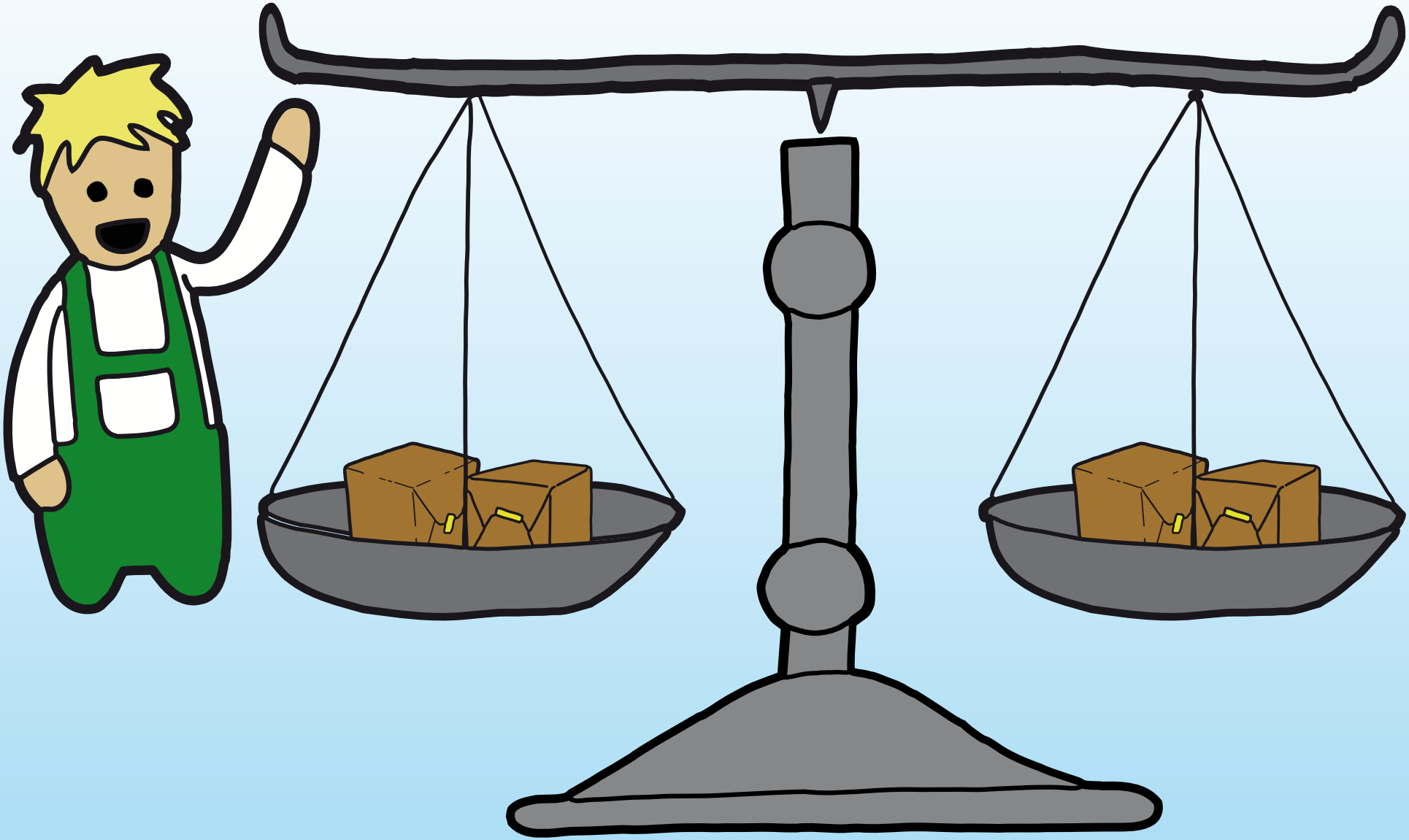
sixteen...



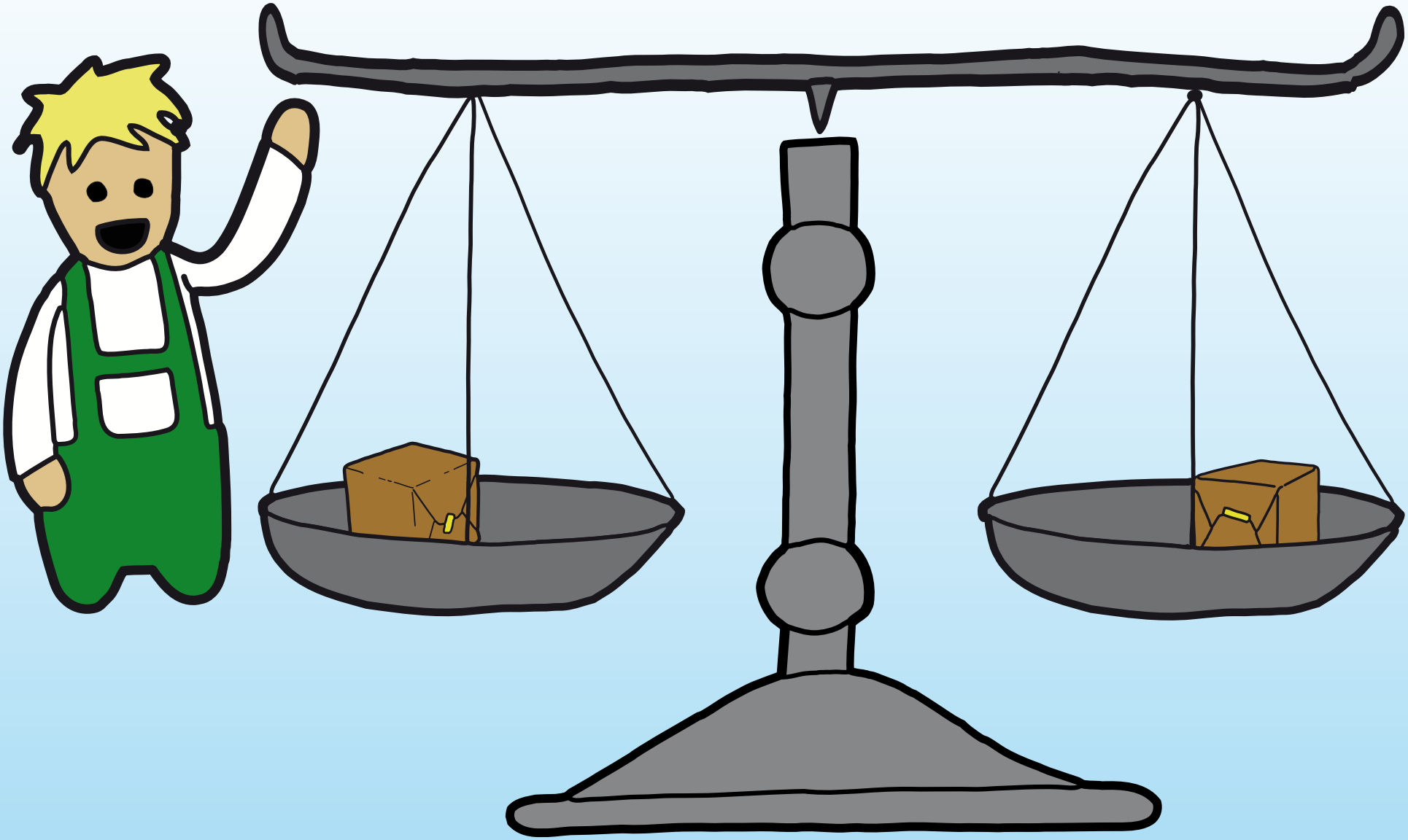
eight...



four...



two...



...it's true!

On the tenth comparison, with much joy,
this elf had found the erroneous toy.
A job that could've gone well beyond the time limits
took just a matter of minutes.

So the gift was replaced, the elves went home,
and Santa was set for his world-wide roam.
No poor child, far or near,
will have to smell Santa's dirty underwear!

But first the little elf was approached by Saint Nick,
“Where did you learn your clever trick?”
The little elf replied “On magic I make no reliance,
all I need to use is a little computer science.”

The End

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For more information see
csunplugged.org/DivideAndConquer

Here are some ideas for follow-up discussion after students have heard the story. Some of these questions overlap, and are just guidelines for discussion.

- Consider doing the activity with a balance scale and, say, 32 weights that are identical except one. Now engage in a thought experiment - how many more weighings would be needed if there were 64 weights?
- If there were 2048 boxes, how many weighings would this process take?
- In general, if you double the number of gifts, how many more weighings are needed?
- How many weighings if there are 4 times as many gifts?
- How many weighings if there are 1024 times as many gifts?
- How many gifts are there if there are 1024 times as many as in the story? How many weighings are needed in this case to find the one with the socks?

- How many gifts can be checked in 30 weighings ?
- Do you think this story is true?
- Suppose you are making a search engine that searches a billion words (that is, 1,000,000,000 words), and the words are listed in alphabetical list. The search engine looks at a word in the middle of the list, and eliminates half the list with one check. How many words does it need to check before you find the one you're after?

For more mathematically able students:

- How would you adjust the algorithm to cope with the number of boxes not being a power of two (e.g. consider weighing 30 boxes)?
- What is the formula for the number of weighings that will be performed if there are ***n*** boxes?

More information and answers to the questions are available at csunplugged.org/DivideAndConquer

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