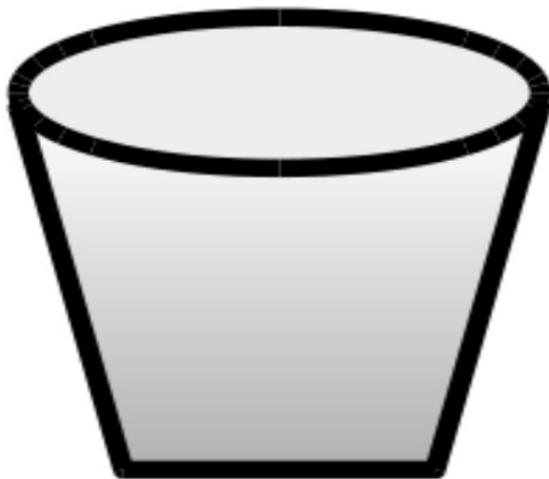


Eureka!

The Queen of Sheba and
the Scientist of Syracuse



By



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The Queen of Sheba and the Scientist of Syracuse

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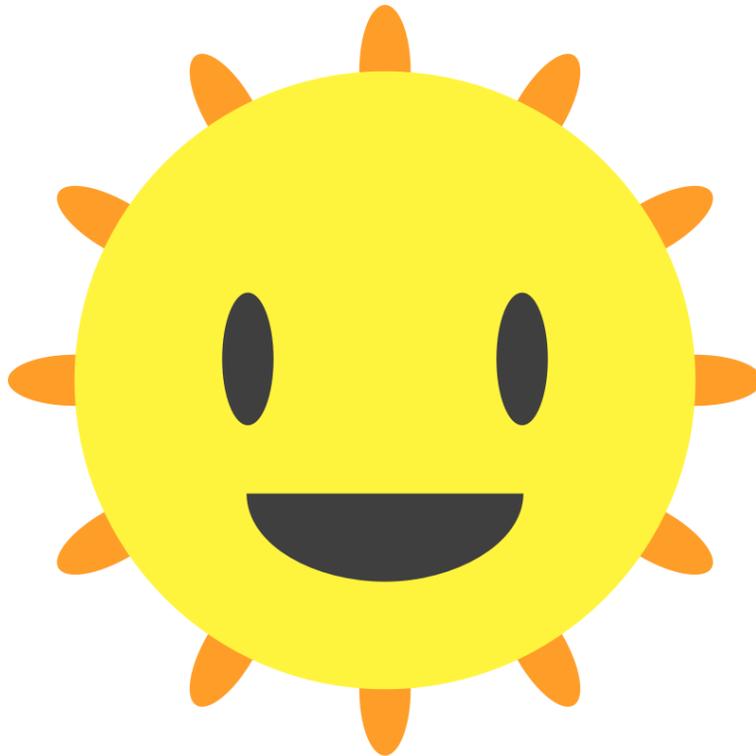
It was a lovely sunny morning in September. *Ganesh Chaturthi* meant it was a holiday from school. Tania and her friends were at Karishma's house celebrating the festival of the elephant headed God Ganesh.



There was an idol of Ganesh decorated with flowers and surrounded by lamps. Karishma's mother was distributing *modaks*. *Modaks* are dumplings made of rice flour stuffed with jaggery and grated coconut. They are supposed to be Ganesh's favorite food and was Tania's favorite part of the celebration. Karishma's mother also served *puranpolis* and some other Maharashtrian delicacies.



Replete with tasty wholesome food, Tania, Tanisha, Sonali, Rajiv and Nikhil decided to go outside and play to make the most of a rare sunny day in the midst of the Bombay monsoon.



Tanisha announced that her sister Trisha had taught her a new game called *The Queen of Sheba*. She said, "One of us has to be the queen of Sheba and ask everyone to get something from the surroundings. The person bringing the best sample wins." Tapping her wrist watch she added, "Of course, there is a time limit."



"Sounds like fun," Nikhil said, looking around at the others, and they nodded. "Tanisha since the game was your idea you should be queen."

Tania, Sonali and Rajiv agreed. Tanisha was thrilled. "Let us do a trial round," she suggested, "so I can explain better." Then she cleared her throat and announced, "The queen of Sheba wants a feather. The person bringing the longest feather wins. You have ninety seconds. Your time starts now."

Tania, Sonali, Nikhil and Rajiv shot off in different directions in search of feathers. Nikhil was the first to return with a feather, closely followed by Sonali and then Tania. Rajiv arrived last, just as the time was up, but he was empty handed. Poor Rajiv had not found a single feather.



Nikhil, Sonali and Tania placed their feathers next to each other to compare their lengths. Sonali's was the longest, so she won. With a clearer idea of the game, they all waited eagerly for the next round. The next time Tanisha asked them to get white stones and the person who found the largest number of white stones would win.



Rajiv

4



Sonali

5



Nikhil

15

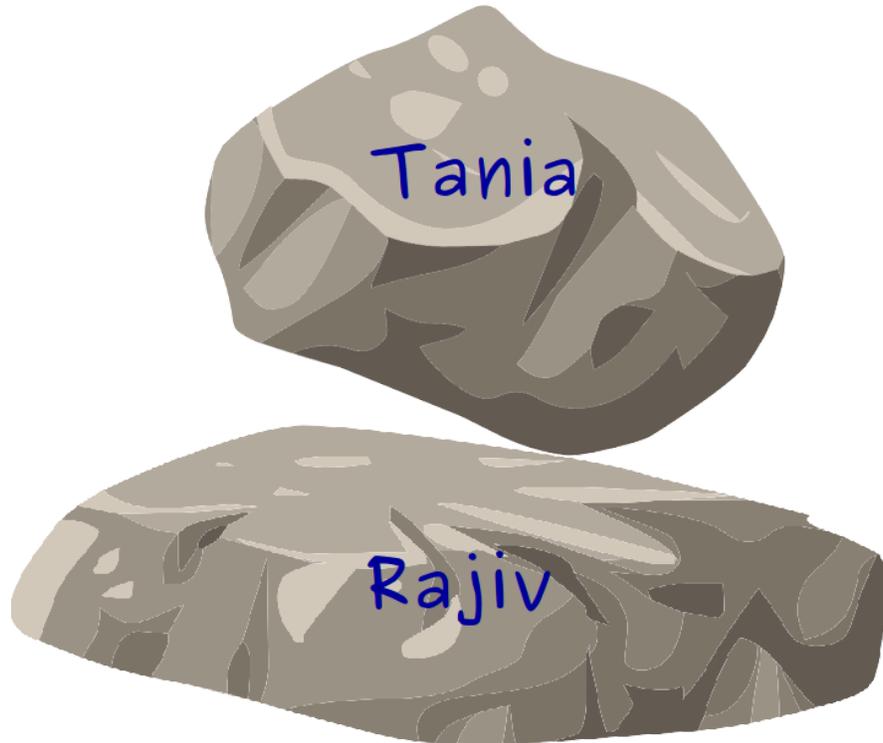


Tania

10

Nikhil, who managed to get 15 stones won this round. The game was quite enjoyable. Tanisha was inventive with her orders and fair in her judgments. She made a great queen, until

It was round five, and Tanisha said the person bringing the biggest rock would win. The rocks Sonali and Nikhil brought were clearly smaller than the other two. But Tanisha simply could not tell whether the rock Tania had brought was bigger or smaller than the one Rajiv had brought. They had very different shapes, and it was very difficult to compare their sizes.



Tania and Rajiv started fighting, and Tanisha felt harassed. Then Tanisha spotted Tania's Papa sitting on a bench nearby reading a book. She shouted over the din, "Okay, stop! I see Tania's Papa there. We should ask him. He may know how to decide which one is bigger." Every one agreed this was a good idea. They all approached Tania's Papa. Tanisha explained their problem and asked if he could help.

Papa nodded. "Over 2000 years ago the king of Syracuse had a similar problem," he told the kids. "The king had given a goldsmith a block of pure gold to make a crown for him. The goldsmith though talented was also known to be dishonest. He presented the king with a beautifully crafted crown."

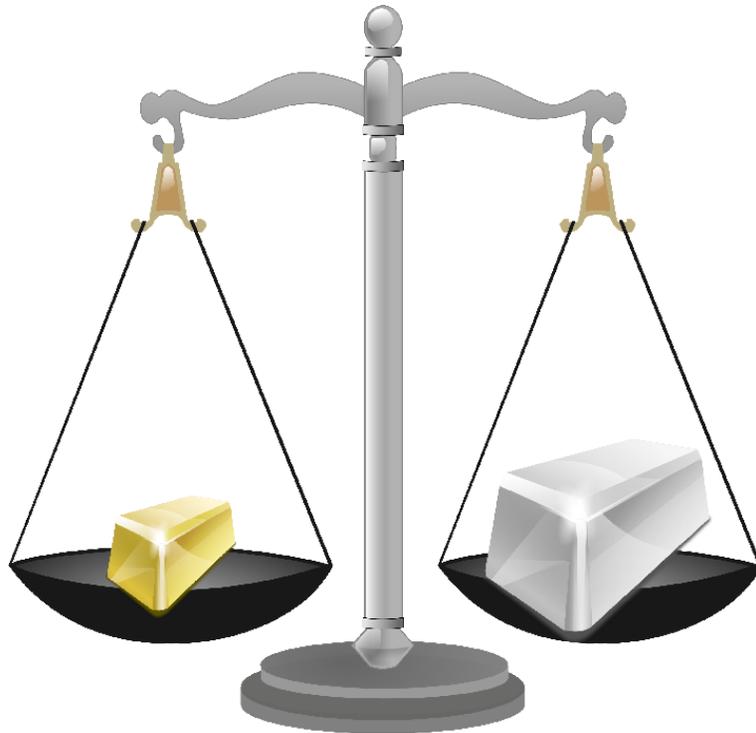
"But what have kings and crowns to do with our stones?" Rajiv asked, bewildered.



"Patience, Rajiv. I promise you this story will help you solve your problem." Tania's papa assured him and then continued with his story. "The king suspected that the goldsmith had substituted some of the pure gold with silver, and kept the gold for himself. Desperate to know the truth, the king approached the scientist Archimedes. Archimedes promised to do his best."



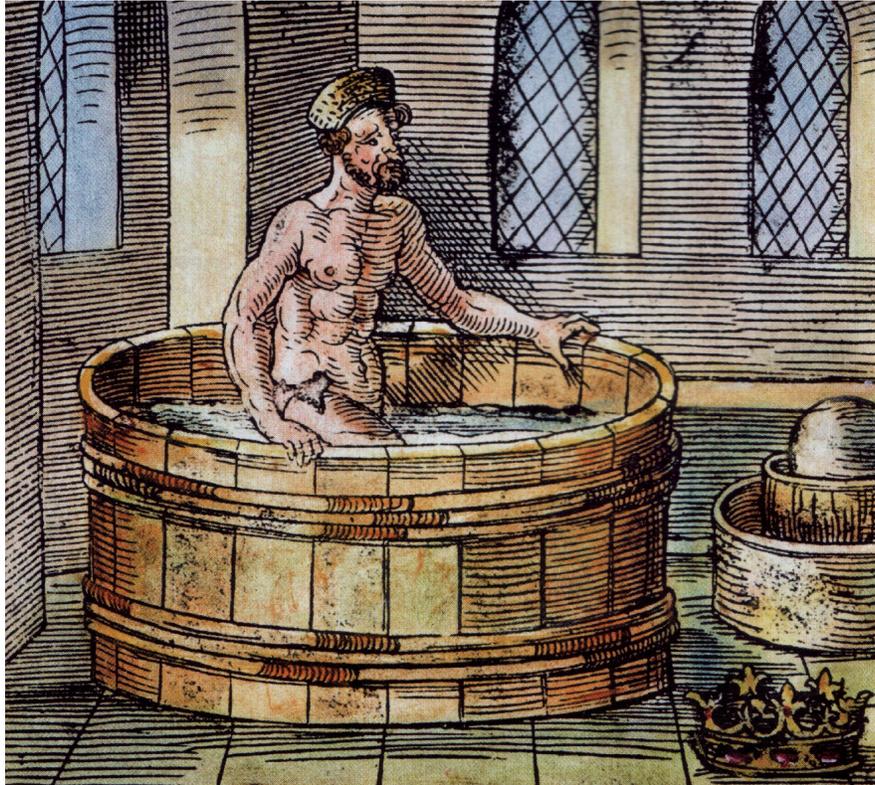
"Archimedes knew that if a gold and silver bar are of the same weight the silver one is bigger, because silver is lighter. So if silver was mixed in while making the crown, then the crown would be bigger than a block of pure gold of the same weight as the crown."



"So the problem was to figure out if the crown was bigger than a block of gold of the same weight or not. It was so hard to tell, because of the funny shape of the crown. So the problem was essentially the same as the one you have."

"So then what did Archimedes do, Papa?" asked Tania. "Did he figure it out?"

"I am coming to that. Archimedes was still thinking about the problem when he went for a bath. The water level in the bath tub rose when Archimedes stepped in. That triggered an idea, and Archimedes got so excited that he ran out of the bathroom, forgetting even his clothes, shouting **eureka! eureka!**"



"What is eureka?" interrupted Sonali.

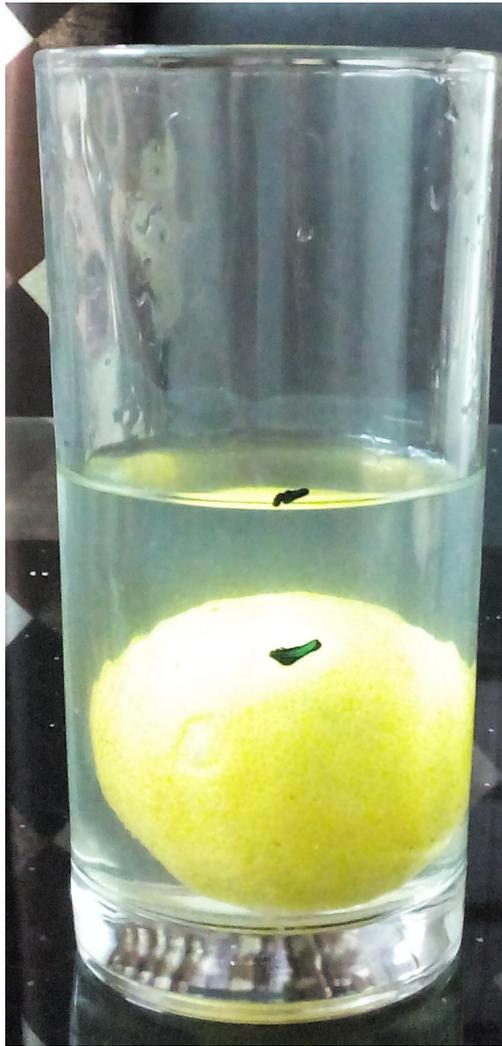
"Eureka is the Greek word for 'I got it!'," Papa explained.

"So he did figure it out then. But how? I don't understand."
Rajiv frowned.

"Okay let me explain with an example. Suppose you have a glass with a little water in it. You mark the water level."



"Now say you put a lemon in that glass. Then what happens?"

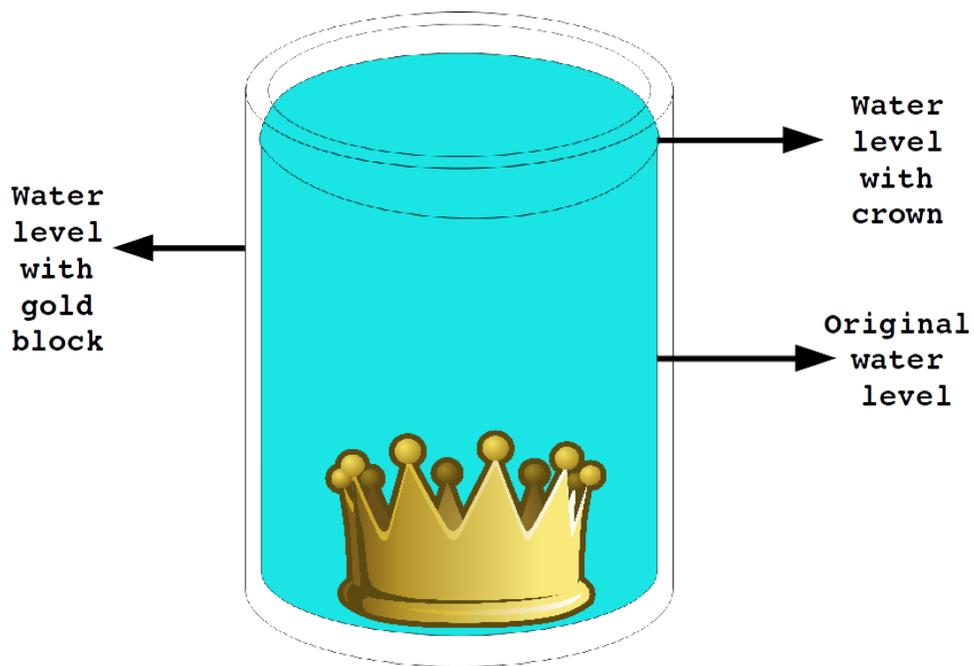


"The water level goes up, just like in the story of the thirsty crow." Tania cried out, her eyes shining.

Papa prompted "The bigger the lemon..."

"The higher the water level rises," finished Nikhil.

"So now you can imagine what Archimedes did. He took a glass container and filled it with some water and marked the water level. Then he put the block of pure gold of the same weight as the crown in the container and marked the new water level. Next, he replaced the block with the crown. The water level rose higher than it had for the gold block. That meant that the crown was bigger than the gold block. So it was not made of pure gold."



Then Papa turned to Tanisha and said, "So now do you know how to solve your problem *Queen of Sheba*?"

"Yes!" exclaimed Tanisha. "Look Rajiv, your brother is washing his new motorbike there. We can ask him to lend us the bucket."



The kids filled the bucket with some water and marked the water level. Then, they put Tania's rock in and marked the new level. Next they replaced Tania's rock with Rajiv's rock. This time the water level rose higher than it did for Tania's rock. That meant Rajiv's rock was bigger, making him the winner.

That evening at dinner, Tania was quiet and thoughtful. "Papa we could not have used that idea to compare the size of two objects if one of them floated, like a piece of wood," she ventured.

"I am really impressed you thought of that." Papa smiled. "It is good to know the limitations of any scientific method. But it is also important to see if you can come up with a simple work-around. Can you think of a way to work around that problem, Tania?"

Tania thought for a moment and said, "You could push the wooden piece in, so it is submerged in the water." She sounded very skeptical that the solution could be that simple.

To her surprise, Papa nodded. "That is correct Tania, but you need to push it just a little below the surface, so your finger does not get submerged too, pushing the water further up."



"The real problem," Papa noted, "would be to compare the size of two objects, if one of them was spongy, like a sponge or a pillow. Then the sponge would soak up the water, and the water level would not rise much. In that case, you would have to look for a different solution."

As Tania pondered over this new conundrum, Papa added, "Tania, I think this was a great way to celebrate *Ganesh Chaturthi*."

"What do you mean?" asked Tania, puzzled.

"Well Ganesh doesn't only eat *modaks* you know. He is also a patron of arts and sciences and the God of intellect and

wisdom," Papa pointed out, grinning.

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"Although he is known by many attributes, Ganesha's elephant head makes him easy to identify. Ganesha is widely revered as the remover of obstacles, the patron of arts and sciences and the deva of intellect and wisdom." This information was obtained from <http://en.wikipedia.org/wiki/Ganesha>