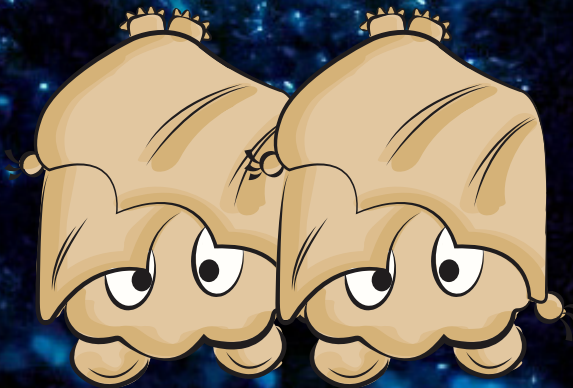


# Shamaa Shines!

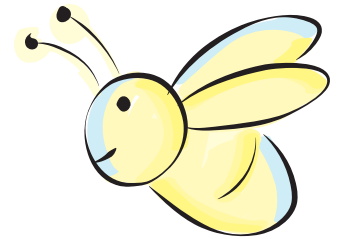
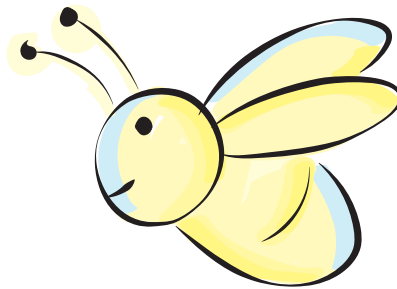
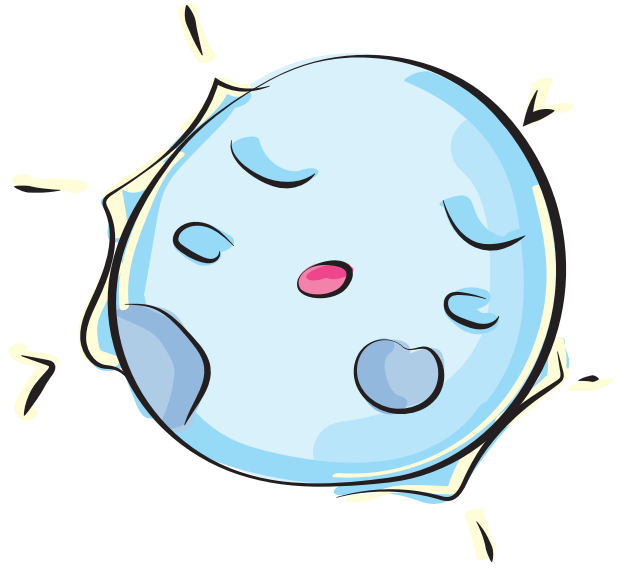
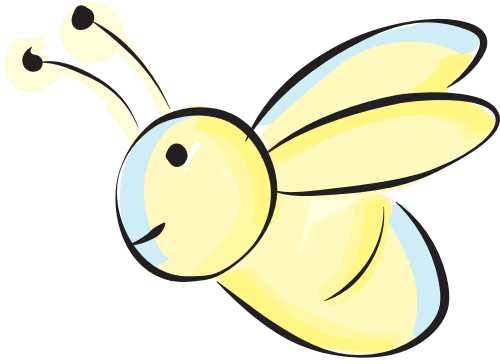


STEM Tot®

Explore light and  
sight with Jugnoo  
and Shamaa!

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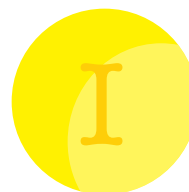
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By: Stephanie Meyen, Aysha Imtiaz, Jake Hunter, and Beth Hunter. Illustrations by Bella Hunter

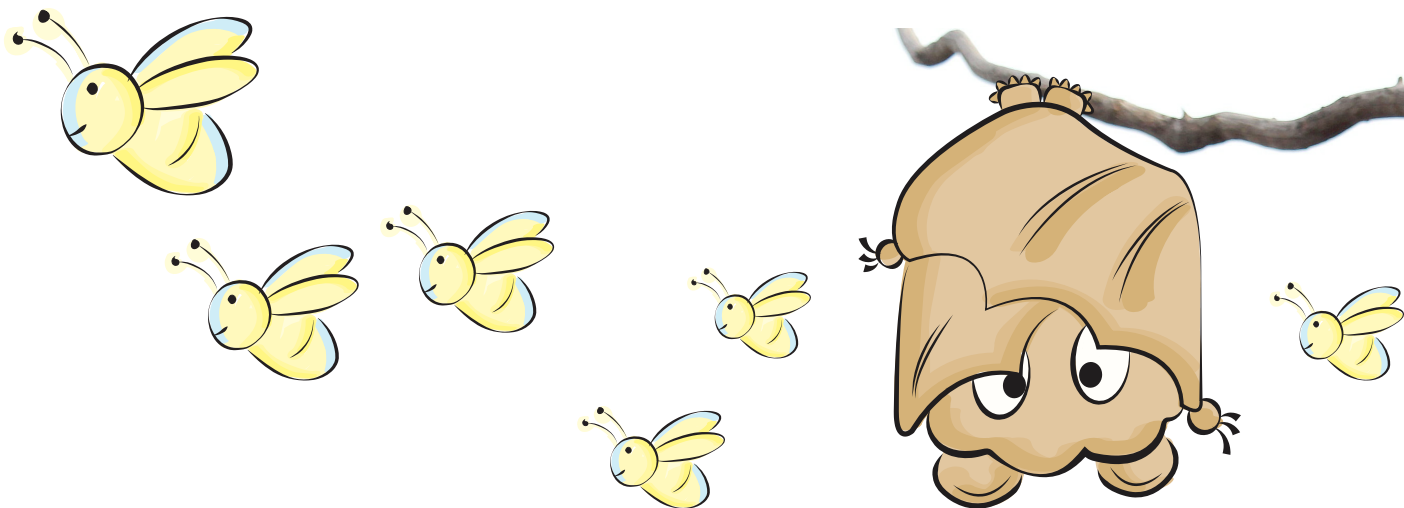
## Light Reveals the World to Us: Shamaa Shines!

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STEM Taught®  
Next Generation  
Science

1-PS4-2 Waves and Their Applications in Technologies for Information Transfer: Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.





*Arachnocampa luminosa* (glowworm larvae)

Credit: Steve Axford

## Meet the glowworms!

These glowworms live in New Zealand. When the glowworm larvae hatch from their tiny eggs, they immediately begin to glow with a soft blue light!

Each larva crawls across the walls of the cave until it selects a site to build a beautiful silk nest. The larva then spins silk threads and covers them with sticky droplets to make a sticky trap. Its blue light attracts insects that the glowworms like to eat!

As they guard their traps, they create an amazing sea of starry lights. Each glowworm will eventually change into an adult—a tiny flying gnat.



*Arachnocampa luminosa* (adult)  
Pronounced: Arak-no-camp-a

## Meet Jugnoo and Shamaa

Aww, so cute! Jugnoo and Shamaa are twin brother and sister bats. They are the stars of the story.



*Do you know why bats are so special?  
They are the only mammals that can  
actually fly and not just glide!*

Bats are most active at night. When they are not flying, they prefer to roost upside down. Most large bats can see as well as humans during day or night. Most small bats have poor vision and rely on echolocation. When using echolocation, bats make sounds and listen for the echo to return to them.





## Make salt dough

Make a batch of salt dough. You will use the dough to model a cave and a baby bat.

### What you'll need to make the dough:

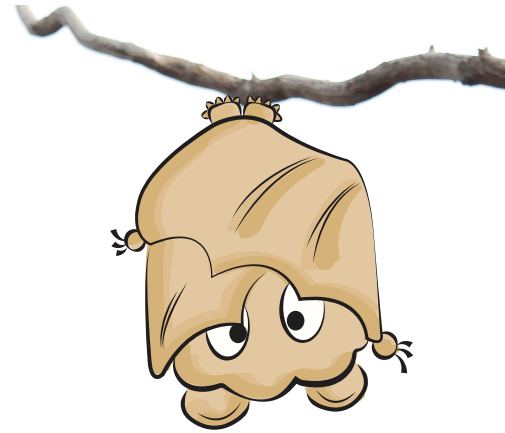
1 cup flour



1 cup salt



1/2 cup warm water



### What you'll do:

1. Mix 1 cup salt and 1/2 cup warm water.
2. Mix in 1 cup flour with a spoon. Squish the mixture with your fingers until it becomes doughy.
3. Sprinkle more flour as you mix to get a doughy consistency.

# Shamaa Shines

## Chapter 1: Let's go exploring!



'Drip, drip, drop.' The cave is dark and cold. Shamaa and Jugnoo are with mama bat.

### Read to me:

Drip, drip, drop. The calm sounds of the dripping water put Jugnoo and Shamaa to sleep. Oh, how they loved to snuggle in their mother's fur. She was as soft as a pillow. They had never actually seen their mother because they lived in complete darkness. To raise her pups in safety, Mother lived a dark cave.

As Momma hung upside down, she thought about her two wonderful babies—beautiful Shamaa and sweet Jugnoo.

Why can't the bat pups see their Mother? How do they sense her?







Oh no! Jugnoo falls into the mud.  
He must learn to fly far.

### Read to me:

Just then she heard, 'Bump. Thump. Owwie!' Jugnoo was sliding in the mud on the cave floor. Mother bat was startled out of her pleasant daydream.

"Jugnoo! What are you doing in that mud! It will get on your wings."

"Momma!" Jugnoo's voice echoed through the cave. "Check this out!"

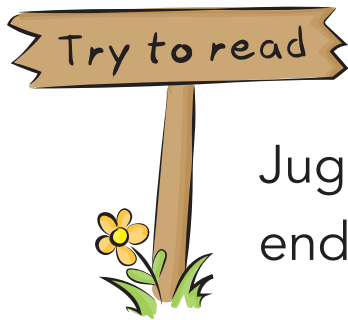
Flapping his strong wings, Jugnoo tried to fly as high as he could but instead tumbled and crashed into the wall of the cave.

Jugnoo's name meant firefly. He was called that because he could never fly in a straight line. Instead, he flew in zigzags just like a firefly.

Why do you think Jugnoo crashed into the wall of the cave?







Jugnoo wants to go to the end of the cave.

### Read to me:

"My poor, sweet Jugnoo," said mother bat. "You must make your clicking noises and learn to listen to your echo if you want to fly in darkness. Your sense of sight will not help you here, for there is no light here to guide your way."

It is time for me to go and look for fruit in the forest." She said, "You must be good little bats while I am away," and off she flew.

Jugnoo was ready for an adventure. "It's so dark and dreary in this cave. Come with me!" Jungoo tugged at Shamaa's fur. "I want to go to the edge of the cave and see what the world looks like."

Which body parts do bats use to sense light? Sound?







Shamaa is scared but Jugnoo wants to go.

### Read to me:

"Oh no! We mustn't do that!" exclaimed Shamaa. "In this lovely, dark cave we are safe. There's no telling what might happen to small pups like us if we leave the cave!"

Jugnoo wasn't listening. He was practicing his 'one footer' so he could hang like the other bats.

Plus, Jugnoo had already learned to do hanging curl-ups without any help. "Four, five and siiiiiix!" Jugnoo shouted excitedly. He had just done six curl-ups for the first time.

Jugnoo continued, "I'm not afraid of anything! I want to be like all the other bats. Let's go exploring!"

What light source do you think the bats will find at the edge of the cave?





Coach  
Roach

## Chapter 2: A glitter in the gloom



Off Jugnoo flew!  
Shamaa comes too.

### Read to me:

With that, Jugnoo grabbed Shamaa by the wing, pulling her off their roost. They fell into complete darkness. Shamaa squeaked loudly but swooped gracefully while Jugnoo flitted around, colliding into another roosting bat.

"Hey!" The bat croaked at poor little Jugnoo. "What's the big idea?" With a little humpff, it wrapped its body tightly in its own wings and turned to go back to sleep.

"You're just a scaredy-bat, Shamaa!" teased Jugnoo.

"Stop it!" squeaked Shamaa, "I'll explore with you, but only because I know you'll never find your way without me."

Why did Shamaa squeak loudly  
when she fell into the darkness?







They see a blue light. What is it?

### Read to me:

They set off together into the darkness. Shamaa's name meant lantern. She was named that because when she flew, she always went exactly where she needed to go, as if a lantern lit her path.

Before long, the pups saw a soft glimmer in the darkness. "Jugnoo! Look at that!" Shamaa exclaimed.

The glimmering lights scared little Jugnoo. Shamaa, however, was fascinated by the soft glow. She landed gently on the wall of the cave where she found tiny glowing creatures—glowworms!

Each glowworm surrounded itself with strands of silk thread. The strands were decorated with plump droplets of sticky liquid that looked like glowing pearl necklaces.

What living things to give off light?





Credit: Tambourine Mountain Glowworm Caves



Look! They are glowworms!

### Read to me:

"Oh my!" exclaimed Shamaa, "You are the most beautiful things I have ever seen!" She reached out to touch one of the glowing strands.

"Ah, ah, ah!" exclaimed a little glowing worm. "That's not for you to touch! I use my sticky droplets to trap moths that fly into the cave. They are attracted to my light and when they come near, they get stuck in my sticky trap."

"And you eat them?" asked Jugnoo, amazed.

"When I feel a strand trembling, I slowly slurp up the strand like a spaghetti noodle until I find my treat, the moth!"

"Eewww!" exclaimed Shamaa, "I only want to eat sweet mango fruits and nectar."

"I would eat a bug!" said Jugnoo with a batty smile. "I would try anything once!"

How do the glowworms use their glowing light? How does their trap work?





## Chapter 3: A light to warm the darkness



The worms shine in the dark. The bats make friends with Tiwi, a worm.

### Read to me:

"We are on our way to the edge of the cave!" Shamaa explained excitedly. "We want to see moonlight and taste sweet mango fruit from the forest. Would you like to come with us?"

"No, certainly not." said the glowworm. "We like our cave."

All the glowworms muttered in agreement— except for one little worm named Tiwi.

"Did you say that a mango fruit is sweet?" Tiwi squeaked. "I'm so tired of eating bugs, I want to try something new. I'll spin you a beautiful necklace to light the way for you!"

Shamaa held out her wing. Tiwi crawled onto her soft, warm fur and began to spin a silk strand.

How well do you think you could  
see in the glowworm cave?







"Can I come too?" asks Tiwi.

Shamaa picks up Tiwi and off they go!

### Read to me:

Tiwi quickly made a sticky silk necklace, perched himself on it and glowed proudly.

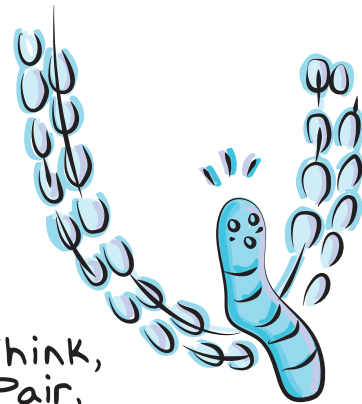
Shamaa loved her beautiful little glowing worm. The worm's light surrounded her with its soft blue glow. What a beautiful sight it was! It was a light to warm the darkness.

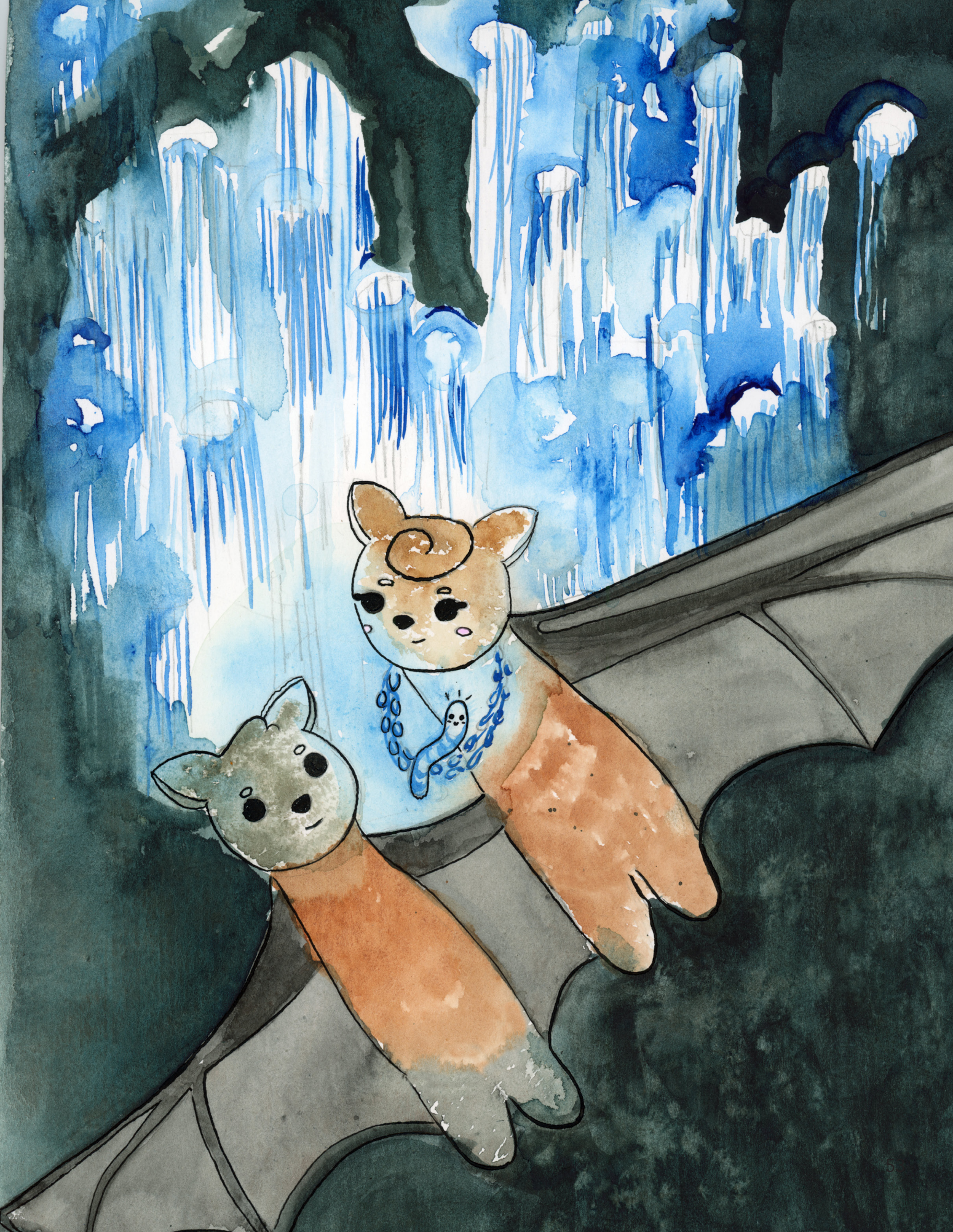
Shamaa felt exquisite and Jugnoo marveled at how the light made Shamaa's fur look. Following Shamaa's light, he was able to fly as straight and as gracefully as she did. Together, they flapped through the darkness toward the edge of the cave.

How does Tiwi's light help Jugnoo?



Think,  
Pair,  
Share!





## Chapter 4: The gleaming light of day



They fly out of the cave. "There is so much to see in the light!" they say.

### Read to me:

Before long, Jugnoo spotted the edge of the darkness. Great shafts of sunlight poured into the cave, lighting its walls.

"This is amazing!" Jugnoo cried. "I can see where I am flying!" He twisted and flew in loops.

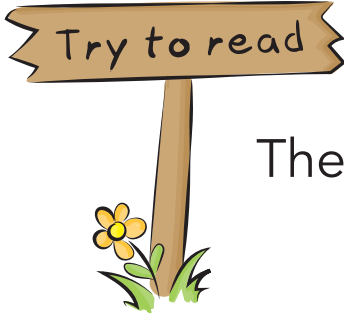
At the edge of the cave, they blinked as their eyes adjusted to the light.

They looked at each other for the first time in the light of day. Shamaa smoothed her fur and wondered if she looked as funny as her brother did. His ears were gigantic and his black, hairless wings looked strange. Jugnoo thought Shamaa was just as beautiful as Momma had described.

What did the sunlight show the bats?







They find a big mango in a tree.

### Read to me:

They looked out into the forest. "I can see everything!" Jugnoo shouted.

Every green leaf wiggled in the wind on its branch. Then, Jugnoo saw a plump, bright orange fruit among the leaves. Its branch sagged under its weight.

Jugnoo and Shamaa flew to the mango and began to feast. Jugnoo licked his wet, pink tongue over his lips. "Join us Tiwi! Mmmm! Here's all the food you could ever want!"

Jugnoo, Shamaa, and the glowworm ate until they couldn't swallow another bite. Seeing the magnificent orange color of the mango fruit made eating it so much more exciting than nibbling on snacks in the darkness.

How did light help Jugnoo sense the mango from far away?







Yum! They eat and eat.  
What a treat!

### Read to me:

When his tummy was full, Jugnoo fluttered away to explore.

"Jugnoo, come back! What kind of brother are you? We're supposed to stay together!" Shamaa complained.

"Then come with me, sister!" Jugnoo shouted back.

"I'm going to stay here by this mango where it's safe!" Shamaa grunted, and then wrapped herself in her wings.

Jugnoo arrived at the top of the tree and peered all around at the magnificent forest. He marveled at the sight. Then he saw a large creature with great talons and a sharp, hooked beak flying toward Shamaa!

How did the falcon find Shamaa  
from far away?







Oh no! A big bird can see them!  
They fly away fast!

### Read to me:

Jugnoo's heart pounded and he raced the falcon. "I have to reach her first!" thought scared little Jugnoo.

With Shamaa in its sight, the falcon tucked its wings to dive and grab his tasty treat.

Just in time, little Jugnoo collided with Shamaa and knocked her off the branch. 'Sloosh!' The falcon's claws pierced deep into the mango's flesh while the two bats fell down into the leaves.

When the falcon was gone, they dashed into the safety of the cave. The little bats fell asleep as they clung upside down to the rocks, protected by the cave's darkness.

Why did the cave protect the bats?





## Chapter 5: The soft, silvery light of the Moon

Try to read



Back at the cave they can be safe.  
When the moon is up they fly out.

### Read to me:

A few hours later, Jugnoo woke up. He stretched out his wings and yawned. His tummy was grumbling again and the memory of the gigantic mango made him smile. He opened his eyes.

The soft, silvery light of the Moon showed through the cave's entrance. The pale moonbeams seemed so cool and inviting.

He tapped Shamaa to wake her up too. Shamaa opened her eyes and gasped in wonder at the beautiful light of the moon. Wide-eyed, they spread their wings and flew out of the cave into the moon-lit forest.

How does the brightness of the moonlight  
compare to the brightness of sunlight?



Think,  
Pair,  
Share!





## Chapter 6:

# The dancing light of the fireflies



Try to read



Jungoo sees glowing lights. What can it be? Look! They are fireflies!

### Read to me:

Suddenly, Jugnoo noticed a faint light below him. Then, he noticed another. And another. The little glowing circles pranced around and glimmered in the darkness. This was the most dazzling display of lights that he had ever seen!

Tiwi was entranced. "These must be fireflies!" he exclaimed, "My grandmother told me stories about them." The sparkling fireflies floated and danced to the song of the breeze.

Have you seen fireflies? Can you describe how they look?



Think,  
Pair,  
Share!



Try to read



The fireflies come closer.  
They like Tiwi's blue glow.

### Read to me:

Shamaa felt completely at home in this magical, faraway land. She wished she could stay here forever. She wished she could be one of the fireflies. Holding her breath, Shamaa made her way carefully towards them.

Maybe they could be best friends! If only the fireflies could come live with her in her cave!

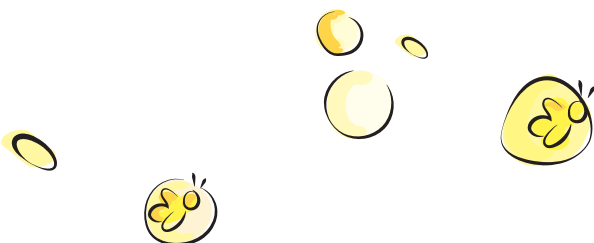
One firefly came so close to her they touched noses. She got up and moved. The fireflies moved with her.

"It's your necklace!" exclaimed Jugnoo. "They're attracted to Tiwi's light!"

Can you describe the light of the fireflies?



Think,  
Pair,  
Share!





Try to read



The fireflies go with Tiwi and the bats. They follow Tiwi's light.

### Read to me:

It was true! The fireflies were ready to follow Shamaa wherever she went. The warm golden glow of the fireflies mixed with Tiwi's cool blue light. Shamaa had become a spectacular lantern after all!

One by one, the fireflies sat atop Shamaa, who was trying to stay very, very still. As each firefly nestled into her fur, she glowed a little brighter in the darkness.

Then Shamaa had an idea! She would guide the fireflies into her cave.

"Glow Tiwi, glow!" Shamaa said. Tiwi tried to shine as brightly as he could for Shamaa.







## Chapter 7: Our beautiful home



Now, the cave is full of light. The bats see how pretty the cave can be!

### Read to me:

Shamaa, Jugnoo and Tiwi led the fireflies into the cave. Their parade of lights looked spectacular in the gloomy darkness. Thousands of fireflies swirled around them, casting their golden light on the roosting bats.

Glimmering lights and shadows danced through the darkness, revealing the features of the cave. Shamaa thought it was the most magnificent place she had ever seen! A wonderland of sparkling stalactites hung from the ceiling. Strong stalagmites cast shadows on the floor of the cave.

What do Shamaa and Jugnoo see by firefly light in their cave?



Think,  
Pair,  
Share!



Try to read



“Meet our new friends, Mama!” said Shamaa and Jugnoo. “See how they glow!”

### Read to me:

Even Momma caught her breath when she saw the intricate cave formations pushing their way out from the walls. The way that they grew sideways and upwards seemed to defy gravity. It was the fanciest thing she had ever seen!

The fireflies gleamed and sparkled as they moved through the delicate formations. The cave seemed like a palace full of jewels! Shamaa and Jugnoo never thought that their own home could be so beautiful or magnificent. All they had needed was a little light to see it all.

Jugnoo had a full tummy and was proud that he had helped his sister. Shamaa and her fireflies beamed with happiness. Momma beamed brightest of all because her babies had discovered so many lights.

How did the dark, cold cave look in the light?





## Bring more light into your bat's cave

Bring more light into your viewing box so you can see your bat's beautiful home better.

### What you'll need:

- your viewing box
- Tedros test tube
- water



### What you'll do:

1. Fill Tedros test tube with water and put on the cap.
2. Place the test tube half way through the top hole of your box.



3. Look through your viewing hole. Observe your cave decorations and your bat.





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