



## *Science Your Way* Texts



**Emily Starr**  
**President/CEO**

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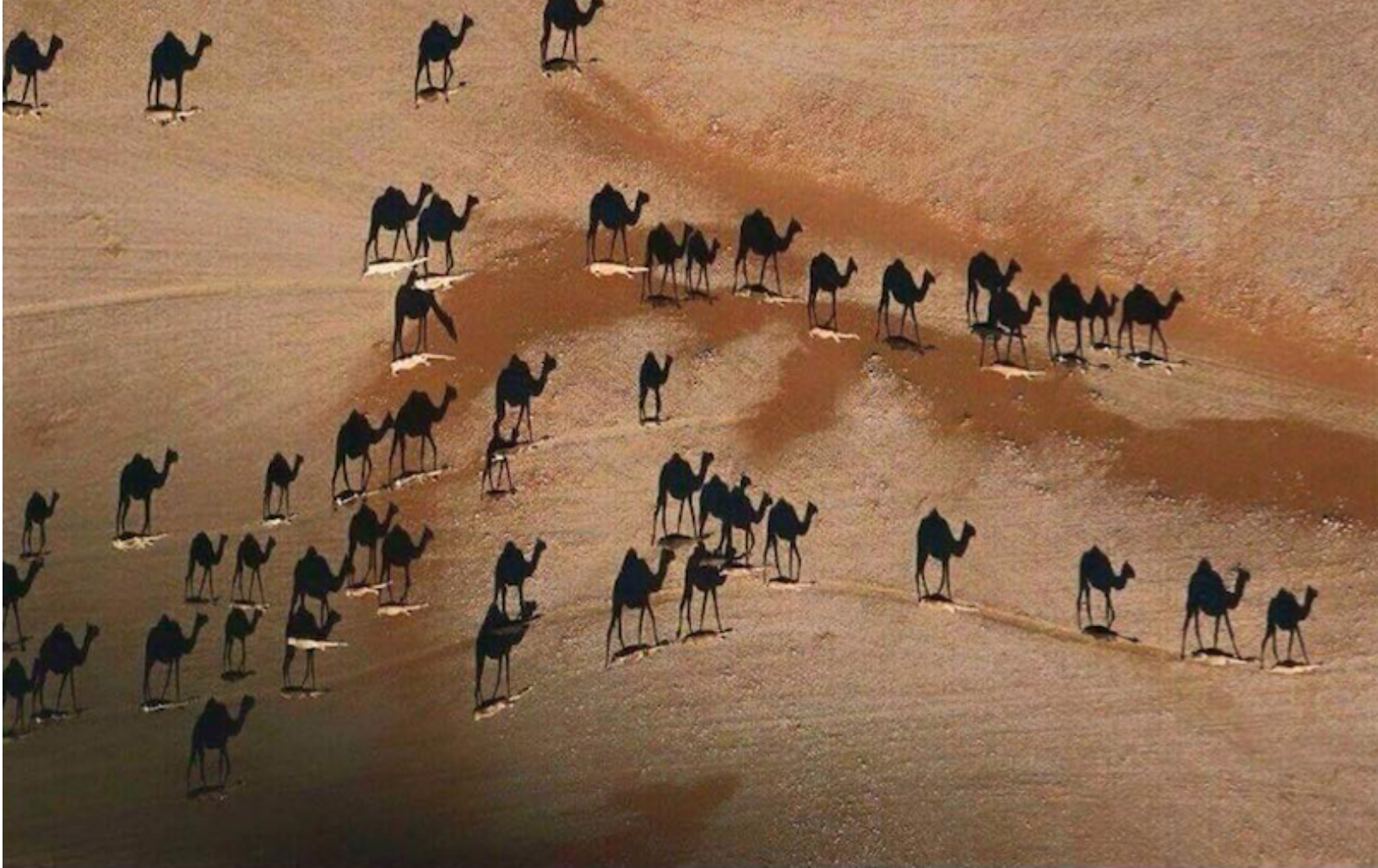
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WHAT DO YOU SEE IN THIS PHOTO?

# KEEPING TRACK OF YOUR SHADOW

By Michelle Negron Bueno

Do you see a caravan of black camels crossing the desert in this photo? At first glance it might seem so. But take a closer look and you discover that what you are seeing are the camels' shadows. Since the photographer took the photo from above, you can only see the small, white tops of the camels!

What do you think causes the camels' shadows to loom so long? Have you ever observed other shadows during the course of your day and wondered what makes them change? If you have ever played outside and noticed your own shadow, I bet you observed that sometimes your shadow is excessively tall, and at other times your shadow is scarcely there at all. Why do you think this phenomenon occurs?

## *What is a Shadow*

In order to answer these questions, it is critical to examine what exactly is a shadow. A shadow is created by two elements: light and something that obstructs the light.

When light collides with something solid and cannot penetrate it, a shadow is produced in a shape congruent to the object, and when an object, such as our self, blocks the light of the sun, a shadow is generated.

### Shadow Changes

The changes in the length of our shadows have to do with the position of the sun. Assuming you are standing still outside all day long, the sun would appear to rise and set. When the sun's light is blocked while it is low on the horizon, either in the morning or the evening, your shadow will be longer. As the sun approaches midday, shadows become shorter and shorter until the sun is overhead.



*This diagram shows how the Earth blocks the sun's light. Because the Earth rotates every 24 hours, you see both night and day.*

relatively short or may scarcely be here at all. If you are outside at sunset, your shadow is elongated again, stretched out in the opposite direction than in the morning. This is because the sun's light is hitting you from the opposite side of the sky.

Have you ever observed anything else about shadows? If you have been at a park or at the beach on a very hot day, have you noticed where people gather to have lunch or place their towels or chairs on the sand? Most people sit near trees or under umbrellas because they are looking for shade. Shadows can keep us cool. The sun's energy not only produces illumination, but it also generates heat, and when an object, like an umbrella, is blocking the light, it is also blocking some of the heat.

As you may have noticed, shadows don't look exactly the same every time we go out to play. They change in size throughout the day. If we have recess at lunch time, our shadows may look pretty small or may barely be there at all. When we play right before sunset, our shadows are so tall that we look stretched out like a giant rubber band.

Depending on the time of day, shadows change in size and direction. As you make your way to school in the morning, you might observe that the sun's rays hit on one side of you, generating an elongated shadow on the other side of you. If you venture outside during lunch, when the sun is overhead, it shines down on your head. Your shadow may look

### Did You Know?



#### **Shadows exist in space, too!**

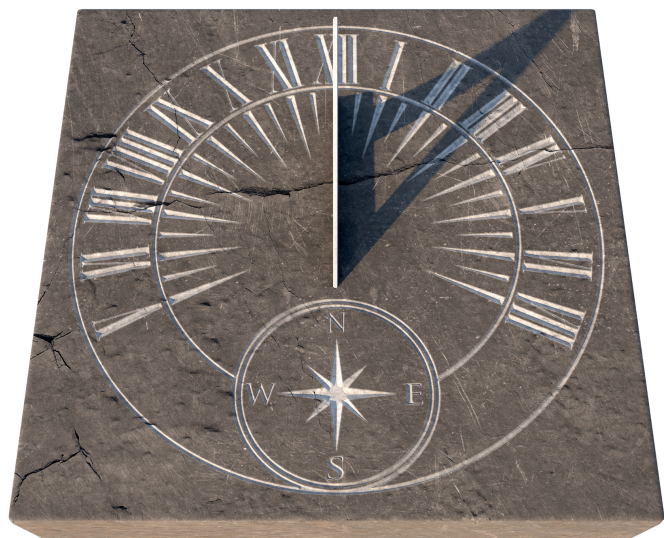
Scientists from NASA were concerned a spacecraft called MESSENGER would get overheated by the sun while in space. Before launch, they used a large piece of fabric to create a sunshade. **The shadow from the sunshade kept cool the side of the craft that faced the sun.**



## *The Biggest Shadow of All*

Just like in the park or on the beach, large objects like trees and umbrellas create large, corresponding shadows. Can you think of another object that makes one of the biggest shadows of all? A hint is that you see its shadow every night. If you guessed the Earth, you are right!

When the Earth blocks the sun's light from reaching the side of Earth facing away from the sun, a very large shadow is created, which we call night. I bet you can guess why it's cooler at night than in the day. As the Earth blocks the sun's light, the heat from the sun is also blocked, which is why the day grows warmer and warmer as the sun rises and becomes cooler and cooler after sunset.



*Sundials are the first instruments humans used to tell time.*

## *Day and Night*

Have you wondered how day and night actually happen? While we might perceive that the sun is moving over us, in fact, it is the Earth that is moving while the sun is still. When the Earth rotates on its axis, the sun appears to “move” across the sky, rising in the East and setting in the West, and causes objects to cast shadows. The Earth rotates completely every 24 hours or once every day. People on Earth see both day and night during that time.

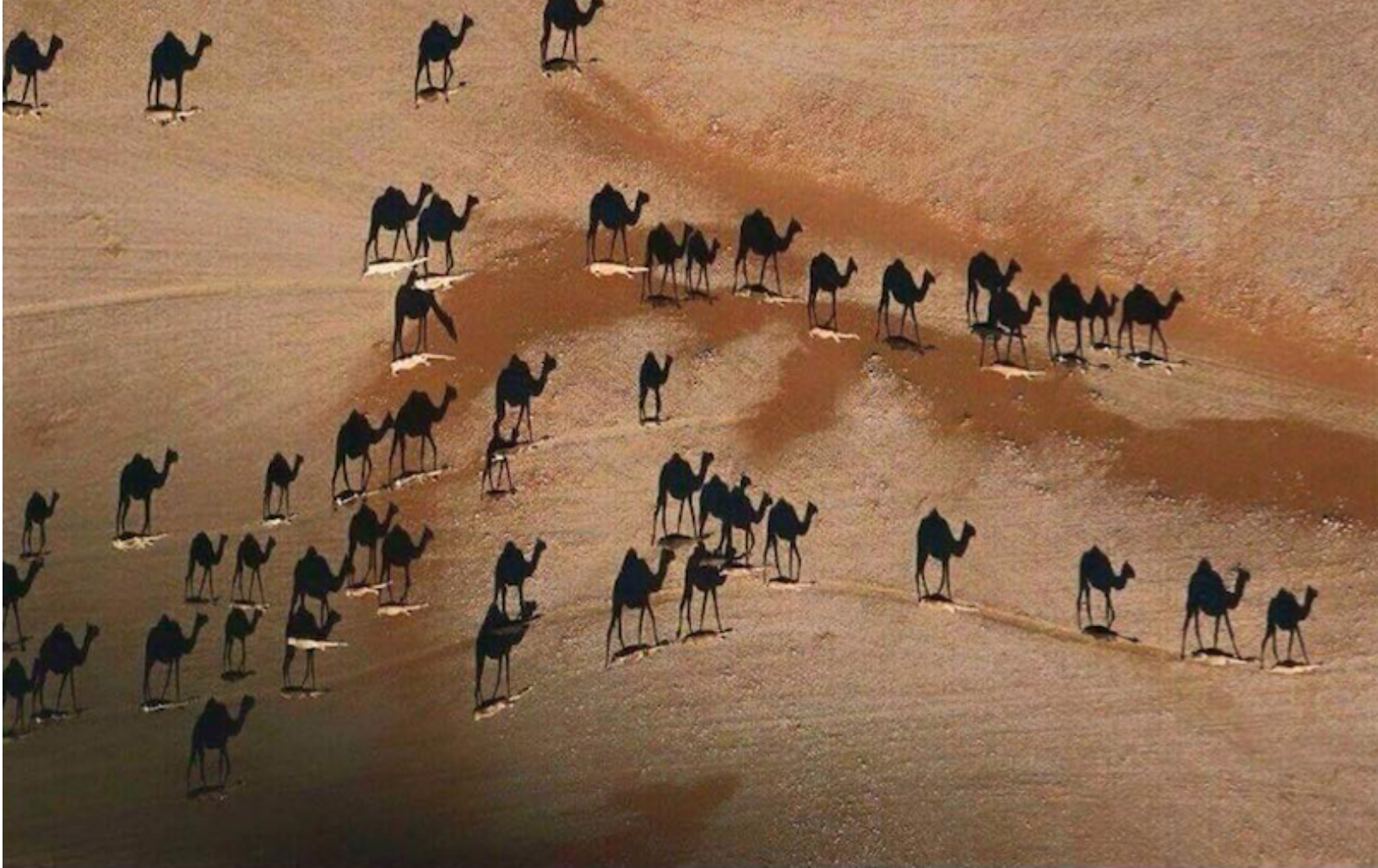
## *Telling Time*

The movement of the Earth is so predictable that for centuries people have used it to tell the time. In order to track time more accurately, they

invented what is called a sundial, one of the oldest instruments created to tell time. Take a look at the sundial photo and guess what you think it uses to indicate the time of day? It's something you're an expert on now. Shadows!

A sundial is made of a flat platform called a plate with etchings for each hour of daylight and a piece that stands up like a thin rod and points north called a **gnomon**. As the sun's position changes, the gnomon blocks the light and casts a shadow on the sundial's face. The shadow points to a specific place on the plate, corresponding to the time.

Now if you look back at the photo of the camels, what time of day do you think it is? As the sun descends toward the western horizon, do you think the camels have just woken up and started their journey or are they close to the end of their day? If you guessed evening and they are about to get some sleep, you're an expert! The picture was taken at sunset!



WHAT DO YOU SEE IN THIS PHOTO?

# KEEPING TRACK OF YOUR SHADOW

By Michelle Negron Bueno

What do you see in this photo? Most people see large, black camels crossing the desert. But if you look closer, you discover that what you are seeing are the camels' shadows. The actual camels are small and white, located at the shadows' feet. This photo was taken directly from above. You can only see the tops of the camels!

Why do you think the camels' shadows are so large? Have you ever seen other really long shadows? Have you ever been playing outside in the evening and noticed that your shadow is really tall like a giant? Have you ever noticed that at other times of the day your shadow is closer to your size or hardly there at all? Why is that?

*What is a Shadow?*

To answer these questions, let's find out what exactly is a shadow. A shadow is created by two things. The first is light.



The second is something that blocks the light. When light hits something solid and cannot go through it, a shadow is produced in a shape similar to the object. Outside, shadows are created when an object, such as our self, our bike, or a basketball hoop, is blocking the light of the sun.

### Shadow Changes

Shadows don't look exactly the same every time we go out to play. They change in size throughout the day. At lunch time, our shadows may look pretty small or may barely be there at all. Right before sunset, our shadows are so tall that we look stretched out like a giant rubber band.



*This diagram shows how the Earth blocks the sun's light. Because the Earth rotates every 24 hours, you see both night and day.*

Our changing shadows have to do with the position of the sun. If you stand still outside all day long, the sun would seem to rise and set. When the sun is near the horizon in the morning, our shadows are long. This is also the same in the evening. As the sun moves up in the sky, shadows become shorter and shorter until the sun is overhead.

Shadows also change in direction throughout the day. When the sun is behind you, where is your shadow? You guessed it! It is in front of you. When you are facing the sun, your shadow trails behind you. If the sun is to your left, then shadows form on your right. If the sun is on your right, shadows appear on your left.

What else do you notice about shadows? Have you ever been at a park or at the beach on a very hot day? Where do people sit to have lunch or place their towels or chairs on the sand? Most people sit near trees or under umbrellas because they are looking for shade. Shadows can keep us cool on a hot day. The sun's energy not only produces light but also heat. When an object, like an umbrella, is blocking the light, it is also blocking some of the heat.



#### **Shadows exist in space, too!**

Scientists from NASA were concerned a spacecraft called MESSENGER would get overheated by the sun while in space. Before launch, they used a large piece of fabric to create a sunshade. **The shadow from the sunshade kept cool the side of the craft that**

### *The Biggest Shadow of All*

Just like in the park or on the beach, large objects like trees and umbrellas make large shadows. Can you think of another object that makes one of the biggest shadows of all? A hint is that you see its shadow every night. If you guessed the Earth, you are right!

Nighttime is created by a very large shadow. Earth blocks the sun's light from reaching the side of Earth facing away from the sun. I bet you can guess why it's cooler at night than in the day. Without the sunlight, there is no heat from its rays. That is why the day gets warmer and warmer as the sun rises. It grows cooler after sunset.

### *Day and Night*

How does this happen? Is the sun moving over you? It sure seems that way, doesn't it? But it is the Earth that is moving. The Earth turns completely once every 24 hours. People on Earth see both day and night. During that time, the sun appears to rise in the East and set in the West.

### *Telling Time*

The movement of the Earth is so predictable that people have long used it to tell the time. If you walk outside and see the sun just above the eastern horizon, what time of day do you think it is? Morning! If the sun is high in the sky, what meal do you think you might eat? Probably your lunch, because it is around midday. It is pretty easy to know what time of day it is in a general way.



*Sundials are the first instruments humans used to tell time.*

A long time ago people wanted a better way to track the time. They invented what is called a sundial. A sundial is round and flat like a clock. But it doesn't have moving parts. It has numbered lines for each hour of daylight. What do you think it uses to track the time of day? It's something you're an expert in now. Shadows!

A piece that stands up on the face of the sundial points north. It is called a **gnomon**. As the sun's position changes, the gnomon blocks the light. The shadow that it makes points to the time.

Now look back at the photo of the camels crossing the desert. The camels are walking as the sun is low on the western horizon. Do you think the camels have just woken up and started their journey or are they close to the end of their day? If you guessed that they are about to have dinner and get some sleep, you're an expert time keeper! The picture was taken at sunset!



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