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NATIONAL GEOGRAPHIC

Explorer

TRAILBLAZER

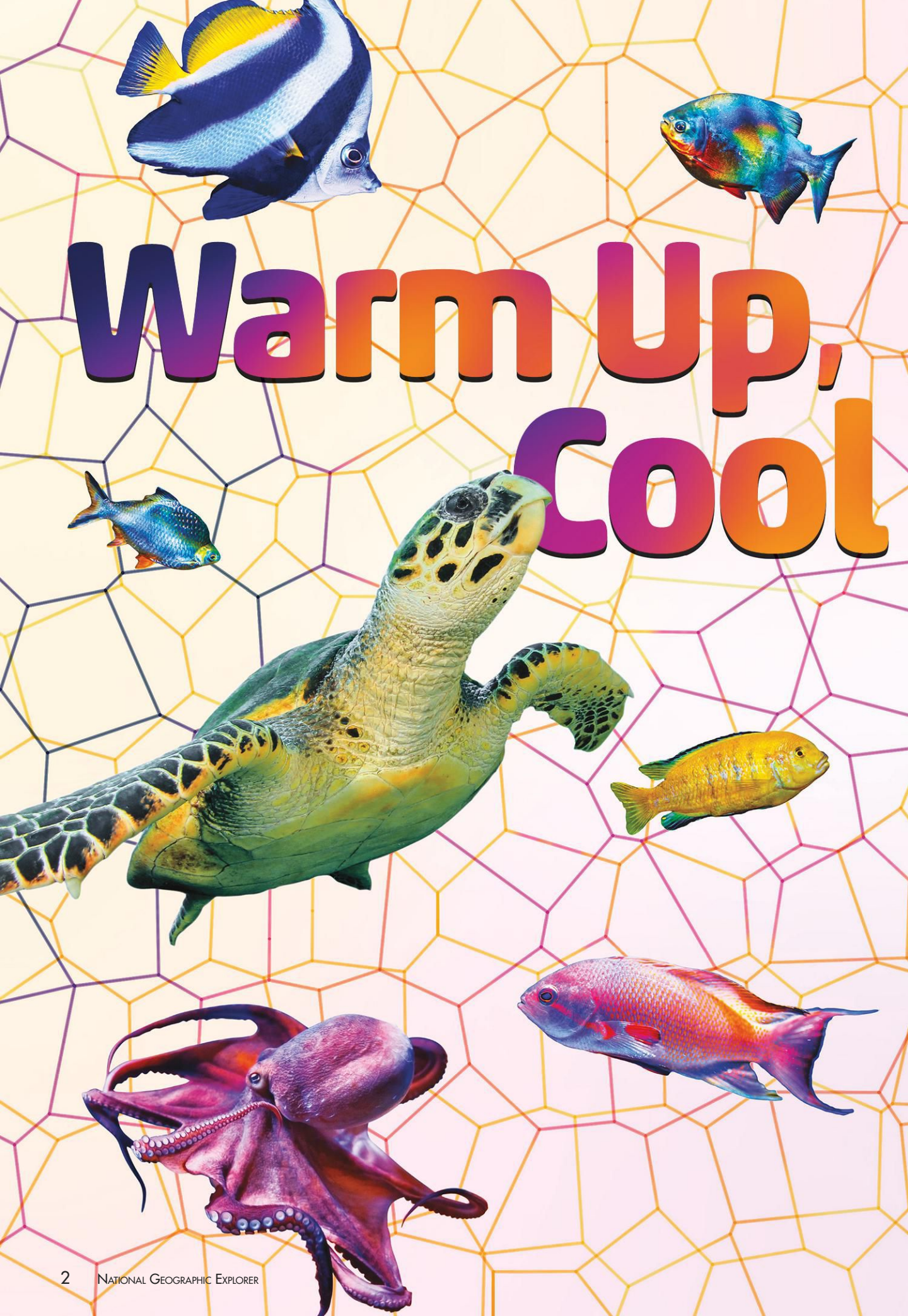
TEACHERS' CHOICE AWARD TCA FOR THE CLASSROOM 2019 LEARNING MAGAZINE



Rhino Rescue 10

Hot and Cold 2

Ocean Plastics 18



Warm Up, Cool

As you read, think about the similarities and differences between ectotherms and endotherms.





Down



By Glen Phelan

Check out these colorful critters.
What do these animals have in common?
They are all **ectotherms.**
What's that?



Soaking Up the Sun

Imagine taking a nature hike along a creek. It's a sunny spring morning. The sun feels warm, but the air is chilly.

A large gray rock sticks out of a muddy bank. A flash of color catches your eye. You step closer and see a lizard lying on the rock. Its skin shimmers in the sun. It is as still as a statue. Is it sleeping? No! The little lizard is sunbathing.

Lizards, snakes, and other reptiles are ectotherms. Fish, insects, worms, and frogs are ectotherms, too. Ectotherms produce very little heat inside their body. To warm up, they get heat from their environment.

That's why the lizard is sunbathing. Sunlight strikes its body, warming it. The rock absorbs heat, too. This warms the lizard's underside.

At night, the lizard's body becomes as cool as the air around it. The low body temperature makes its muscles slow down. It will need the morning sun to warm up again.



The desert lizard basks in the sun to warm itself up.

Heat From the Inside

As you hike, you hear a sound: *Clickety, clickety, clickety.* It's the sound of tiny claws on tree bark. Two squirrels chase each other around a tree trunk.

Unlike the lizard, these furry rodents don't need sunlight for energy. That's because squirrels and other mammals are **endotherms.** An endotherm is an animal that produces enough heat to keep its insides warm.



Squirrels don't have to wait for the sun. They can be active the moment they wake up. So can birds. They are endotherms, too. And so can you.

That's right! *You* are an endotherm. It doesn't matter if it's hot or cold outside. The inside of your body stays at the same warm temperature.



What's In a Name?

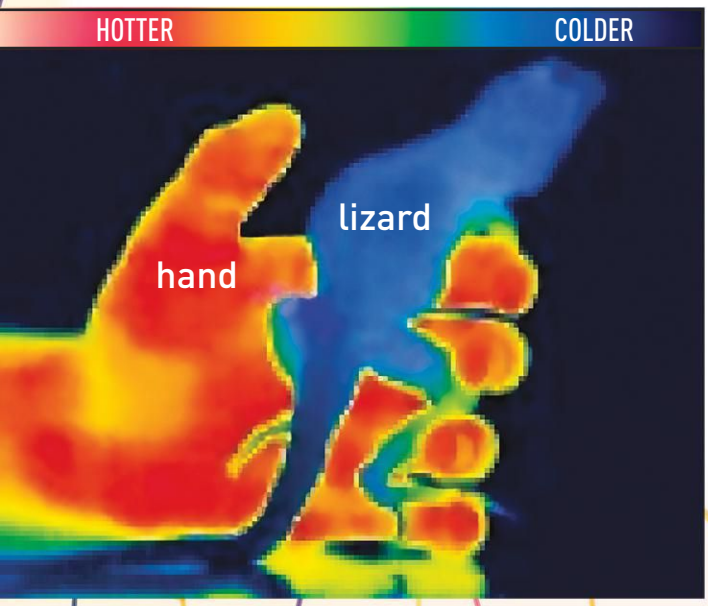
Ectotherm and *endotherm* may sound like strange words. Yet, they make sense when you break them down.

Ectotherm comes from the Greek words *ektos*, meaning "outside," and *thermos*, meaning *"warm."* An ectotherm gets warmth from outside its body.

Endotherm comes from the Greek word *endo*, meaning "within." An endotherm gets warmth from inside its body.

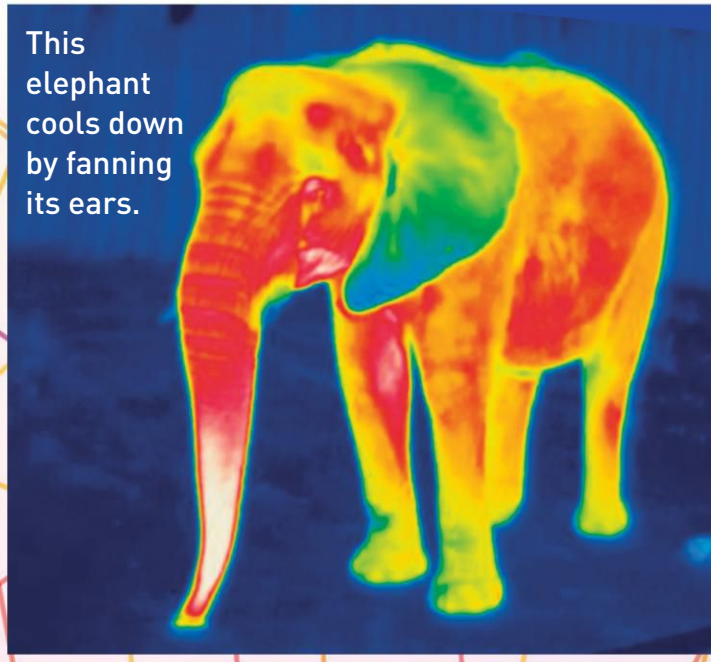
See the Difference

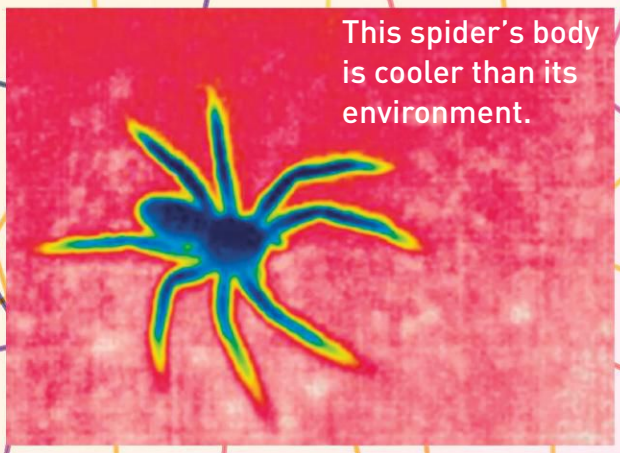
Have you ever held a lizard? Its body temperature is likely lower than yours. You probably wouldn't feel a difference. But you can see it in these images taken with a special camera. They show how much heat an object gives off.



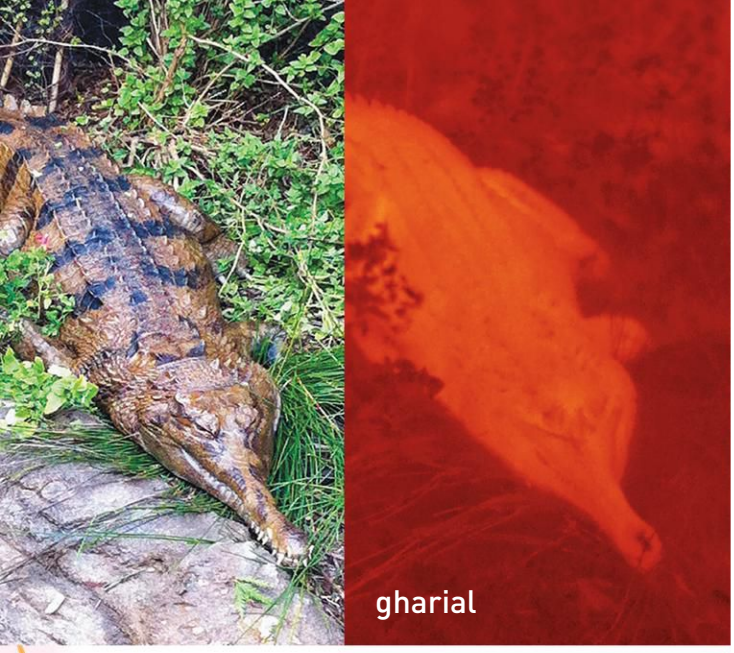
Look at the image of a hand holding a lizard. The bright red of the hand shows a warm body temperature. This is true even though the air around it is cooler. The lizard shows up mostly as blue. Before being held, it was dark blue, like the background. Its body temperature was the same as the air around it.

But what happens as the lizard and the person touch? The lizard gets heat from the person's hand. Its body is warming. Its feet and legs show up as green and yellow.

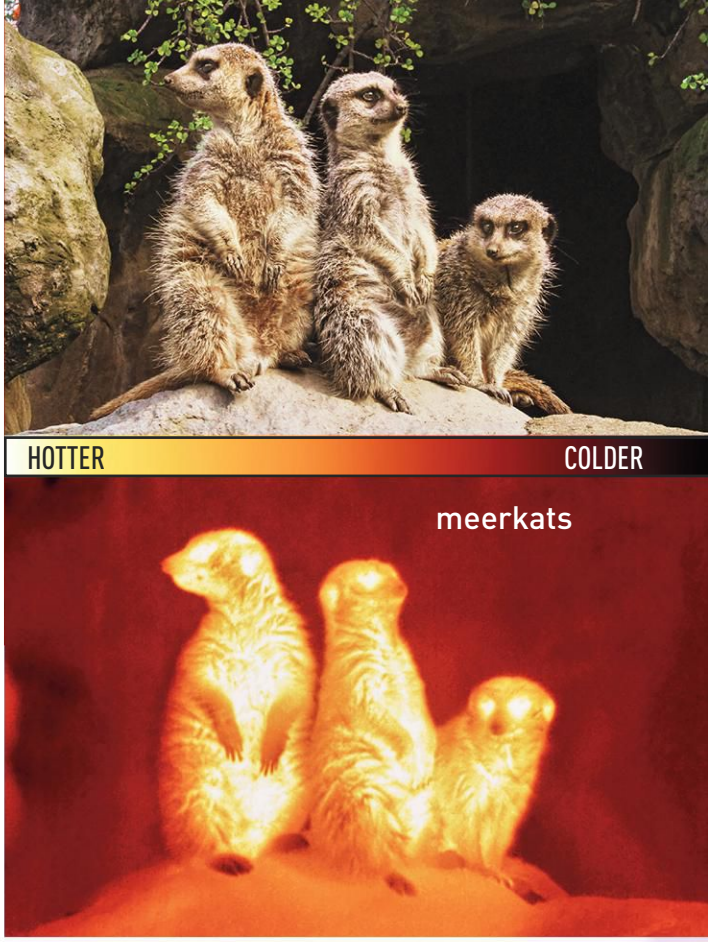

This elephant cools down by fanning its ears.


This spider's body is cooler than its environment.





This gharial soaks up the sun's rays. Then its temperature begins to rise.



These meerkats don't need to wait for the sun. They control their own body heat.

A Living Furnace

Why can some animals keep the same body temperature while others cannot? The answer is **metabolism.**

Metabolism is all of the chemical reactions that take place in the body. Tiny **molecules** combine and break apart in body cells. They form new substances. Most of this happens as food breaks down.

Food provides the materials to grow. It also repairs damaged cells. If you cut your finger, new cells grow and heal it. The new cells come from food. Food also provides energy. And energy produces heat. In this way, an animal's body is like a furnace.

The faster an animal's metabolism, the more energy the animal has for keeping warm. An endotherm's metabolism is fast. For birds and mammals, it is fast enough to produce constant warmth. This allows the animal to keep its body temperature high. Birds have the fastest metabolism and a body temperature of 40°C to 42°C (104°F to 108°F). Can you think of a reason why birds need a fast metabolism? Think about how birds move. The high rate of metabolism makes the energy birds need to fly.

How to Beat the Heat

Endotherms and ectotherms have various ways to keep from getting too hot. One way is sweating. Endotherms sweat to keep their bodies from overheating. When you sweat, heat moves outside your body as water. As the water evaporates, you cool down.

Most endotherms don't have sweat glands. Yet, they have other ways to cool down. Dogs pant. With each breath, moisture evaporates from their tongues.

Many animals use their ears to beat the heat. An elephant's large ears have many veins. Heat from the warm blood moves through the thin skin into the air. Cooled blood then circulates through the body.

Kangaroos lick their forearms to cool down. It's a little gross, but it works for kangaroos. Ectotherms can overheat, too. Some lizards burrow into the ground to keep cool.



This fennec fox uses its big ears to cool down.

How to Turn Up the Heat

Ectotherms such as reptiles sometimes burrow into the ground for another reason. When the weather turns cold, they **hibernate.**

Endotherms like birds and mammals turn up the heat by shivering. The brain signals muscles to vibrate. This produces heat to warm the body. Some ectotherms, like bees, shiver, too.

Many endotherms have hair, fur, or feathers that keep the cold air out and the body heat in. Marine mammals grow thick layers of fat called blubber.



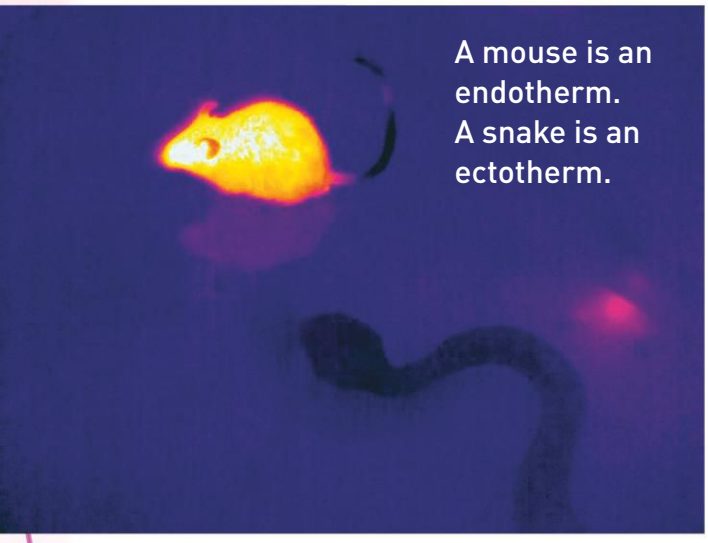
This iguana burrows into the soil to cool down.



This kangaroo licks its arm to keep cool.







A mouse is an endotherm. A snake is an ectotherm.

Endotherm vs. Ectotherm

So, which animals have the advantage to survive? If a snake was trying to catch a mouse on a cool day, the mouse probably has the advantage.

However, the snake needs a lot less food than the mouse does to survive.

Endotherms can live almost any place on Earth. Most ectotherms can only survive in warm and mild climates. It's hard to say which has the upper hand. Looks like both have ways to survive in their environment.

This walrus's layers of blubber help protect it from the cold.



Wordwise

ectotherm: an animal that cannot produce enough heat inside its body to maintain a steady, warm temperature

endotherm: an animal that produces enough heat inside its body to maintain a steady, warm temperature

hibernate: to be in a long sleep during cold weather by greatly lowering body functions, such as heart rate and breathing rate

metabolism: all of the chemical reactions that take place in an animal's body

molecules: the smallest unit of a substance that has all the properties of that substance



Rhino Re

Time is running out to save this species from **extinction.**



scue

By Brenna Maloney

Wildlife

LIFE SCIENCE

As you read, think about what changes to the environment led to this rhino being endangered.

The trap had been set, but there was no rushing a 770-kilogram (1,700-pound) rhino. The **conservationists** waited and waited.

Then, it happened. The rhino stepped onto a leafy spot. It fell into a shallow pit. The conservationists had dug that pit in the forest floor. But why did they want to trap a rhino?

It's all part of a plan. They are trying to save the Sumatran rhino from extinction. It's called the Sumatran Rhino Rescue.

Rhinos in Trouble

All five rhino **species** are in danger of extinction. The Sumatran rhino is the most **endangered** of all.

Rhinos have been hunted for their valuable horns. For centuries, they have been used in Asian medicine. Powdered rhino horns have been used to treat everything from asthma to chicken pox. No proof exists that rhino horns cure illness. Yet, people still want them.

Experts now think there are only 80 Sumatran rhinos left in the wild. These rhinos live in 10 separate places. Their isolation is a threat to their future.

A Rescue Plan

The rescue plan is to safely capture as many wild rhinos as possible. The rhinos would be taken to nearby sanctuaries. Scientists would then assist in their reproduction. This is called **captive breeding.**

Right now, there's only one place where this can happen. It's called the Sumatran Rhino Sanctuary.

Sumatran rhinos are not social animals. They cannot live together. A rhino's pregnancy lasts 15 months. Yet, if female rhinos can't find a mate, they go a long time without breeding. This makes problems that can prevent the female from getting pregnant.



This rhino is now living in the Sumatran Rhino Sanctuary. Here, it is safe from poachers.

PROTECT THE NATURAL WORLD

Protecting the planet is vital! The National Geographic Society has set a goal to help improve the status of 100 species or populations by 2030.



Emi nibbles on leaves with her baby at the Cincinnati Zoo, U.S.A.

Rhino Research

The work of one scientist at the Cincinnati Zoo showed promise. Terri Roth and her team developed ways of handling the rhinos that made their work more successful. In 2001, a captive rhino named Emi gave birth to a calf. They named him Andalas. He became the first Sumatran rhino born in captivity in 112 years. Now he lives in Sumatra.

The newest rhino is named Pahu. She was removed from the wild and transported to a sanctuary in Borneo.



Rhino horns are made of keratin. This material is found in your hair and fingernails.

Pahu's Rescue

Veterinarians guided Pahu into a crate. The crate was then loaded onto a truck. Heavy rains filled the roads with debris. So, a local company sent a bulldozer to clear the way. Pahu was given a police escort to a safe place.

At the sanctuaries, each animal lives in its own section of rainforest. Pahu will be given time to settle in to her new home. Plans continue to find other rhinos in the wild, too.

For now, Pahu's rescue marks another major step in rescuing the Sumatran rhino. The work is slow, but promising.

In Captivity

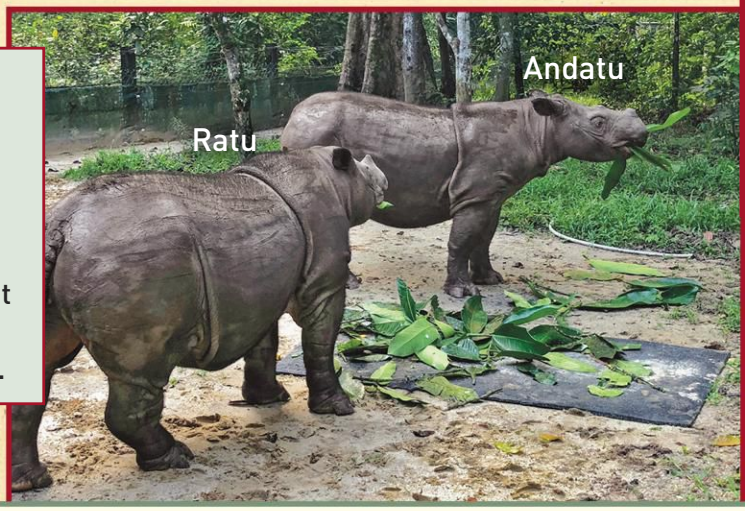
The Sumatran Rhino Sanctuary is home to seven rhinos. They are part of a program to increase Sumatra's rhino population.



Andalas is the first in a long line of Sumatran rhinos that will be bred in captivity. In time, they will go back into the wild. There they will help to boost wild rhino populations.

Ratu was born in the protected area where the sanctuary is located. She is the primary breeding female with the sanctuary's young male, Andalas.

Andatu was the first rhino ever born in captivity in Indonesia. He weighed about 27 kilograms (60 pounds) at birth, but now tops 450 kilograms (1,000 pounds).



A Rhino Family


Harapan

brothers


Andalas

father

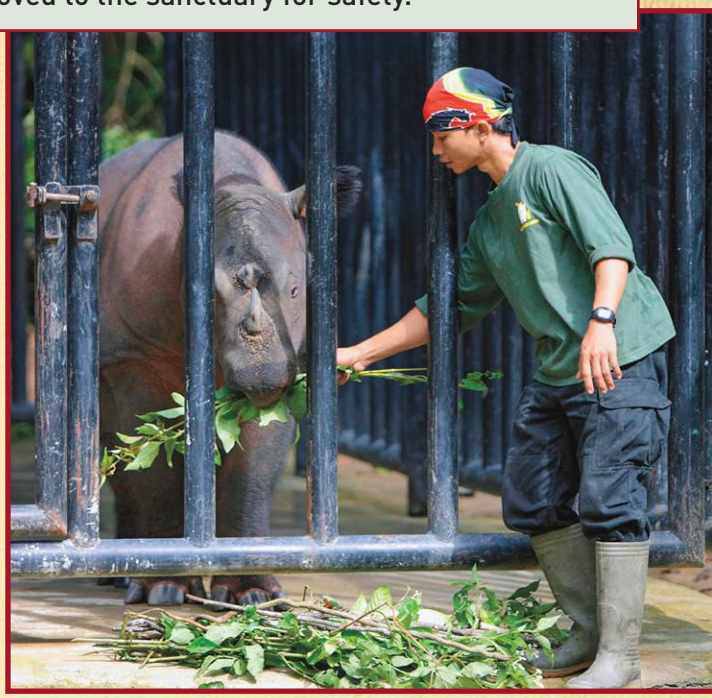

Ratu

mother



Bina is one of the first Sumatran rhinos to be captured in Indonesia. She is the oldest living captive Sumatran rhinoceros.

In 2003, **Rosa** was seen wandering through villages, looking for food. In 2015, she was moved to the sanctuary for safety.

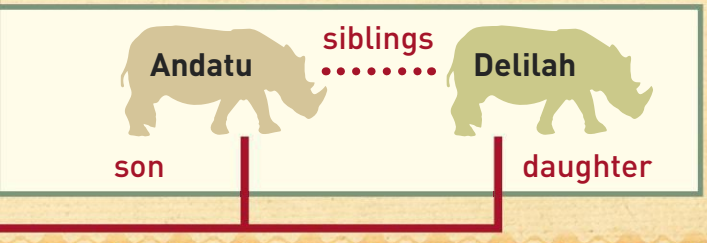




Harapan was born at the Cincinnati Zoo. His parents were part of a breeding program. "Harry" was eventually moved to the Sumatran Rhino Sanctuary.

Delilah was born at the sanctuary. She is Ratu's second calf. She weighed 20 kilograms (45 pounds) at birth. Fully grown, she will soon weigh more than half a ton.





Rhino Recovery

Sightings of Sumatran rhinos are rare. They live in four remote regions of steep, dense forest. Isolation is the real threat to this endangered animal.



Leuser Ecosystem
Fewer than 50 rhinos in 6 subpopulations

In 2015, rhinos were declared extinct in the wild in Malaysia.

Sumatra
Fewer than 75 rhinos in 10 subpopulations

Kerinci Seblat N.P.
Last record of wild rhino: *2004*

Bukit Barisan Selatan National Park
Fewer than 5 rhinos in 2 subpopulations

Way Kambas National Park
Fewer than 20 rhinos in 2 subpopulations

WORDWISE

captive breeding: the reproduction of rare species controlled by humans in a closed environment, such as a zoo or animal sanctuary

conservationist: a person who advocates or acts for the protection and preservation of the environment and wildlife

endangered: at risk of becoming extinct, or dying out

extinction: the condition of no longer existing in living form

species: a group of similar organisms that are able to reproduce

Height: Up to 1.5 meters (5 feet)

Sumatran rhino
(Dicerorhinus sumatrensis)



Weight: Up to 900 kilograms (2,000 pounds)

Tabin Wildlife Reserve
1 rhino in captivity
(1 female)
unable to reproduce

Danum Valley Conservation Area

BRUNEI
Bandar Seri Begawan

MALAYSIA

BORNEO
(KALIMANTAN)

Pahu lives here now.

Indonesian Borneo
Fewer than 10 rhinos

NESIA

SULAWESI
(CELEBES)

Sumatran Rhino Sanctuary
7 rhinos in captivity
(3 males, 4 females)

So, there I was in a remote part of Greenland. I was holding a tiny bird called a little auk in my hand. I was waiting for it to poop. This is *not* what I expected to be doing on my first major research expedition!

I'm a marine biologist. I was going to study where these seabirds were getting their food. I had put tracking devices on them. I'd collect the devices when the birds returned from their food runs. The data would show where they had flown. I hadn't counted on the trackers falling off and getting lost at sea. That's what happened. Was my project ruined?

No! I couldn't figure out where they got their food. But, I could figure out what they'd eaten. So, as the birds came back, I caught them and held them over my notebook and waited. When a bird pooped, I had my sample! Before I even tested my samples, though, I heard some troubling news. Parent birds were bringing back **plastic** for their chicks to eat.



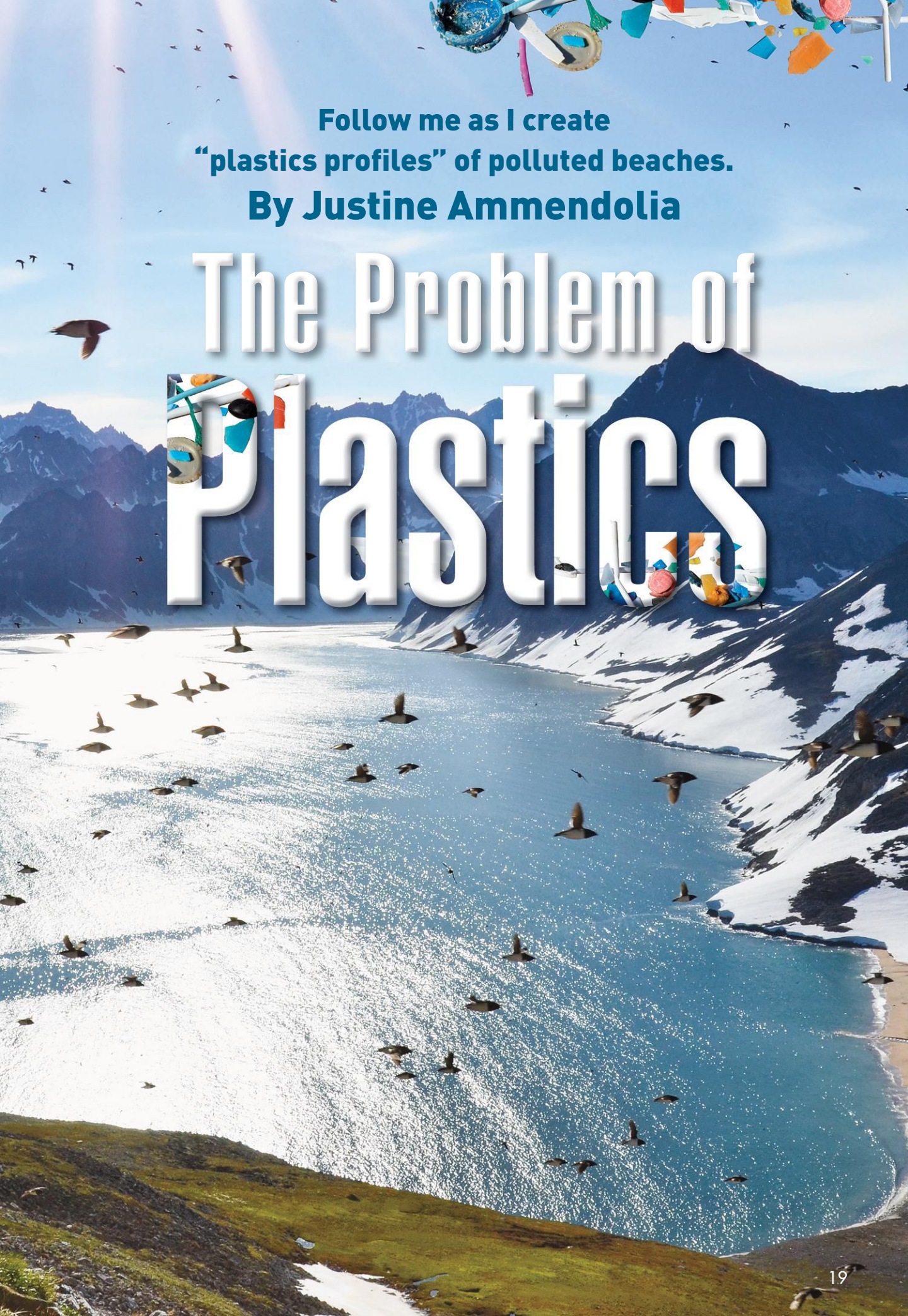
a little auk

Human Footprint

OBTAINING AND EVALUATING INFORMATION

As you read, think about how changes in habitats affect living things.





Follow me as I create "plastics profiles" of polluted beaches.

By Justine Ammendolia

The Problem of Plastics







Career Change

I live in Newfoundland in eastern Canada. This island is as far east in North America as you can get. The ocean and fishing are important to people on the island. But, I knew our shores were piling up with plastic.

I had a lot of questions. How much plastic was getting into the oceans? Where was it coming from? I had to figure this out before taking on the bigger question. How can we stop plastics from getting into oceans?

I became a garbage detective. My partners and I created a "plastics profile." We began studying seven beaches in Newfoundland. What was there? Where did it come from?

Detective Work

Every month, we visit the same beaches. We record what types of garbage we find. This is not exciting work. It's slow and grimy. There can be strong winds. It's almost always wet. It can even be sad at times. But it's a great way to see what's there.

To most people, ocean pollution means water bottles or plastic bags. But we find other things, too. We find metal, glass, rubber, even lumber. Some beaches have plastic foam from take-out containers. Others have fishing gear, like rope and nets.

On one beach, I found a tiny plant, struggling to grow past the trash. Or so I thought.



Collecting plastic trash is important science for my team's research. But it isn't glamorous work!

Bits and Pieces

When I looked closer at the tiny plant, I saw that it was plastic, too! It was one of those fake plants that you put in a fish tank. How disappointing!

Most of the plastics we find are tiny. They're called **microplastics.** They are any piece of plastic less than five millimeters in size. The plastic is hard to identify since it's lost its original shape.

Still, we begin to make connections between big pieces of garbage and microplastics. On one beach, for example, we find thin, plastic threads. The threads were coming from frayed fishing ropes. When the ropes heated up in the sun, the threads broke free.

This handful of trash is made up of all single-use plastic.





LIVE SMARTER ON OUR PLANET

Reducing human pressure on our planet is important! The National Geographic Society hopes to reduce the amount of plastic entering our rivers by 30 percent by 2030.



Getting Help

Looking for answers is more than just looking for trash. It also means talking to people. Often, people who live near the beaches know the plastics better than we do. They can help us answer questions as we do beach clean-ups.

Plastic on the beaches doesn't mean that local people are to blame. It can travel far, pushed by waves and ocean currents. That's why we go out on boats to find plastics in the water.

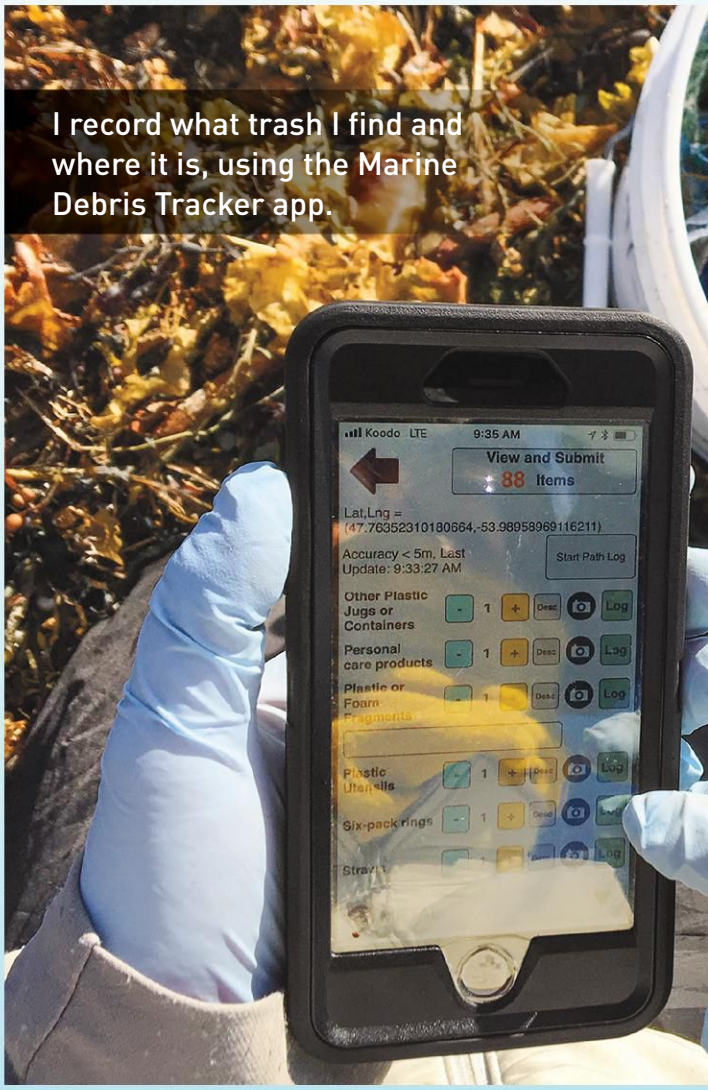


I keep careful records when I'm working in the field.

Making a Record

From month to month, we build a record of what we find. But we don't write everything in our notebooks. Instead, we use our cell phones. We report what we find on an app called Marine Debris Tracker.

Putting our data in one central place helps build the "plastics profile" of each beach. It also allows us to share our data. Anyone in the world who is interested in our research can look up our findings. This free app can be used by anyone. Even you. Tools like this are part of a movement called **citizen science.** Anyone can go out and collect data, too. By working together, we can come up with a better picture of the problem.



I record what trash I find and where it is, using the Marine Debris Tracker app.

Moving Forward

The plastics problem feels big, and it is. Some people think it can't be solved. But we do have the power to reduce our plastics problem.

We can all make a difference. We can walk along beaches, picking up pollution. We can avoid using single-use plastics like straws, bags, and containers.

I don't mind picking up trash. Because in doing so, I am working toward a solution. You can help, too.





WORDWISE

citizen science: the collection and analysis of data relating to the natural world by members of the general public, often done in collaboration with professional scientists

microplastics: small plastic pieces less than five millimeters in size that can be harmful to ocean and aquatic life

plastic: a human-made material that can be formed into almost any shape



Even under a microscope, it can be hard to identify plastic trash.

NATIONAL GEOGRAPHIC | EXPLORER CLASSROOM



Meet Justine Ammendolia!

Here's your chance to meet National Geographic Explorer and marine biologist Justine Ammendolia. She'll be participating in National Geographic's Explorer Classroom program on September 26, 2019. Find out what it's like to be a trash detective and create beach profiles of plastic pollution. This live event is hosted on YouTube. There's no cost to join, and your classroom could be on camera with Justine to ask her questions.

If you miss the livestream on September 26, the recording will be posted on YouTube, so you can tune in later.

Sign up at *NatGeoEd.org/ExplorerClassroom*

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Explorer

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Cover: a Sumatran rhinoceros
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Explorer

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Endotherm or Ectotherm

Warm-blooded animals—endotherms—can regulate their own body temperature. Cold-blooded animals—ectotherms—cannot. Here's a look at the differences between these types of animals.





Endotherms vs. Ectotherms

Known as warm-blooded animals	Known as cold-blooded animals
Animals that are capable of generating heat internally	Animals that depend on external sources to warm themselves
Body temperature does not vary with	Body temperature varies with







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surrounding temperature

surrounding temperature





Active over a wide range of weather conditions

Less active in cold temperatures



Body temperature is kept constant

Body temperature varies over time



Most mammals and birds; people, too

Almost all reptiles, fish, insects, amphibians, and arachnids



Found in most climates

Found mostly in warm climates



Require more food

Require less food



Test the Science:

Ectotherms



Here's a way to model what happens in a cold-blooded animal when it is exposed to a heat source. Make a series of cold-blooded animals from temperature-sensitive dough. When the dough is heated, it will change color. In this experiment, the color change is the indication that the "body temperature" of the dough creature is changing.

Temperature-sensitive Dough Recipe

What You'll Need

- 1.5-2 cups of flour
- 1 cup of salt
- 2 tablespoons of cream of tartar
- 2-3 tablespoons of baby oil
- thermochromic pigment*
- 1 cup of very hot water

* Thermochromic pigment can be purchased online.



Directions

1. In a heat-safe bowl, mix 1 cup of hot water with your thermochromic pigment. Add enough pigment until you get the color you'd like. Stir thoroughly to dissolve all of the pigment.
2. Add baby oil, cream of tartar, and salt. Stir thoroughly to dissolve the salt.
3. Add flour and mix together until it no longer sticks to your hands. It's ready! This dough can keep for several weeks in an airtight container before it starts to degrade.

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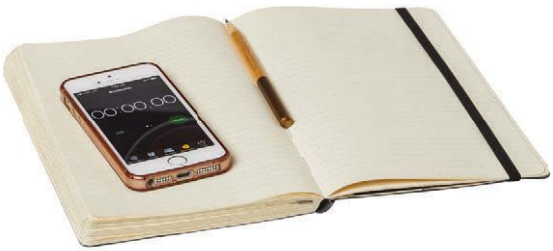
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at You'll Need for the Experiment

- mperature-sensitive dough
- heat-generating lamp
- clean workspace
- stopwatch
- datasheet and pencil record results







ke a Hypothesis

ve students make a hypothesis about the outcome of ning the light on the dough animals. Will they heat ? How long will it take for the animal to change color?

duct the Experiment

Create three cold-blooded nimals from the dough: long, skinny snake; a nedium-size lizard; a round, lump turtle.



Place each animal under the eat-generating lamp.



Time how long it takes for ach animal to fully change olor. As the dough warms p, the color should fade.

yze the Results

ch animal heated up the fastest?

t can be said about the shape of animal that might explain this?

ch animal was the slowest to up? Why?

long did the animals retain their ? Why?

