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**LEARN TO BE A
SCIENTIST!**

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The Louisville Zoological Gardens, a non-profit organization and state zoo of Kentucky, is dedicated to its mission to "Better the Bond Between People and Our Planet" by providing excellent care for animals, a great experience for visitors, and leadership in conservation education. The Louisville Zoo is accredited by the Association of Zoos and Aquariums (AZA) and is an agency of Louisville Metro Government.

**ASSOCIATION
OF ZOOS &
AQUARIUMS**

SAFE
SAVING ANIMALS
FROM EXTINCTION

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What is a Backyard Action Hero?

A Backyard Action Hero is a kid or adult who is really into nature and wildlife and is ready to take action to protect them. They care about the animals and habitats in their own backyards as well as all around the world. They know that to make a difference they need to both learn and act! This guidebook will help you learn about the natural world around you and how you can help nature in need. Since the Louisville Zoo is a great place to learn about plants, animals and ways to help our wonderful world, your guidebook will also use examples from the Zoo!

Welcome Future Heroes!

At Toyota Motor Manufacturing, Kentucky, Inc. (TMMK), we believe that protecting the environment is part of our mission to be a good neighbor across Kentucky. As we build cars in our plant in Georgetown, we are committed to protecting the environment, following environmental laws, preventing pollution and continuously improving our processes. Our commitment doesn't stop there — and neither should yours! It is everyone's responsibility to protect the environment.



By becoming a Backyard Action Hero, you commit yourself to taking an active step to coexist and learn about nature and wildlife. Once you have learned about some of the things in this book, you will be ready to take conservation action to your backyard and beyond. Good luck Heroes!

Sincerely,

Your Friends at

Toyota Motor Manufacturing, Kentucky, Inc.

Saving Species

Your role in protecting our planet...

What's Different About This Issue of the Backyard Action Hero Guidebook?

Welcome to the first online-only edition of the Backyard Action Hero Guidebook!

Because we know so many of you are learning at home this year, we sent the fun to you digitally! This way, everyone can be a Backyard Action Hero, no matter where you are! If you prefer reading on paper, don't worry. This issue can easily be printed at home with 8 ½" x 11" paper; just don't forget to recycle it when you are finished! According to the [University of Southern Indiana](#) approximately 1 billion trees worth of paper is thrown away every year in the USA.

What's in This Issue?

Many parents have been tasked with teaching their kids from home during the COVID-19 pandemic. It's a challenge, to say the least! The Louisville Zoo wants to help make education fun for you and your family.

As a parent, you probably feel that it's important to teach kids about science, but it can seem kind of intimidating, right? What exactly *is* science? How can we foster a love of science in ourselves and in our children to become "science teachers" for our little ones?

The good news is, you don't need to have a lab coat, budget-breaking science equipment, or even technology on hand to start "doing science." As you read this magazine together with your little ones, you'll quickly begin nurturing your child's imaginative and scientific spirit, reinforcing skills that the whole family

can use. Not only will you score major points as a great role model, you'll help the children in your life see that science is not only fun, but also important in our everyday lives.

In this issue, together, you and your child will learn about science, the scientific method and conducting your own experiment. Your young scientist will also learn how science relates to the world around them — like how colors can affect the disappearing sea ice habitat of polar bears in the remnant wild. They'll learn to think critically about how our actions may affect the world around us. At the end, we will share tips with you on ways we can all have a positive impact on our environment.

Protecting the world around you may seem like a big job, but when everyone helps, we can make an impact. Just by reading this, you have already begun! It all starts with becoming informed about the world around you. Start your journey on the path to becoming a scientist and conservation hero. After you have finished reading, you can learn more about the natural world by visiting your Louisville Zoo.

By educating Zoo guests about [wildlife conservation](#) through amazing encounters with animal ambassadors and nature, the Louisville Zoo works to demonstrate how our actions at home impact our world and inspire guests to consider their role in the balance of the health of our planet.

For more Backyard Action Hero content, visit LouisvilleZoo.org/BAH

What is Science?

According to Merriam-Webster's dictionary, science is...

1. Knowledge about the natural world that is based on facts learned through experiments and observation.
 2. An area of study that deals with the natural world (as biology or physics).
-

Children already have many of the basic skills that scientists possess. They are very curious about the natural world around them and they make lots of observations, like looking in wonder at the stars, picking up worms, and collecting leaves. They use their senses to explore the world of nature by touching an animal's fur, smelling ripe summer fruit and listening to leaves rustle underfoot in autumn. They also ask lots of questions. How do caterpillars become butterflies? What do plants need in order to grow? Kids try to make sense of the world around them by seeking explanations and making predictions about how and why things happen. Would ants be more attracted to an apple or a pepper? If the air temperature is hotter, will ice melt faster?

Your involvement and guidance will help your learners explore in a fun, safe way. Kids are very hands-on in their learning approach, and that lends itself perfectly to the world of science education. So, encourage your kids to delve into things they really like. Is your child interested in gardens? Dinosaurs? Walking by a pond? Planets? Seashells? Explore those passions using science!



DID YOU KNOW?

If you have taken your child to a zoo, science center, park or nature center, you already have a jump on science education! We fondly refer to our Zoo grounds as a "living classroom." We take advantage of the natural world around us to help teach our guests about animals and science. Exploring the world of science assists your child in developing critical thinking skills.

Science and Animal Conservation

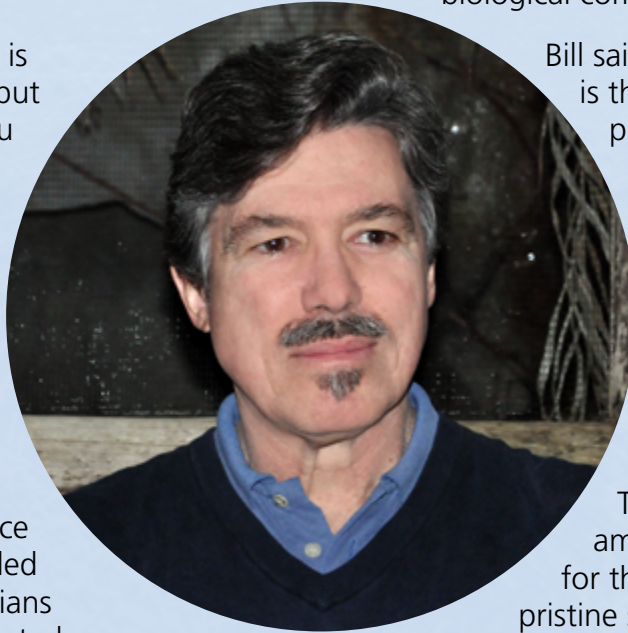
Cuban Crocodile Conservation

Part of being a good scientist is observing and measuring — but did you know it can make you a great conservationist also?

Bill McMahan, the Curator of Ectotherms at the Louisville Zoo, is one of the experts behind the effort to keep Cuban crocodiles from going extinct. Cuban crocodiles are the most endangered new world crocodilian and face an uncertain future. Bill traveled to Cuba to study the crocodilians in their native habitat and created a "Species Survival Plan" to help ensure a future for these critically endangered reptiles.

It is important for conservationists to study and understand animals so we can better care for them, protect them and safeguard their future. "Crocodilians are a keystone species," Bill said. "They help regulate prey numbers, and create water holes that help other animals during

periods of drought. They are an apex predator that occupies a position that controls the health of the biological community they belong to."



Bill said their endangerment is the result of a "myriad of problems," many caused by human activity, but also due to climate change — not the man-made kind, but the kind that takes place over hundreds and thousands of years. Cuban crocodiles first evolved in the Pleistocene era that began about 2.6 million years ago.

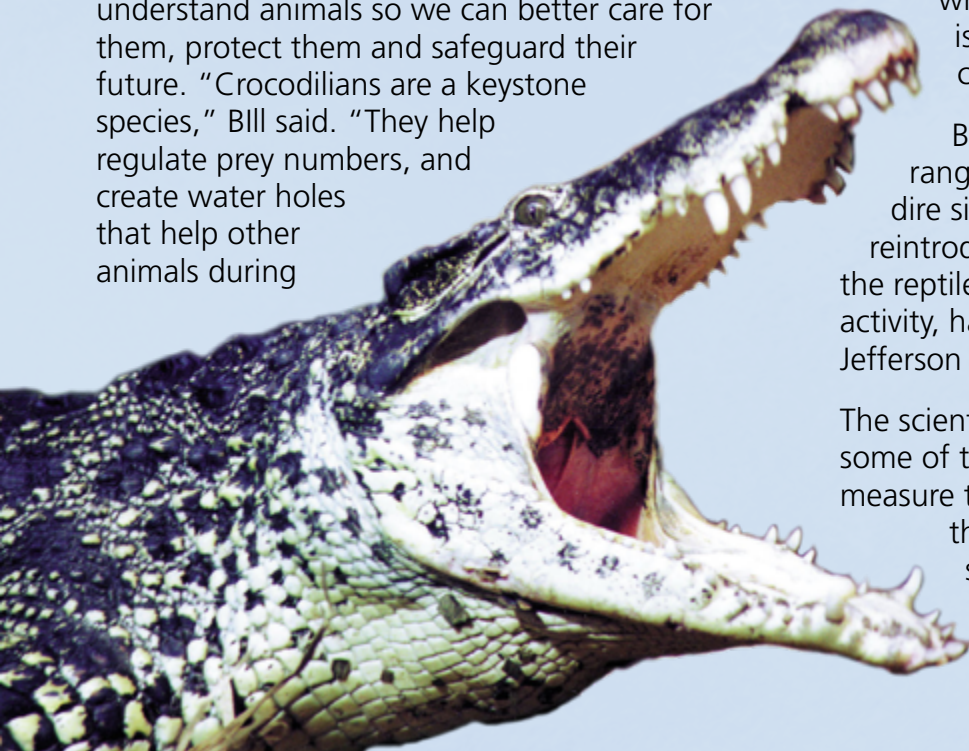
Today, they face a tremendous amount of poaching pressure for their small population. The pristine swamps they once inhabited have been modified by humans, which now makes much of their historic range unlivable for the species. They have also been impacted by

hybridization with American crocodiles,

which have been introduced to the once isolated swamps inhabited by the Cuban crocodiles.

By going to Cuba, the crocodiles' natural range, Bill was able to witness firsthand this dire situation. The resulting conservation effort reintroduced 600 Cuban crocodiles back into the reptile's natural habitat which, due to human activity, has been reduced to about the size of Jefferson County in Kentucky.

The scientists involved in the effort also caught some of the reintroduced Cuban crocodiles to measure them, track their growth, see how far they had traveled from the introduction site, and if they had reproduced. By utilizing the scientific method, Bill and his team were able to better understand how these crocodiles behaved in their swampy home.



How to be a Good Scientist

Observe Things!

Adults:

Look at the world around you. It doesn't matter where you are in this moment; you are surrounded by science! Help your little scientist engage their naturally curious spirit by following these steps.

Step one "I notice..."

Open your senses! Describe what you are looking at, what you smell, what you feel, what you hear. Ask your scientist for an "I notice..." statement.

"I notice the clouds are big and dark."

"I notice the smell of flowers blooming."

"I notice the bark of the tree is rough and bumpy."

"I notice the birds calling."

"I notice the banana is sweet and the lemon is sour."



Focus your thoughts on one specific observation. The sky is the limit, literally.

Step two "It reminds me of..."

What does the "I notice" remind you of? Did the clouds remind you about playing in the rain and seeing a rainbow appear when the sun came back out? Make a connection between what you noticed and what you have experienced.

Step three "I wonder..."

Create curiosity! You'll be amazed what fabulous ideas your scientist will have. The best part is that you don't need to know the answer.

Fostering curiosity isn't always about learning or knowing the answer to your questions; it's about having questions!

For example: "I wonder if it will rain today because the clouds are big and dark?"

Have you ever wondered why some animals have dark markings near their eyes? Once you've completed the experiment inside, find out on page 20!

These three steps can be used anywhere, anytime, at any age. Help your child make frequent, meaningful science connections by using these steps next time you're taking a walk, brushing your teeth, cooking dinner, the possibilities are endless.







How to Be a Good Scientist

Measure Things!

Every day we use measurements to make sense of the world around us. From seeing how tall we are, to weighing things, to cooking, we use measurements every day whether we realize it or not. Measurements allow us to compare things to one another. For instance, how tall are you?

Could you compare your height to someone else's? Scientists use measurements to be precise. Instead of describing something as big or small, they measure the object and describe it in exact units like inches or centimeters.

Use the activity below to match some measurement tools to the things they measure with your child. Then, practice using measurement by answering the questions with the correct tool.

-
- | | | |
|----|---|---|
| A. |  | 1. ____ How hot is it inside my house? |
| | <small>SPEEDOMETER</small> | |
| B. |  | 2. ____ How tall am I? |
| | <small>WEIGHT SCALE</small> | |
| C. |  | 3. ____ How much does an apple weigh? |
| | <small>KITCHEN SCALE</small> | |
| D. |  | 4. ____ How quickly can I run to a tree and back? |
| | <small>STOPWATCH</small> | |
| E. |  | 5. ____ How fast is a car driving? |
| | <small>THERMOMETER</small> | |
| F. |  | 6. ____ How much do I weigh? |
| | <small>TAPE MEASURE</small> | |

What Do GOOD Scientists Do?

Communicate!

How Scientists Communicate

Scientists share their discoveries and findings. They know how important it is to share the information they learn with other scientists. Often, they are also excited to share their findings with the public. Maybe they made a breakthrough in a new medication or discovered that an animal can do something we didn't know about. By communicating what they have researched, others can build upon that information by doing further experiments.

How Backyard Action Hero Scientists Communicate

Science findings can help improve all our lives, as well as the health of the beautiful planet we call home.

Professional scientists may publish their findings in academic journals. Backyard Action Heroes can communicate their findings too; it just may look a little different.

Help your scientist put into words the things they observe and discover. They will want to share! Start a science journal with pictures or words, so they can start to explain what they observed, experimented with and learned. Can they think of any new experiments to try, based on the research they conducted? **Your young scientist may be the next one to make an incredible discovery one day. Wouldn't that be thrilling to share?**

Adults:

Talk to your children about what they discover! They can't express themselves the same way adults can, so spend time getting them to explain to you their ideas and work through their thought process — even if it's wrong.



The Scientific Method

What is the Scientific Method?



We know your kids LOVE to ask questions about everything around them. Put that natural curiosity to good use with SCIENCE, particularly, the scientific method!

The scientific method is a step-by-step, logical process for figuring out why things happen in the natural world. In other words, it's a way of doing research! Many important discoveries about our planet have been made using the scientific method.

Although you may come across slightly different variations of the scientific method, the goal is always the same: to ask questions that lead to experiments, which provide evidence. Your children will encounter the scientific method as they progress through science classes over the years at school.

Your little scientist can use this method to explore anything that interests them.

Whether they like ladybugs, pine cones or ponds, they can find something to study. And they'll want to share what they learn with family and friends to get *them* excited about science too!

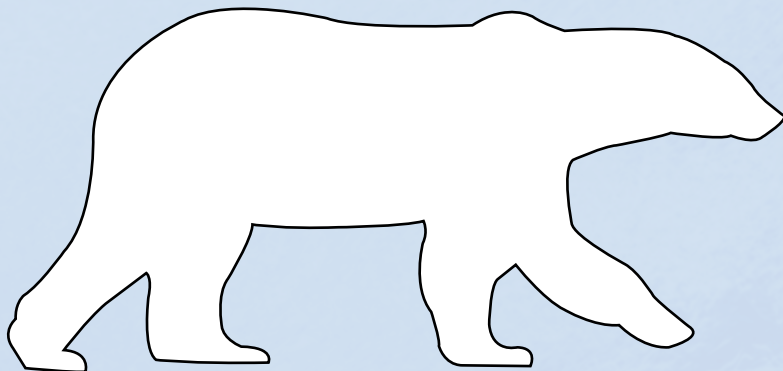
Why Is the Scientific Method Important?

The scientific method is the very foundation of modern science. It's an organized, standardized approach to finding out about the world. **It is based on facts, not just thoughts or feelings.** When you guide your scientist to utilize the scientific method, you are actually teaching your kids how to learn. What a fantastic gift!

Work as a team, like many scientists do, and experience a true sense of wonder about the world, together. If things don't turn out as expected, that's okay! **Keep in mind that scientists seek to provide evidence to explain things, not prove them.**

Science and the Animal World

Once you learn the scientific method, we'll show you how to use your scientific prowess to learn how to help animals. Even small things can make a big difference. Our color and heat absorption experiment will demonstrate how the colors we choose for our roofs and even pavement colors can have an impact on climate change and the Arctic's disappearing sea ice.



The Scientific Method

Where Do I Start?

The following experiment will walk you step-by-step through the scientific method. As you learn, you will complete an experiment designed to help understand the problem of disappearing sea ice and how we can help.

Step #1. Ask a Question

The very first thing is to ask a good question! A question can come from an observation that you have made, or something that you think is really cool and want to explore. You should word the question so that it can be answered by doing an experiment. **Examples:**

Why do you sweat more in a dark colored t-shirt?

Why does dark colored pavement get so hot?

How does the Arctic help keep the Earth cool?

For this experiment, we're providing you with the question, but most scientists will start their research with their own unique questions.

Our question: do some colors absorb more heat than others?

If you have younger children, this is the perfect opportunity to have a discussion and reflect on times your family has noticed certain surfaces or areas becoming hot more quickly than others. Are you able to identify any similarities between the surfaces that become hot more quickly?

Maybe the discussion with your children only lasted a few moments; help them expand on those ideas. **Here are a few great questions to ask your scientists:**

Describe how it feels when you walk

across the driveway barefoot on a hot day. Does it feel the same on colder days?

On a hot, sunny summer day, would you want to wear a dark or light colored t-shirt?

If you put several pieces of the same kind of paper out in the sun, would one become hotter if left in the sun over a period of time?

Think about experiences your child can talk and reflect on. Allow them to explain their thinking, even if it's incorrect.

Step #2. Gather Information

After the problem or question has been presented, it's time to gather information. How can you find out more? One way is to use your senses. You can also read about the topic in books at your local library or on the Internet. Maybe you can contact an expert and ask to do a short interview! **How your family chooses to research can be different depending on ages, available technology, and personal experiences.**

Questions to keep in mind:

What do I know already?

What other sources could help me find the answer?

Who could I talk to and learn more from?

The Scientific Method

Step #3. Form a Hypothesis

What is a Hypothesis?

Hypothesis sounds like a scary word, but the idea behind it is simple. **It means that you state what you believe will happen, based on what you know from gathering information.** It's an educated guess or you might also think of it as a prediction. It's important to remember that your young scientist may need some extra help understanding this idea. Work through the activity at the bottom of the page with them to help them gain a better understanding.

What Do You Think Is Going to Happen?

To form your hypothesis, think about the question and the information you've gathered. **We asked: do some colors absorb heat more than others?**

Based on what you've learned from research and your own experience, what do you think is going to happen?

What Leads You To Believe That Outcome Is Likely?

Ask yourself: does the outcome you predict make sense given the information you've learned so far? If so, it may be a good hypothesis to test with an experiment! If not, maybe you need to rethink your hypothesis.

Can You Test It?

One of the most important elements of a hypothesis is that **it must be able to be tested.** If you need help, remember to keep it simple.

My hypothesis is _____ because _____.

Hypothesis Activity

Can you tell which of these hypotheses are good? Use the knowledge you already have to click or circle the statements you think would make a good hypothesis for an experiment. *(Remember: a good hypothesis makes sense with the knowledge you already have and must be testable.)*

Plants grow faster when I give them fertilizer and water rather than if I just give them water.

The temperature outside goes down at night because the sun isn't shining.

All dogs are louder than cats because of their barks.

The Scientific Method

Step #4. Do an Experiment:

This is the fun part! Make a step-by-step plan to test your hypothesis. In this experiment, you will test your hypothesis about color. You will need to get your materials, run your experiment, and record what happens (measurable data and outcomes). Only change one thing at a time and keep everything else the same.

What Makes a Good Experiment?

Planning

Make sure you plan ahead for your experiment. A good scientist thinks about what will affect their experiment and plans accordingly. Some aspects to keep in mind when doing this experiment:

Choose your day wisely. A perfectly clear day with little or no clouds will work best. The temperatures can fluctuate very quickly. If a cloud passes over while you're recording temperatures, it could lead to inaccurate data.

Watch out for the shade. Think about where the sun will be throughout the duration of the experiment. Make sure each paper is exposed to as much direct sunlight as possible.

Measurement

Be sure to measure accurately to get the clearest results from your experiment! Remember, good scientists use the proper measuring tools for each job.

For this experiment, that means using a thermometer to measure heat. To ensure accurate measurements, lay your paper pockets in the grass and weigh them down with a small object while facing the sun. We learned that if you lay your paper on concrete it will absorb heat from the ground, leading to inaccurate data.

Consistent Results

A good experiment must give us consistent results. If the experiment can't be repeated with the same outcome, then the results can't be trusted.



The Scientific Method

Performing the Experiment

Gathering Materials

The materials you will need are:

- **A sunny day**
- **Two pieces of construction paper in different colors (black and white)**
- **Tape**
- **Thermometer**
- **Timer**
- **Results chart (below)**

ADULTS:

Curious scientists may want to use more than just black and white. Incorporate colors like yellow, purple, or red and find out how those colors compare!

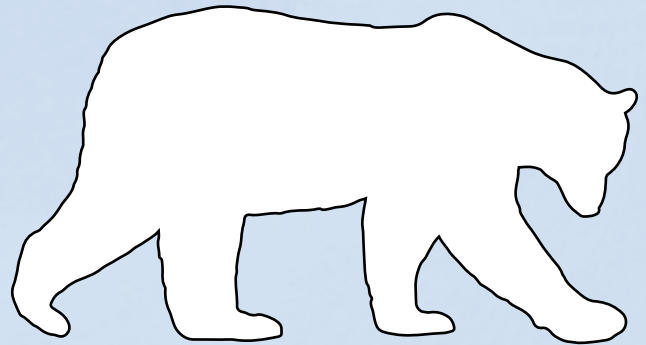
Set Up

1. Fold each piece of paper in half and tape it closed. Taping the paper closed gives you a pocket to insert your thermometer.
2. Lay the paper in a sunny spot. It could be helpful to place a weight on top, like a rock, so that the paper does not blow away.

Recording Measurements

Record the initial temperature of each paper pocket. Do so indoors, prior to placing them in the sun.

Insert your thermometer into the paper pocket and record the temperature every 10–15 minutes. Repeat two times.



Results chart	Temperature before going outside	After 10 minutes outside	After 20 minutes outside
Black paper			
White paper			

The Scientific Method

Step #5. Share Results:

Results

Great job! Now that you and your young scientist have completed the experiment, it's time to take a look at the results. If this was for a school project, the teacher might have your scientist present their findings on a poster board, in a written report, or in a presentation. **Use these questions to help reflect on what you've both learned:**

Was your hypothesis correct?

Review the data you collected. Did the temperatures remain the same?

Did all temperatures heat up at the same rate or did some heat up faster and others slower?

Do you need to revise your hypothesis or did your experiment support your claim?

Could you do this experiment again?

What could you do next time to learn more?

Applying What You've Learned

Talk to your child about what they've learned.

Take a look at the image below. In it, you see a polar bear on top of sea ice next to the open ocean. What colors do you see? Is the ice a lighter or darker color than the surrounding ocean? How might the colors affect the temperature of the ocean? **Do you think the ocean or the ice would be cooler?**



Our Polar Bear Qannik



Have you met the Louisville Zoo's polar bear Qannik? She's a special bear that was born in the Alaskan wilderness. Qannik was found alone when she was about 3 months old. She was underweight for her age, so experts believe she was abandoned because her mother was unable to find enough food to feed the young cub.

Qannik was luckily saved by humans, and made her way to the Louisville Zoo. Polar bears are listed as vulnerable by the International Union

for Conservation of Nature (IUCN). **This means they face a high risk of going extinct in the near future due to climate change. Luckily, as scientists and conservation heroes — we can help!**

To learn more about Qannik's story and polar bears in general, click the bubbles above. They will take you to webpages about polar bears created by the Louisville Zoo and by Polar Bear International.



Conservation Connection

Experiment Excellence!

Did you have a good time conducting the experiment with your young scientists? **Fantastic work! Now, let's make a connection between your science experiment and a real life challenge in nature.** Think back to your experiment results. What paper color heated up the most?

Darker colors absorb more heat energy than lighter colors. Lighter colors reflect heat energy more effectively than darker colors. Keep this in mind! This concept has real applications to nature and is especially connected to our polar regions.

Polar Implications

Polar bears need sea ice for hunting seals, breeding and creating dens for giving birth to cubs. Without this ice, polar bears face an uncertain future.

The sea ice reflects much of the sun's rays, and doesn't heat up very much or very quickly. Now look at the picture above of open ocean water and ice in the Arctic Circle. What color is the water? Is it dark or light?

Darker colors, like the open water, reflect less energy and instead absorb the sun's rays which increases the water's temperature.

We can't change sea ice melting due to the water being darker, but **we CAN help some of the things that cause the water to heat up!**

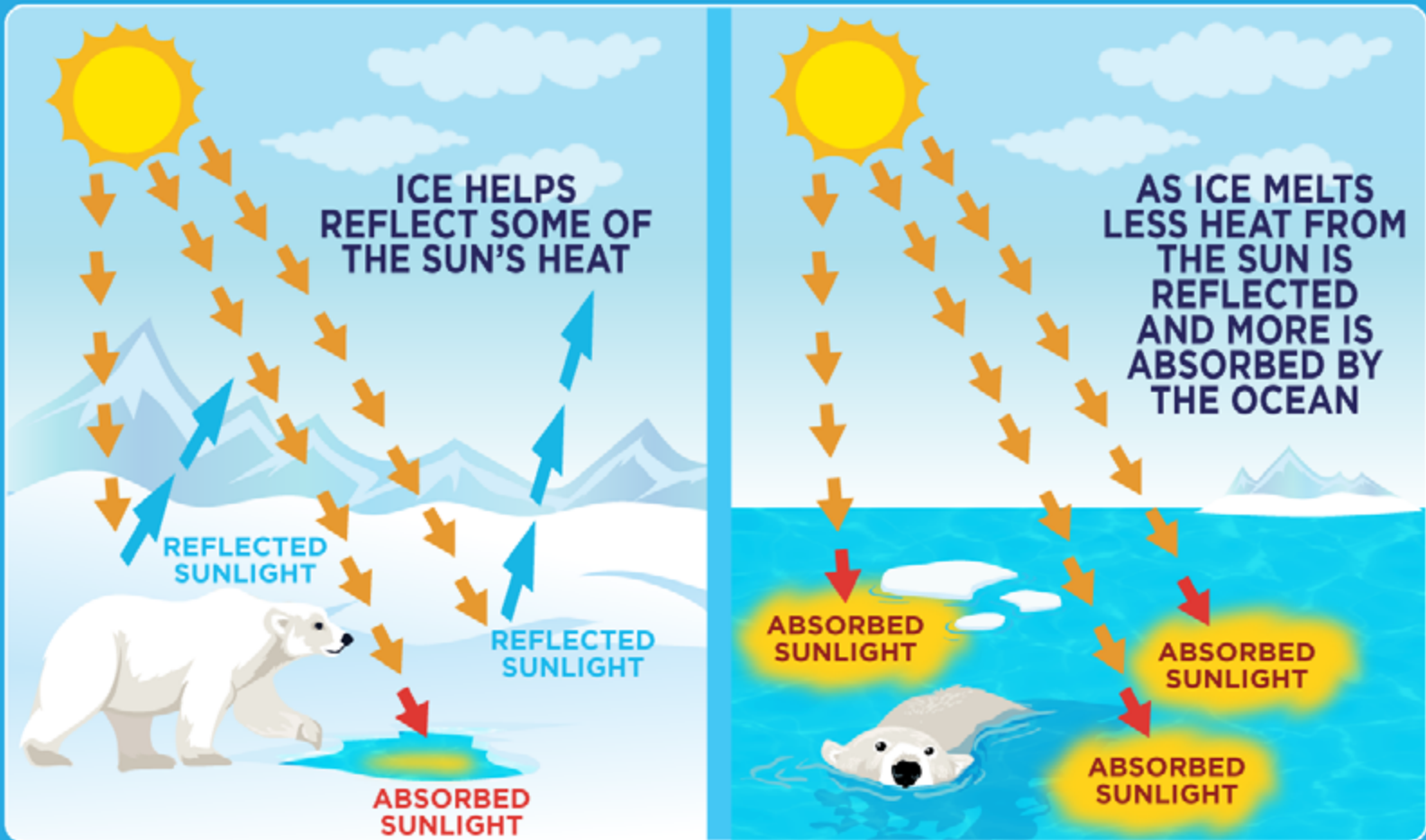
Climate Change

You've probably heard the term "climate change" before, but what causes it? The **Earth's atmosphere has gases called greenhouse gases, like carbon dioxide, which absorb and radiate heat. This warms our planet, just like glass in a greenhouse traps heat to keep plants warm year-round.**

We need some heat to live. The trouble is, these **greenhouse gases have been building up in our atmosphere over the past couple hundred years, adding an extra "blanket" over our planet and causing it to slowly warm up.**

The increased greenhouse gases come from human activity like burning fossil fuels. The more we increase the greenhouse gases in the atmosphere, the more Earth's surface warms as temperatures rise. **In the Arctic, this effect causes the lighter colored sea ice to melt. Less ice means more of the warmer dark colored water. The water melts more sea ice. This makes the water even warmer. It's a continuing cycle.** Scientists gathering data over the years have reported this cycle and a trend of sea ice gradually melting away. Check the next page to see how this effect actually works.

Conservation Connection



Less sea ice means more heat is absorbed into the ocean. Just as a heart circulates blood and regulates the body's temperature, the ocean controls the world's climate system by circulating heat, moisture, and nutrients around the planet. Disruptions in this system, such as extra heat, have global impacts and can lead to more frequent and extreme weather events around the world.



POLAR BEARS
INTERNATIONAL

Learn more at: www.polarbearsinternational.org

How to Help



Personal Changes

You can make a difference. People all over the world are working hard and doing amazing things each day to make a difference—that includes kids! Here are some simple actions you can do to decrease the use of fossil fuels and help polar bears and their vanishing sea ice habitat:

- Turn off lights
- Don't idle in your car
- Use less hot water
- Take advantage of natural light
- Open windows on cool days
- Insulate windows and doors during colder months
- Recycle plastic
- Reduce single use plastic waste

Community Changes

Get your community involved! **Share your knowledge to help spread awareness to your neighbors, parents and friends about global warming. If someone needs a roof replaced, a "cool roof" is a great option, which can help reduce the amount of dark surfaces on Earth.** Your young scientists can talk to your neighbors about driveway colors, too! Choosing lighter colored paving materials for driveways, or even painting your driveway a light color, can also reduce the dark surface area of the Earth.

The Zoo is working to be more sustainable, too! See what we're doing to help our community and our planet.

Use What You Learned!

Why Do Animals Have Dark Markings Near Their Eyes?



Let's use some of the skills we've been learning to help solve why some animals have dark markings on their faces.

We already know what question we need to ask: **why would dark markings around an animal's eyes be useful?**

Now let's gather information: what animals can you think of with dark markings around their eyes? Some animals have dark spots around their eyes, but what about people? Have you ever seen sports players use dark paint near their eyes? What would sports players and animals have in common that would make this useful? Are light and eyesight connected? If you turned off the lights, would you be able to see? Does

too much light make it difficult to see?

You may have already thought of a hypothesis; **for this part we won't conduct an experiment to test it, but instead let's use what we already know to get to the bottom of this!** We know that light is absorbed better by darker colors than lighter colors. We also know that light is important for both humans and animals because it's how we are able to see. **If we combine these two things, it might mean that dark markings near and around the eyes can help absorb light to reduce glare, an important skill for animals and sports players.** If your eyesight is even a little bit better than the competition, do you think it might affect the outcome? If you were an animal looking for food, do you think having better eyesight would be useful?

The answer is YES! Research suggests the dark markings around some animals' eyes absorb sunlight, which gives a slight improvement to eyesight. **Click the images to learn more about animals with dark eye markings.**

We can learn a lot from nature. Every day, scientists look at the natural world for inspiration for new experiments and products. **Use your observation skills to look for other ways animals might affect the way humans do things.** Have you ever used flippers to swim? Do coats and jackets remind you of anything animals use to keep warm? What other everyday objects could be inspired by animals?



theZOO

L O U I S V I L L E



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The Louisville Zoo, a non-profit organization and state zoo of Kentucky, is accredited by the Association of Zoos and Aquariums.