**WEBCAST: *How Birds Stay Warm with Ornithologist Sahas Barve***

The webcast program will be broadcast at 11am and 2pm ET on February 6, 2020. A recording of the live broadcast will be available later that evening.

**Participation Logistics**

* Participate in the webcast here: <https://naturalhistory.si.edu/education/distance-learning/how-birds-stay-warm-ornithologist-sahas-barve>
* There will be a 3-minute video looping on this webpage before the live programs begin. The live shows should automatically start playing at 11am and 2pm ET. If they do not, try refreshing your page.
* See our Webcast Technology Guide (PDF) for troubleshooting guidance : <https://naturalhistory.si.edu/sites/default/files/media/file/smithsonian-science-how-webcasts-tech-guide-updateoct24-2019.pdf>
* Email ScienceHow@si.edu on if you continue to have connectivity problems.
* We recommend using a separate phone, tablet, or computer to facilitate your students’ questions and poll responses. Go directly to [**Slido.com/ScienceHow**](https://slido.com/sciencehow) on any device.

**Pre- and Post- webcast Resources:**

1. **Watch this 1-minute video with students** to introduce them to ornithologist Sahas Barve: <https://youtu.be/TSuKYvzmwPo>
2. **Distribute the student worksheet,** <https://naturalhistory.si.edu/sites/default/files/media/file/student-worksheet-sciencehow-sahas-barve-birds-v2.docx>,for use **before and after** the live webcast
3. **Start a conversation** with your students about who does science and how they do it.
* **Before watching the live webcast on 2/6:**
	+ Why would scientists study how birds stay warm?
	+ Why do scientists study birds?
	+ What can you learn from studying birds?
	+ Can the study of birds tell scientists about their habitats?
	+ What kind of skills do you think scientists use to study birds? Do you use any of those same skills? (e.g. making observations, finding patterns, asking questions)
	+ What kind of tools do you think scientists use to study birds?
* **After watching the live webcast on 2/6:**
	+ Do you have new ideas about what a scientist does?
	+ Do you have any new ideas about what we can learn from studying birds?
	+ Can you remember one way that Sahas studies birds?
	+ What kind of skills do you and scientists have in common?
1. **Submit your students’ questions:** Do your students have more questions about birds or being a scientist? Send students’ questions to ScienceHow@si.edu or through our webpage on [*Ask Science How*](https://naturalhistory.si.edu/education/distance-learning/ask-science-how)*!*

**Background Information for Teachers**

* **About Ornithologist Sahas Barve and his research**

As a kid growing up in Mumbai, India, Sahas Barve loved being outside and observing the natural world around him, especially birds. Now, as an adult and self-acclaimed bird-nerd, Sahas has observed thousands of birds around the world, and calls a field-site in the Himalayas home-base for several months each year to study the birds that live there. Habitats within the Himalayas are especially diverse, or different, since the mountain range stretches over 1,500 miles long and includes some of Earth’s highest mountain peaks, including Mount Everest. Studying how birds stay warm, especially in these ecosystems that stretch far and high, is of particular interest to Sahas. Sahas hopes to better understand if birds living in extremely cold temperatures at extremely high elevations, like some parts of the Himalayas, are more dependent on their warm feathers than birds that live in slightly lower and warmer elevations. To research this question, he studies birds in the wild when he is at his field site, by observing them in nature, recording their calls, studying their feathers, and taking tiny blood samples that can reveal a lot about the animal. Back at the Smithsonian’s National Museum of Natural History, Sahas uses a collection of birds that has been created over the last 150 years to look at and compare birds’ feathers, searching for patterns that might help him better understand the structure of feathers in birds across these diverse habitats.

* **How Do Birds Stay Warm?**
* **Feathers:** Feathers are modified scales that cover birds’ bodies and provide insulation by trapping air. The two main types of feather structures are downy feathers (plumulaceous) and the stuff part of the feather (pennaceous). The downy feathers trap air close to the bird’s body, keeping it insulated. The stiff portions of feathers, the pennaceous part, have tiny structures that interlock to form a wind and waterproof barrier. Many feathers have both downy regions and pennaceous regions on their feathers.

(source: <https://academy.allaboutbirds.org/feathers-article/>)

* **Generating Body Heat:** When feathers aren’t enough, birds generate their own body heat through metabolic processes, or thermoregulation (meaning “to control heat”). Birds are endotherms, meaning that they must maintain a certain core body temperature to survive. Birds generate heat by moving and flying around and shivering, just like humans. While this helps birds stay warm, it requires energy, which requires food. Birds must have access to food to have the energy they need to move about to maintain their body temperature to survive.
* **Behaviors and Adaptions:** Birds have adapted different behaviors to help them stay warm. For example:
	+ **Migrating:** some birds, like snow geese, migrate to escape cold temperatures
	+ **Grouping:** some birds, like bee eaters, gather in close groups to share and maintain body heat
	+ **Dwelling in cavities:** some birds dwell in cavities, like tree stumps, to shelter them against the cold
	+ **Sunning:** some birds, like vultures, spread their wings out in the sun to warm up
	+ **Food Caching:** some birds, like chickadees and jays, hide or “cache” large amounts of food to have a source of food through the winter
	+ **Communal Roots:** some birds, like crows, will roost in large groups to share information about where food can be food
	+ **Torpor:** like putting your computer to “sleep,” some birds can enter a state of inactivity, or torpor, which lowers the bird’s body temperature and metabolic rate, saving energy. Some chickadees, doves, and hummingbirds use torpor.

**Live Webcast Format- What to Expect**

1. **Introduction**- The hosts of the program will provide an overview for teachers and students for how to participate in the chat, Q&A, and live polls throughout the program. Students will be also introduced toOrnithologist Dr. Sahas Barve, a scientist at the Smithsonian’s National Museum of Natural History. Sahas will introduce students to the Himalayas, the mountain range in which he does his research. He’ll show the students the kinds of birds that live in the Himalayas and will introduce his current research to learn more about how birds in extremely cold environments in the Himalayan Mountain Range stay warm.
2. **Feathers-** Sahas will talk about how feathers keep birds warm and which parts of the feathers are especially important in insulating them against the cold. During this discussion we will show two behind-the-scenes videos that demonstrate the tools and the Smithsonian bird collection he uses to study bird feathers and collect evidence that demonstrates how feathers keep birds warm. Students will have a chance to do to interactive polls focused on interpreting graphs and feathers. Sahas will also discuss and show images of behaviors that keep birds warm, like fluffing their feathers, huddling together, and hiding in cavities.
3. **Generating Body Heat-** Sahas will reveal that birds are endotherms, animals that regulate their temperatures using internal mechanisms (like shivering) to maintain their body temperature. He’ll discuss how all birds must use energy to maintain and generate heat when their feathers aren’t enough. He’ll discuss how moving to maintain body heat requires energy, which requires food. He’ll share some adaptations that birds have evolved to meet their energy needs, like caching food and roosting in groups to share information. He will provide examples from his research in the Himalayas to demonstrate the science concepts and research connections. There will be two interactive polls in this portion of the show, which focus on making hypotheses.
4. **Extended Q&A-** Throughout the program, Sahas will take student questions. After the final content segment, he will answer as many student questions as time allows.

Additional resources related to how birds stay warm are available in this Smithsonian Learning Lab collection, <http://learninglab.si.edu/q/ll-c/aohiuD98Uj1evaHE>

**Next Generation Standards Alignment**

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

* **3-LS2-1** Construct an argument that some animals form groups that help members survive
* Science How alignment: some birds huddle together in groups at night to conserve body heat, while other birds roost in communities to share information about food availability

3-LS3 Heredity: Inheritance and Variation of Traits

* **3-LS3-2**Use evidence to support the explanation that traits can be influenced by the environment
* Science How alignment: some birds that live in colder climates have more downy feathers compared to species that live in warmer climates, who have less downy feathers.

3-LS4 Biological Evolution: Unity and Diversity

* **3-LS4-2**Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
* Science How alignment: birds that have adapted feathers, metabolic processes, and certain behaviors that may provide advantages for survival in cold environments.
* **3-LS4-3** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
* Science How alignment: some birds can’t survive in cold environments, so migrate to escape cold temperatures; some birds have adapted behaviors, like caching food, to survive cold temperatures.

4-LS1 From Molecules to Organisms: Structures and Processes

* **4-LS1-1**Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
* Science How alignment: birds have feathers to keep them warm (external structures) and when feathers aren’t enough insulation from the cold, they can burn calories, e.g. shiver, to keep their body warm (internal physiological mechanism), which is necessary for survival.)

5-LS1 From Molecules to Organisms: Structures and Processes

* **LS1.C** Organization for Matter and Energy Flow in Organisms, Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion
* Science How alignment: food provides birds with calories, which are required to burn energy that the bird uses to shiver and move, which are essential for survival by generating body heat to maintain its core temperature

**Graphics to Support Learning**

More graphics and images are available on the Smithsonian Learning Lab: <https://learninglab.si.edu/collections/how-birds-stay-warm-with-ornithologist-sahas-barve/aohiuD98Uj1evaHE#r>

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