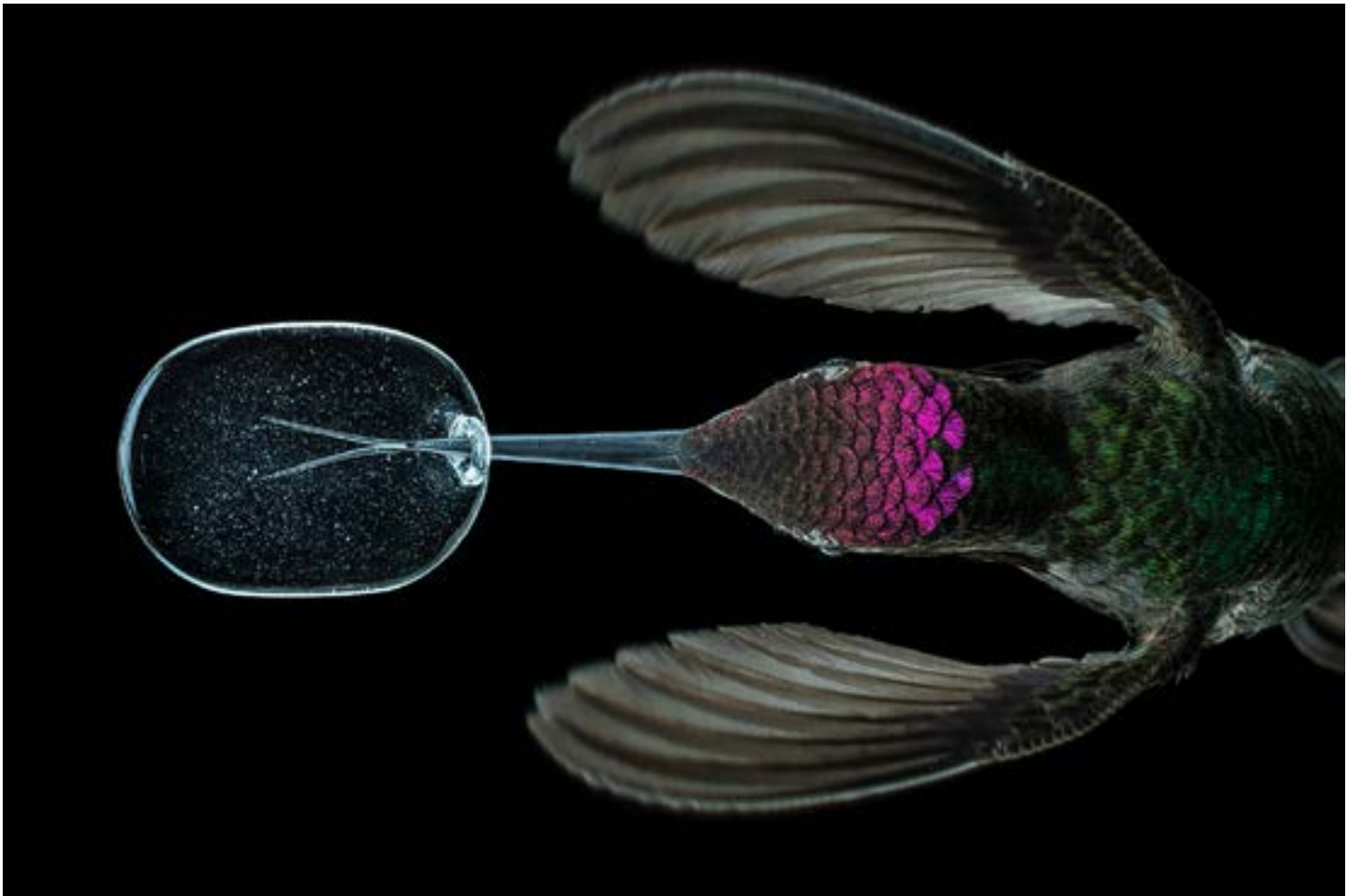


VITAL IMPACTS



# Student Speaker Series



FEATURING

Anand Varma



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All website references in this document are consolidated at  
<https://bit.ly/anandvarmamedia>



# Anand Varma



Anand Varma practices “slow looking” behind the lens of his camera. He takes the time to stop and look carefully at nature, revealing the incredible details the naked eye can’t easily perceive. He spent his childhood in Atlanta, Georgia, exploring the woods at an early age, then went on to study Integrative Biology at the University of California, Berkeley. Instead of pursuing a traditional academic science career, however, he picked up a camera, using it to share his own curiosity about the world with others.

Anand has photographed multiple stories for National Geographic, and has turned his camera on the detailed lives of a variety of animals. He’s documented the first few days of baby bees’ lives, built incredible custom setups to record the biomechanics of how hummingbirds fly, trekked through the Mexican rainforest to film a colony of bats roosting in a Mayan temple, and more.

Much of Anand’s photography is inspired by the graphic high-contrast art style of comic books and he’s interested in finding creative ways to showcase even the creepy crawl world that others might not easily find aesthetic beauty in, such as parasites that can alter and control their hosts’ minds. He builds elaborate setups and uses custom equipment including

wind tunnels, black lights, netting, tanks, and even everyday household items to get exactly the shot he wants. Anand continues to push technological boundaries in photography and collaborate with scientist experts to reveal the incredible detail in the everyday world around us.

Step into a world of wonder with biologist-turned-photographer Anand Varma as he unlocks the mysteries of nature through cutting-edge photography techniques. Anand captures the invisible behaviors of the natural world, beyond our naked eye. From the life cycle of a honeybee to the lightning-fast hummingbird, his images and videos reveal the hidden worlds that exist just beyond our perception.

Visit Anand’s website to learn more about him and see some of his amazing photographs.

Learn even more about Anand at Changemaker Talent.

Anand’s newest book, **National Geographic Invisible Wonders**, showcases some of his spectacular photographs of objects we cannot see with the naked eye.

Varma, Anand. "National Geographic Invisible Wonders." Penguin Random House, 26 Sept. 2023

Links to all background materials can be found on the reference page at <https://bit.ly/anandvarmamedia>

# Relevant Concepts and Standards



## Science concepts related to Anand’s content area include:

- Life cycle, biodiversity, ecosystems, habitat, evolution, animal adaptations, human environmental impact, food web, pollinators, parasitism, engineering, bioinspired design

## 5th-8th grade standards that may be supported by Anand’s content include:

- **5-LS2-1** - Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- **5-ESS3-1** - Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.
- **MS-LS1-4** - Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- **MS-LS1-5** - Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- **MS-LS2-2** - Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- **MS-LS2-4** - Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- **MS-LS4-4** - Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.
- **MS-ESS3-3** - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

# Background Information

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## Mindsuckers

Get up close and personal with the creepy crawly world of parasites and their hosts. Learn more about parasites' complex life cycles, how some can use "mind control" to effect their host's behavior, and see these creatures in stunning detail via Anand's photography. Note: This article requires a National Geographic subscription which may be accessible via certain schools and organizations.

Zimmer, Carl. "Mindsuckers." *National Geographic Magazine*, National Geographic Society, Nov. 2014.

## Quest for a Superbee

Honeybees are facing a variety of threats from pests, to habitat loss, to colony collapse disorder. Learn more about honeybee behavior, beekeeping, and the amazing ecosystem service they provide as pollinators, as well as the work being done to protect bees moving forward, such as breeding more resilient bees and exploring ways to incapacitate a harmful mite that is currently decimating colonies. Note: This article requires a National Geographic subscription which may be accessible via certain schools and organizations.

Mann, Charles C. "Quest for a Superbee." *National Geographic Magazine*, National Geographic Society, May 2015.

## Unlocking the Secrets behind the Hummingbird's Frenzy

Learn all about hummingbirds, the long line of scientists and photographers who have tried to understand their incredible movement, and the way high-speed cameras are currently being used to peek into the hyper-fast world of these birds' behaviors. Note: This article requires a National Geographic subscription which may be accessible via certain schools and organizations.

Borrell, Brendan. "Unlocking the Secrets behind the Hummingbird's Frenzy." *National Geographic Magazine*, National Geographic Society, Jul 2017.

## How to Capture a Hummingbird Mid-Flight

Learn about how Anand uses innovative photography setups with advanced cameras to capture stunning photos of hummingbirds. Note: This article requires a National Geographic subscription which may be accessible via certain schools and organizations.

Goldberg, Susan. "How to Capture a Hummingbird Mid-Flight." *National Geographic Magazine*, National Geographic Society, Jul. 2017.

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Links to all background materials can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Background Information

### Films and Video

#### Varma, Anand. "Science Photographer: Anand Varma | Best Job Ever."

YouTube, uploaded by NatGeoKids, 13 Dec. 2018,  
<https://www.youtube.com/watch?v=ibZqyNwP8G0>

**Run time: ~2 minutes**

Get a brief introduction to Anand and learn more about the types of stories he aims to tell with his photographs.

#### Varma, Anand. "Getting the Pictures | Mindsuckers."

YouTube, uploaded by National Geographic, 31 Oct. 2014,  
<https://www.youtube.com/watch?v=S6tLbyjQGU&t=3s>

**Run time: ~3 minutes**

Learn some of the incredible tricks Anand uses to get photos of parasites. Note: this video contains flashing light effects.

#### Jaacks, Jason. "In Search of Tzotz."

DCEFF, 2017,  
<https://dceff.org/film/in-search-of-tzotz>.

**Run time: 9 minutes**

Meet Dr. Rodrigo Medellin, a biologist known internationally as the "Bat Man of Mexico". He's spent his career documenting the ecosystem services provided by bats all over Mexico, but now he is hoping to track down two particularly rare species deep in the Mayan rainforest. Join Anand as he helps Dr. Medellin find and photograph these amazing creatures.

#### Varma, Anand. "Capturing a Carnivorous Bat on Camera | National Geographic."

YouTube, uploaded by National Geographic, 2 July 2018,  
[https://www.youtube.com/watch?v=B8QhY\\_0H99g](https://www.youtube.com/watch?v=B8QhY_0H99g)

**Run time: ~3 minutes**

This video dives deeper into the detailed photography setup Anand created for documenting bats in Mexico. It offers a glimpse "behind the scenes" and pairs well with the above short film.

#### Varma, Anand. "The First 21 Days of a Bee's Life."

TED Talk,  
[www.ted.com/talks/anand\\_varma\\_the\\_first\\_21\\_days\\_of\\_a\\_bee\\_s\\_life](http://www.ted.com/talks/anand_varma_the_first_21_days_of_a_bee_s_life)

**Run time: 6 minutes**

One way to get up close and personal with bees is to raise them in your backyard and take incredibly detailed photographs of them, which is exactly what Anand did. Watch the first 21 days of a bee's life in incredible detail and learn more about what is making bee colonies so vulnerable and how scientists are working on ways to protect them.

#### Varma, Anand. "Photographing the Real Life of Bees | National Geographic."

YouTube, uploaded by National Geographic, 1 Feb. 2018,  
<https://www.youtube.com/watch?v=NSDZDY6cNDg>

**Run time: ~4 minutes**

Pair this video with the above TED talk to learn more about the techniques Anand used to engineer his beehive and take such detailed photos of these small creatures.

#### Varma, Anand. "What It Takes to Film Hummingbirds in Slow Motion | National Geographic."

YouTube, uploaded by National Geographic, 28 July 2017,  
<https://www.youtube.com/watch?v=2KOxZtLxdK4&t=38s>

**Run time: ~2 minutes**

Learn about the remarkable setup Anand created to film such an incredibly fast bird.

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Links to all films and videos can be found on the reference page at <https://bit.ly/anandvarmamedia>  
We recommend opening these links to follow along.

## Background Information

### Websites

#### US Fish & Wildlife Service: Pollinators

Learn more about pollinators including current threats they are facing and ways we can help.

"Pollinators: Pollinator populations across the United States are declining, and everyone can help." US Fish and Wildlife Services, [www.fws.gov/initiative/pollinators](http://www.fws.gov/initiative/pollinators).

#### The Cornell Lab of Ornithology: eBird

Explore bird photos, sounds, videos, and range maps via eBird. Contribute to participatory science efforts. Take a closer look at native hummingbirds in your area like the ruby-throated hummingbird common across much of the US.

"Cornell Lab of Ornithology-Home." Cornell Lab of Ornithology, 2023, [www.birds.cornell.edu/home/](http://www.birds.cornell.edu/home/).

#### Bat Conservation International

Read about different species of bats, find places you can view bats across the US, and learn more about bat conservation efforts.

"Bat Conservation International / Ending Bat Extinctions Worldwide." Bat Conservation International, 4 Oct. 2023, [www.batcon.org](http://www.batcon.org).

#### Exploring by the Seat of Your Pants

Bringing those on the frontlines of science, exploration, conservation, and adventure live into classrooms through virtual guest speakers and field trips.

Home - Exploring by the Seat of Your Pants. 2023, [www.exploringbytheseat.com](http://www.exploringbytheseat.com).

#### View recordings of their Global Biodiversity Festival presentations.

Global Biodiversity Festival Year 4, Exploring by the Seat of Your Pants, 30 Aug. 2023, [https://www.youtube.com/playlist?list=PLwKFsJZmdxpFfbyVWQ0\\_gCyWoXhGAqY3a](https://www.youtube.com/playlist?list=PLwKFsJZmdxpFfbyVWQ0_gCyWoXhGAqY3a).

Global Biodiversity Festival Year 3, Exploring by the Seat of Your Pants, 24 July. 2022, <https://www.youtube.com/playlist?list=PLwKFsJZmdxpGryUYol9hbrpGZZmBhbO3G>.

Global Biodiversity Festival Year 2, Exploring by the Seat of Your Pants, 20 July. 2023, <https://www.youtube.com/playlist?list=PLwKFsJZmdxpEhK9d-PHhHQqQgdM-2Xay0>.

Global Biodiversity Festival Year 1, Exploring by the Seat of Your Pants, 24 July. 2022, <https://www.youtube.com/playlist?list=PLwKFsJZmdxpGLffxa9I5IXsmBoDeRMD0>.

#### Videos relevant to Anand's work include Anand's own presentation

Varma, Anand. "Anand Varma | Exploring the Hidden Wonders of Our World." YouTube, uploaded by Exploring By The Seat of Your Pants, 28 May. 2021, <https://youtu.be/uodv5BAGOmo>.

Sierra-Durán, Carol. "Cárol Sierra-Durán | Bats & Rice in Mexico." YouTube, uploaded by Exploring By The Seat of Your Pants, 19 Jun. 2023, <https://youtu.be/Oyx6PR6aWw>.

Medellin, Rodrigo. "Rodrigo Medellin | Why Bats Matter: The Goods and Benefits of Having Bats in Our Lives." YouTube, uploaded by Exploring By The Seat of Your Pants, 26 May 2022, <https://youtu.be/eAKyMa3doT0>.

Links to all websites can be found on the reference page at <https://bit.ly/anandvarmamedia>

# Activities

Check out these activities and lessons to prepare your students for the event.

## National Geographic: WonderLab Learning Resources

WonderLab Learning Resources is a collection of online activities, learning tools, professional learning modules, and videos inspired by renowned National Geographic Explorer and photographer Anand Varma's work.

"WonderLab Learning Resources." National Geographic Education, National Geographic Society, <https://education.nationalgeographic.org/resource/wonderlab-learning-resources>.

## Close Looking Compare/Contrast

Compare and contrast different styles and types of parasite photography. Instruct students to first look at one style of parasite photography by Marcus DeSieno

"Old Time Portraits of Parasites." Smithsonian Magazine, Smithsonian Institution, 25 July 2014, [www.smithsonianmag.com/science-nature/old-time-portraits-parasites](http://www.smithsonianmag.com/science-nature/old-time-portraits-parasites).

Encourage students to make observations of these images. You might use a See Think Wonder thinking routine. Other guiding questions could be: What do you notice? What adjectives would you use to describe these parasites? What do these images remind you of? Instruct students to then look at Anand's parasite photography and repeat a similar line of questions.

"Parasites." Anand Varma Photography, [www.varmaphoto.com/parasites?](http://www.varmaphoto.com/parasites?).

Ask students to compare/contrast the two photography styles. What is similar/different? What feelings do you think these two photographers were trying to evoke with their different styles? Is there one you like more than the other? Why? Conclude the discussion by reinforcing that there is no "right" or "wrong" way and no "better" or "worse" way to take photographs or make art. Each artist uses their own technique and style to tell a story.

## Night of the Living Detritus

Use this interactive virtual game by Tyto Online to teach your students about "zombie" ants who have become hosts for the cordyceps fungus parasite. Note: this is a classroom tool that does require a paid subscription but may be accessible for those who already have Tyto accounts.

"Tyto Online." Tyto Online, [www.tytoonline.com](http://www.tytoonline.com).

"Night of the Living Detritus - Teacher Guide for Classroom Storyline Use." Google Docs, <https://docs.google.com/document/d/1H4W22chXa9Z6m2yWPYnlyKHXDobgToc3mNzx4mPD3bs/edit#heading=h.nj23sjpj5u97>.

All activity links can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Activities

**Flowers Seeking Pollinators**

In this activity from the California Academy of Sciences, students learn about plant reproduction and use real data to construct explanations about which flowers are the most attractive to different pollinators.

"Flowers Seeking Pollinators." California Academy of Sciences, [www.calacademy.org/educators/lesson-plans/flowers-seeking-pollinators](http://www.calacademy.org/educators/lesson-plans/flowers-seeking-pollinators).

Smithsonian Science How: Spooky Collections and Spectacular Bat Adaptations

Students will create their own scientific illustrations of bat specimens by drawing along with experts as they showcase different bat specimens at the Smithsonian's National Museum of Natural History. Students will explore the adaptations of these different bats including vampire bats, nectar bats, and giant flying foxes.

"Webinar: Spooky Collections and Spectacular Bat Adaptations!" Smithsonian National Museum of Natural History, <https://s.si.edu/45qJlub>.



All activity links can be found on the reference page at <https://bit.ly/anandvaramedia>

## Activities

**A Picture is Worth a Thousand Words:  
Interpreting Anand's Photos**

**Show your students the following photographs of Anand's. Lead them through close looking and interpretation of the photos using the following questions.**



- What do you notice in this photograph? Gather observations from students.
- What do you think is going on? Encourage students to make connections and educated guesses. What body parts do you recognize on this bee?
- What else do you wonder about what's going on in this image?
- **Reveal the context of the photograph: This is a young honeybee emerging from a brood cell, a cell in the honeycomb where baby bees develop from larva, to pupa, to adult. Bees have hairs all over their bodies which can help trap pollen as they're moving from flower to flower. This image is composed of 23 digitally merged photographs.**

All activity links can be found on the reference page at <https://bit.ly/anandvaramedia>

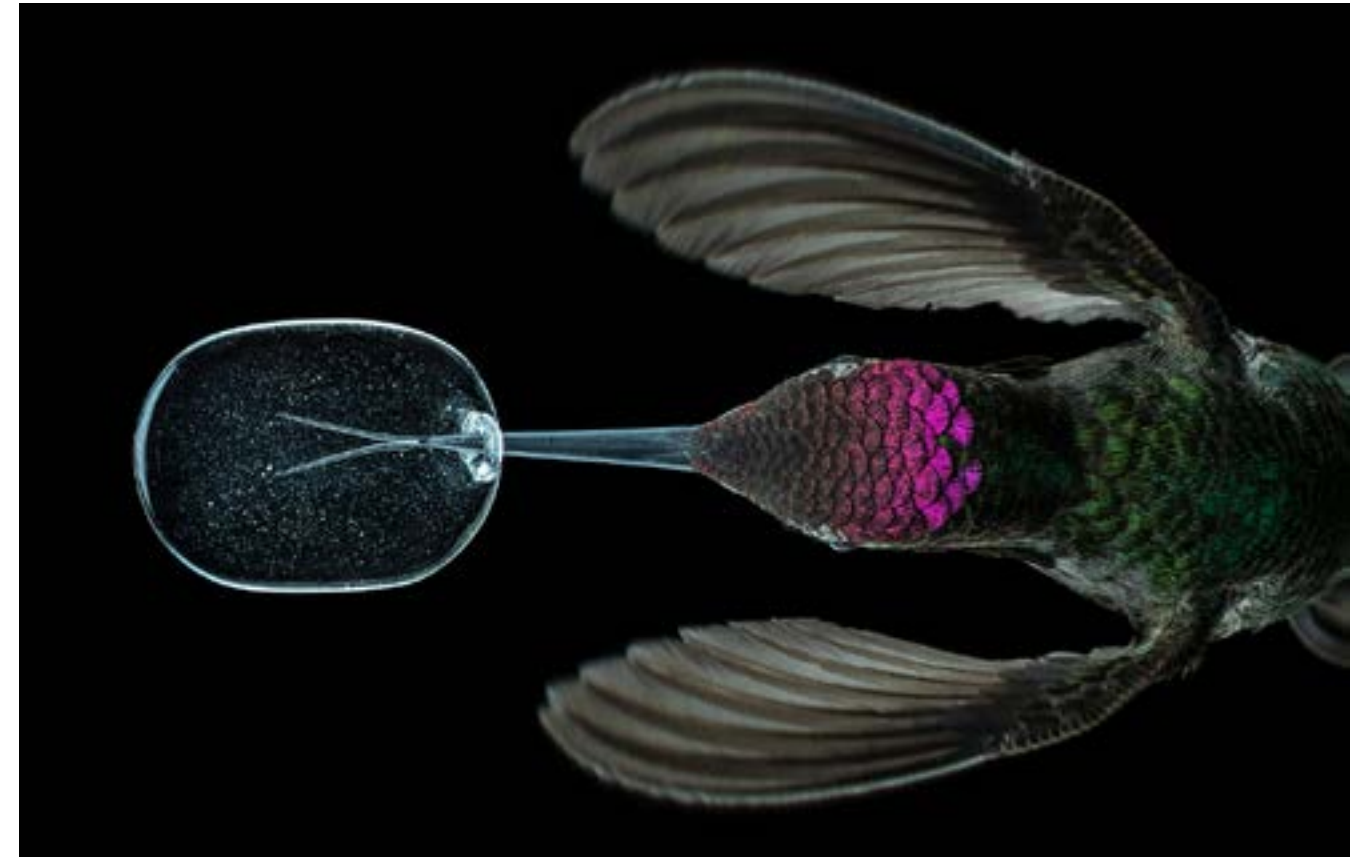
## Activities



- What do you notice in this photograph? Gather observations from students.
- What do you think is going on? Encourage students to make connections and educated guesses. What animals do you recognize? What do you think is happening with this cricket?
- What else do you wonder about what's going on in this image?
- **Reveal the context of the photograph: This is a photo of two organisms, a cricket and a horsehair worm. The cricket is the host and the horsehair worm is the parasite. Horsehair worms, like many parasites, have a complex life cycle that involves living inside a host organism. First, an adult horsehair worm lays eggs in a river or stream. The eggs hatch and those larvae are eaten by things like mayfly larva. But the horsehair worm can only develop inside a cricket, so it waits inside the mayfly (the intermediate host) until the mayfly grows into an adult, heads to dry land, lives its life, and then dies. When a cricket eats the dead mayfly, the horsehair worm gets inside the cricket and starts feeding on fat inside the cricket's body. The horsehair worm essentially "takes over" the cricket - it absorbs the cricket's energy stores and causes them to stop growing and stop chirping. The horsehair worm needs to keep the cricket alive, however, in order to hitch a ride to the water where it has to be to lay its eggs. It begins to tweak chemicals in the cricket's brain that make it walk around randomly so that sooner or later it's more likely to get to a body of water, at which point the cricket**

All activity links can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Activities



- What do you notice in this photograph? Gather observations from students.
- What do you think is going on? Encourage students to make connections and educated guesses. What kind of bird do you think this is? What do you think it's doing here?
- What else do you wonder about what's going on in this image?
- **Reveal the context of the photograph: This is a hummingbird drinking nectar with its feathery forked tongue, as viewed from above. To get just the right view, Anand had a glassblower make this specific glass container and trained hummingbirds to drink from it.**

All activity links can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Activities



- What do you notice in this photograph? Gather observations from students.
- What do you think is going on? Encourage students to make connections and educated guesses. What equipment do you recognize? How would you describe the lighting in this room?
- What else do you wonder about what's going on in this image?
- **Reveal the context of the photograph: This is Anand Varma in his studio. Studio photography often involves more than just a camera - Anand uses lights and backgrounds to create a very specific setup. He sometimes also uses environmental additions like smoke and water to add practical effects to his photographs.**

All activity links can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Activities



- What do you notice in this photograph? Gather observations from students.
- What do you think is going on? Encourage students to make connections and educated guesses. What animals do you recognize? What kind of structure do you think this is? Does it look old or new? Do you recognize what culture built this building?
- What else do you wonder about what's going on in this image?
- **Reveal the context of the photograph: This is a woolly false vampire bat flying in front of a Mayan temple in Mexico. A group of these bats were roosting in the temple, leaving it at night to go hunting for the small animals like mice, frogs, and birds that it likes to eat.**

All activity links can be found on the reference page at <https://bit.ly/anandvarmamedia>

## Activities

## Read and Discuss: Catching Zombies in the Act: How to Picture Parasites

### Learning Objectives

Students will:

- Read and discuss an article about how photographer Anand Varma photographs parasites and their hosts

### Student Outcomes

After participating in this activity, students will be better able to:

- Determine a central idea of a text and how it is conveyed through particular details
- Reflect on visual examples of parasite/host relationships

### Standards

Aligns with:

- CSS.ELA-Literacy.RST.6-8.2 - Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions

### Materials

Lee, Jane. "Catching Zombies in the Act: How to Picture Parasites." National Geographic, 31 Oct. 2014, <https://www.nationalgeographic.com/photography/article/catching-zombies-in-the-act-how-to-picture-parasites>.

### Vocabulary words

- Organism - A living thing.
- Parasite - An organism that lives on or inside another organism (the host) and gets food or other things it needs from the host in a way that harms the host.
- Parasitology - The study of parasites.

### Procedure

1. Give students a copy of the National Geographic article *Catching Zombies in the Act: How to Picture Parasites* for them to read. The videos can be watched together as a class or independently. Note: both videos contain flashing light effects.
2. Once everyone has finished reading and watching the videos, have students write down in their own notebooks their answers to the following questions.
  - a. What is the main message of the article?
  - b. What are you finding difficult to understand?
  - c. What is something you found interesting?

The link for this Read and Discuss article can be found at <https://bit.ly/anandvarmamedia>

## Activities

3. Pose the following 'check for understanding' questions to the class for the group to answer:
  - a. Q: What is a parasite? What is a host?
    - i. A: A parasite is an organism that lives on or inside another and gets food or other things it needs from that host organism at the expense of the host.
  - b. Q: What was the first technique Anand tried to get the images? Why did he decide not to use that technique in the end?
    - i. A: X-rays. He didn't want to use x-rays because it was too hard to tell the difference between the parasite and the host when they were both together in the same image.
  - c. Q: What art style was Anand inspired by?
    - i. A: Comic books and graphic novels.
    - ii. Follow-up question for open discussion: Have you ever read a comic or graphic novel? Did you like it? How would you describe that type of art? What makes it unique?

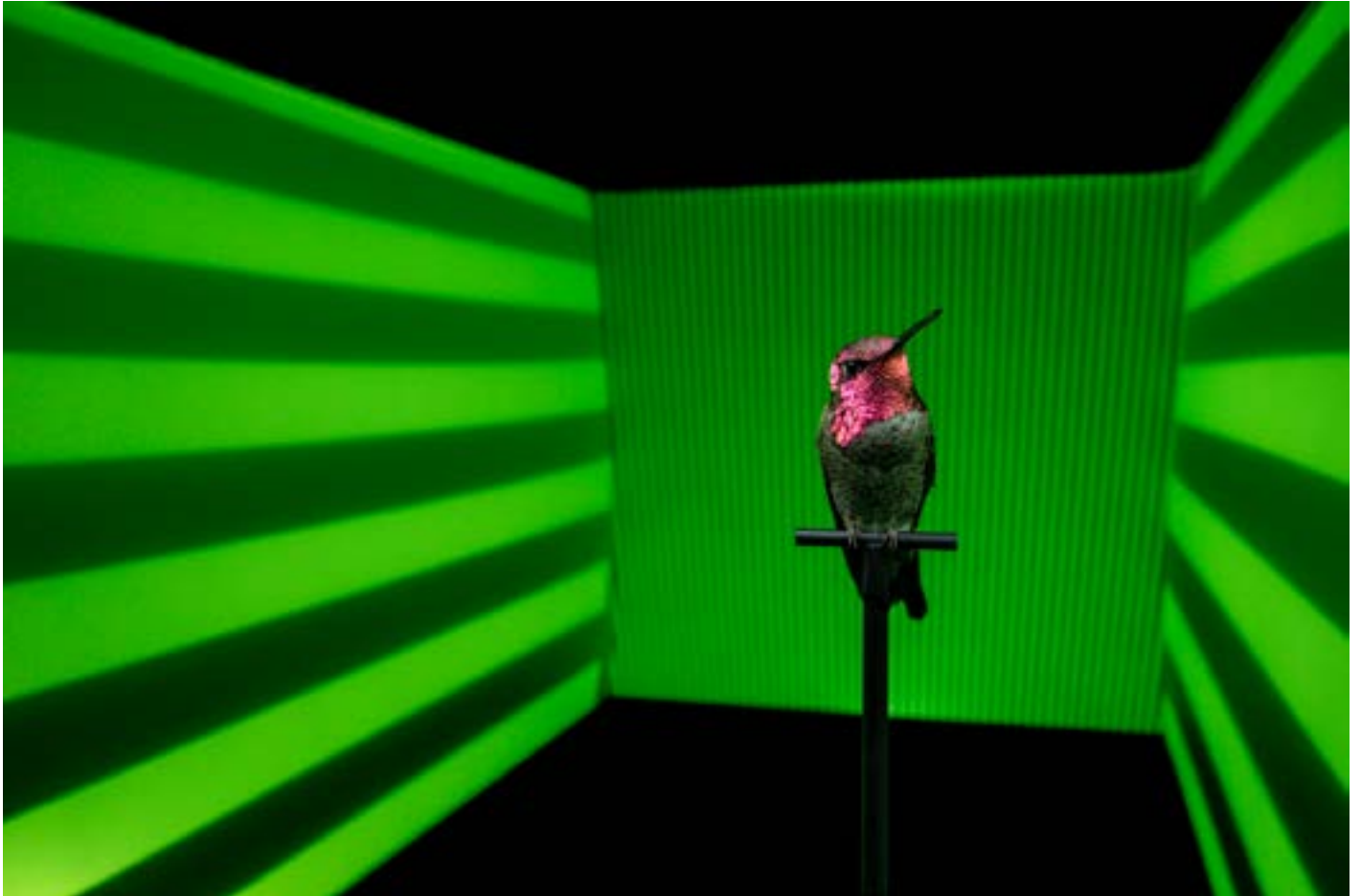
4. Ask if students still have unanswered questions related to something they found difficult to understand and clarify any challenging concepts.

5. Pose the following reflection questions and discuss:
  - a. Anand talks about parasites being gross but also cool. What do you think now after reading the article and watching the videos, are they gross? Cool? Both? How do these images make you feel?
  - b. Why is it important to learn more about parasites?
  - c. If you could take an up-close photo of something in nature to learn more about it, what would you want to photograph? Why?

6. If there are any remaining questions that are difficult to answer, encourage students to do their own research. Alternatively, encourage them to bring those questions to ask at the Speaker Series event.

The link for this Read and Discuss article can be found at <https://bit.ly/anandvarmamedia>

# VITAL IMPACTS



All photos by Anand Varma