

Science in Action: Pearl, Dan, & Kendrick

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Science in Action: Pearl, Dan, & Kendrick



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What About Pluto?

Chapter

1

Nine-year-old Pearl Davis jumped off the school bus and ran up the steps to her home in New Jersey on a Friday afternoon. She found her parents seated at the dining room table surrounded by papers, notebooks, and books. They were deep in conversation about the work of their students.

Pearl threw her arms around her dad, gave him a big hug, and did the same for her mom. Raised by her parents to be curious and ask questions, Pearl didn't disappoint them today.

"What's that scent you are wearing? It smells so great."

"What's for dinner tonight? Do I smell stew?"

"I saw a huge blackbird sitting on a telephone pole when I got off the bus just now. Do you think it was looking for something to eat?"

"Did you hear what happened to Pluto?"



Pearl's dad grinned and said, "Slow down! One question at a time, please. Which of your questions is the most urgent?"

"Let me think," replied Pearl. "I'm always very curious about perfumes and how are they made. Who decides how they smell? How come I can smell some perfumes from across the room?"

"But, right now, Pluto is more urgent. Today, in science, we were talking about weather and climate on Earth and someone asked about weather on the seven other **planets** in our **solar system**."

My teacher said, "Yes, with Earth, there are a total of eight planets in our solar system. But until about ten years ago, there were nine planets. Then scientists decided Pluto is not a planet."

"Why did the scientists change their minds about Pluto?" Pearl asked her parents.

"Let's check out what the NASA website says about Pluto," her mom suggested.

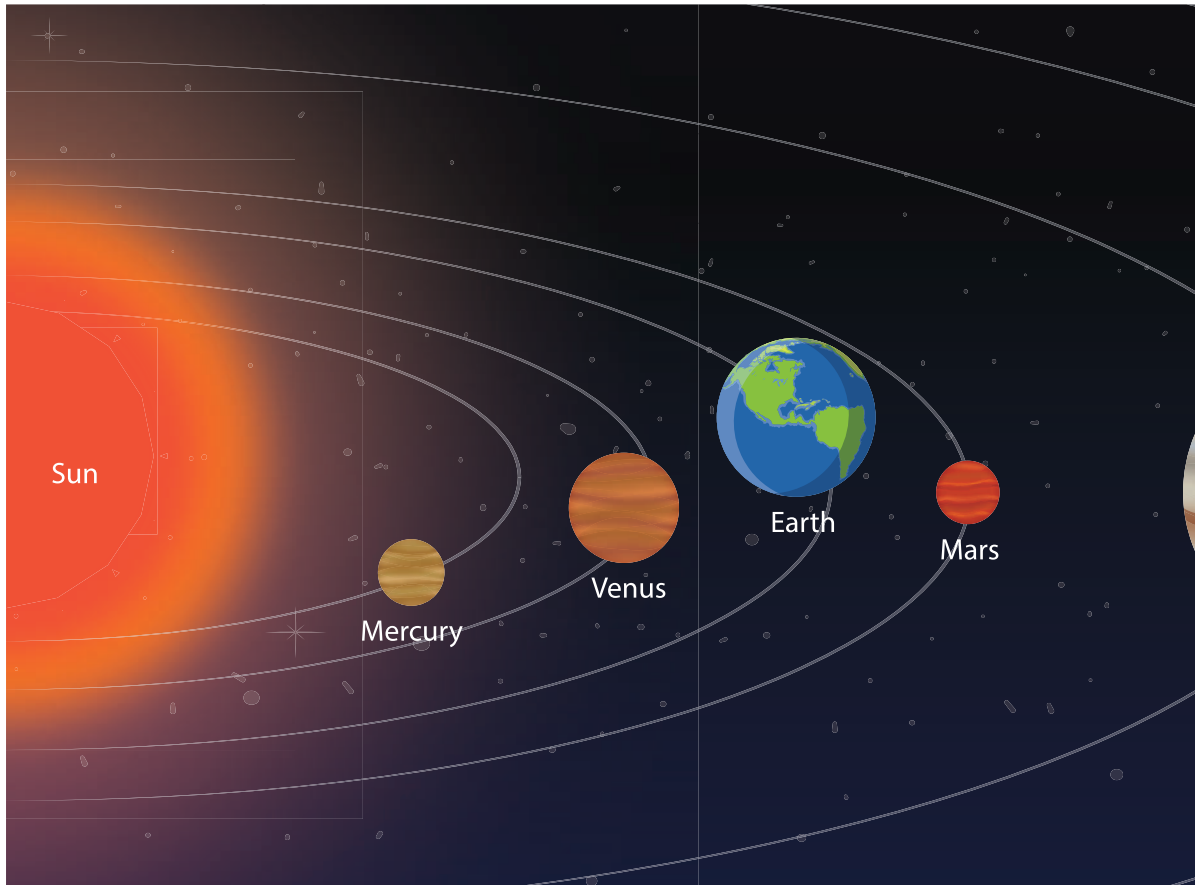
You could turn the page to learn what Pearl found. Or first try looking it up yourself!



Our solar system is made up of many space objects. One of these objects is a star called “the sun.” Stars are huge round balls of gases that give off light.

Our solar system also has eight planets. Planets are also round, but smaller than the sun, and do not give off their own light. The four planets closest to the sun—Mercury, Venus, Earth, and Mars—have surfaces made of solid rock. The four planets farthest from the sun—Jupiter, Saturn, Uranus, and Neptune—have surfaces made of gases.

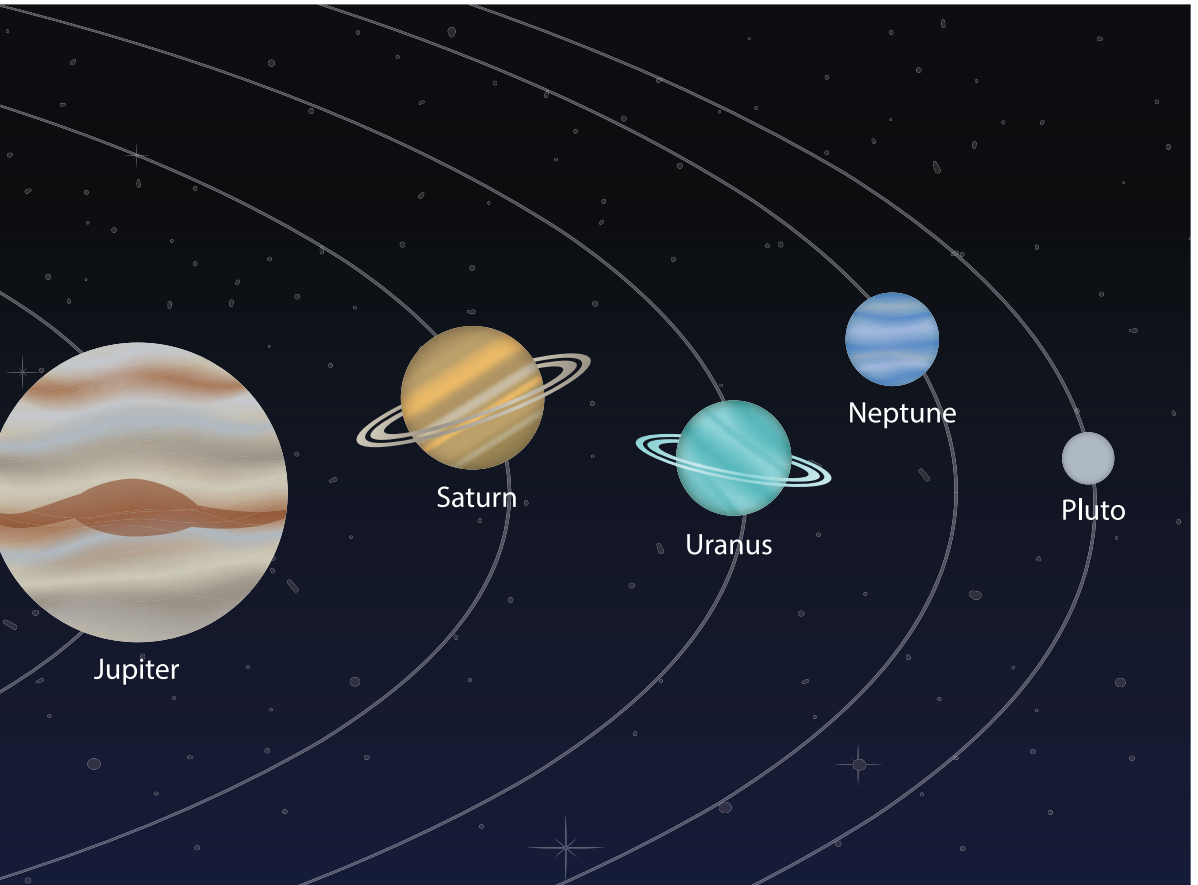
About one hundred years ago, scientists found what they thought was a ninth planet. But in recent years, they have discovered other objects in the distant parts of the solar system that seem like planets, too. Scientists disagreed about what to call these objects.



In 2006, space scientists from around the world met to discuss which objects in our solar system are planets and which are not. They argued for an entire week! Does it surprise you that scientists don't always agree on the answers to their questions?

At the end of the meeting, the scientists made a decision. One of the nine planets was no longer a planet. Pluto was now classified as a **dwarf planet**. Pluto and the other dwarf planets are located past Jupiter—very far from the sun—in a very cold part of space.

If you are anything like Pearl, you might be curious about dwarf planets. What questions do you have? How would you find answers to them?



"I remember, you were just a baby. It was big news in 2006 when scientists agreed to reclassify Pluto from planet to dwarf planet," her dad said.

"What's the difference?" asked Pearl.

"Interesting question, Pearl. I'm curious about that, too. Let's see if we can find answers on the NASA website," her dad said.

They learned that to be called a planet, a space object must do three things.

1. It has to move around the sun but not around other planets.
2. It has to have a round shape.
3. It has to produce enough force to clear away other objects near it.

Dwarf planets do numbers 1 and 2 but not number 3.



Pearl was thoughtful for a moment. Then she asked, “So, is the final answer that Pluto is not a planet because it cannot clear away other space objects near it?”

“Maybe not. Since 2006, space scientists have continued to argue about how to classify objects in space,” Pearl’s mom said.

“Where does the force come from?”

“How do these space objects use force?”

Her mom grabbed an orange from a bowl and tossed it in the air. “When you were in third grade, you learned that gravity is the force that pulls objects down. The force of gravity comes from Earth. But Earth is not the only planet that pulls objects toward it. All space objects pull on other objects near them. When they can pull smaller objects down to their surface, that is called ‘clearing the neighborhood.’ It turns out that Pluto does not have enough force to clear its own neighborhood.”



While she ate breakfast the next morning, Pearl continued to ask her mom questions.

“Can we see planets in the night sky tonight?”

“How do you know that you are seeing a planet and not a star?”

“What about Pluto? Could we see it?”

Pearl’s mom smiled as she replied, “I have an app on my phone that shows where to look for planets and stars in the night sky. If it is not cloudy tonight, we can try using it to find planets.”

Pearl anxiously watched the sky all day, looking for clouds and wishing them away. As the sun was setting, she noticed that the sky was free of clouds. Excited, she reminded her mom of her promise to use the app to look for planets.



As the sky darkened, Pearl and her mom went outdoors. Pearl held her mom's phone up in front of her face, with the sky map app open. As she slowly rotated her body, the app showed the part of the sky she was facing. When she turned to face southwest, she spotted what seemed to be a very bright star on the app. "That's Venus," her mom said.

Pearl looked up in the same direction and saw Venus in the sky. "It looks like it is giving off light. But that cannot be right," she said.

"The light actually comes from the sun. Venus is reflecting sunlight, much like a mirror would," her mom replied.

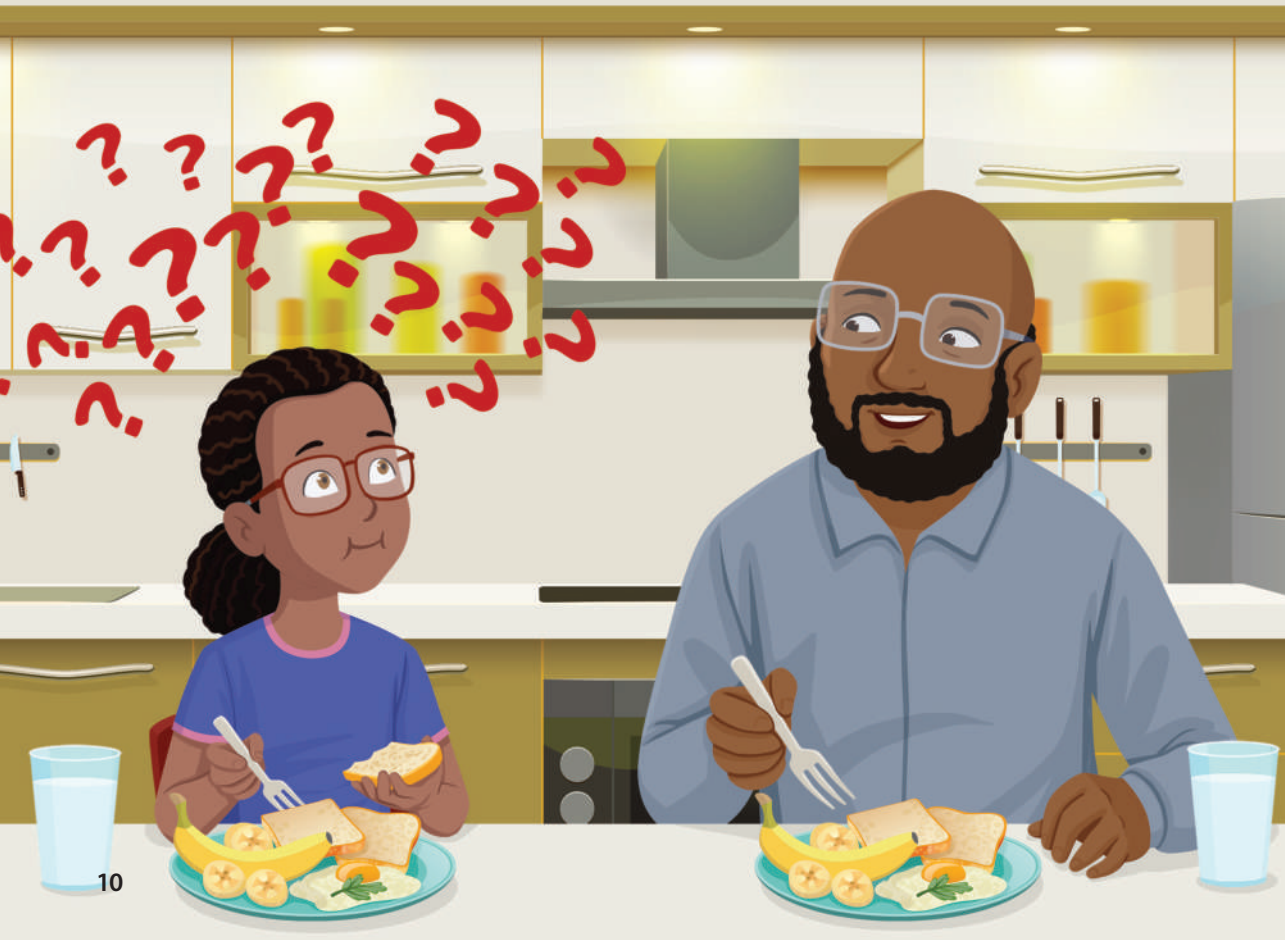
"But what about Pluto?" Pearl asked.

"The app shows that Pluto is slightly below and to right of Venus tonight," Mom answered. "But we cannot see it without a telescope because it's just too far away."



At breakfast the next morning, Pearl's dad asked her if she wants to be a planetary scientist when she grows up. Pearl said, "I don't think so—do I have to choose now? There are so many other things I'm also curious about, like how come I can smell your cologne after you have left the room? And how are perfumes invented? And when can I wear perfumes?"

Her mom and dad looked at each other and answered together, "When you get to high school."



Five years later, Pearl finally did start high school. The night before her first day of ninth grade, she reminded her parents of their promise. Her parents gave her a small bottle of perfume as a gift. It smelled great, and Pearl felt confident wearing it to school the next day. As she walked down the hallway of her new school, she thought to herself, "I can learn the science behind how perfumes work and are made. Maybe, someday, I'll design a new perfume for other people to enjoy."



Pearl Davis: Becoming a Scientist

Chapter

2

The story you read in Chapter 1 about nine-year-old Pearl Davis is pretty accurate. Pearl is a real person, and she really was a very curious child and asked her parents many questions. Pearl's mom and dad encouraged their daughter to ask questions. They knew she would learn more that way.



Why?
Where?
When?
How?
How?
How?
How?

Pearl also asked even more questions in school, especially during science lessons. When her fourth-grade teacher mentioned that Pluto was once a planet but not any longer, Pearl wanted to know, “Why isn’t it a planet anymore?”

When Pearl was older, she thought about her childhood, her family, and elementary school. She said, “I was always raised to ask questions and be curious. So, it felt very natural for me to be in a **STEM** career.”



What did Pearl mean by a “STEM” career? These are jobs in which people use science, technology, engineering, and math. People who work in STEM jobs are in high demand and can be well paid. Which of these jobs would you like to try?

Science

Plant Scientist

The human population of the world is growing. Plant scientists investigate plants that people can use for food. They find ways to grow them faster and make them healthier for people who eat them.



Engineering

Robotics Engineer

Some jobs are too dangerous, hard, or boring for people to do. That’s where robots are helpful. A robotics engineer solves problems like these by designing, building, and testing robotic machines that are helpful to humans.



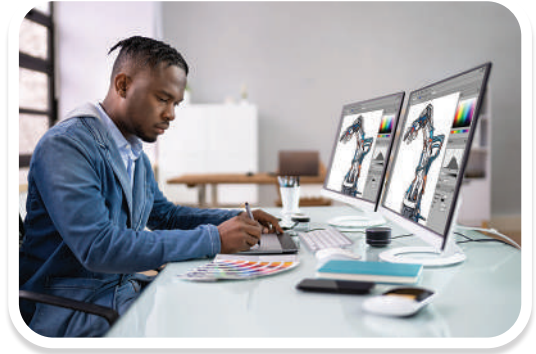
T echnology

Digital Designer

Some websites seem to work better than others, right?

A digital designer writes code that runs websites, designs new web pages, and keeps track of the number of people who use the site.

Digital designers also need to make websites look good by understanding how to use color, photos, and type creatively.



M athematics

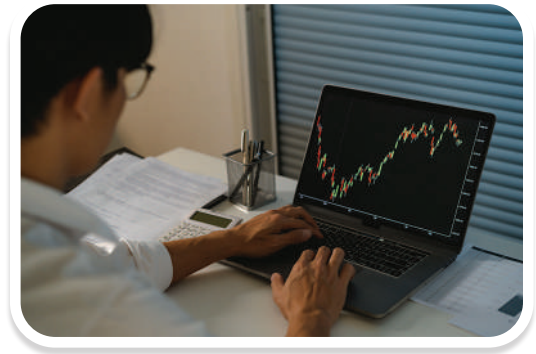
Statistician

Information collected by observing, questioning, or measuring is called *data*.

Statisticians use their math skills to analyze data and make it more useful to people.

Let's say you want to try skateboarding but want to know how safe it is.

Statisticians can provide data on skateboard safety that you can use to make a decision.



What other jobs are STEM careers? How could you find answers to this question?

When Pearl was in middle school, she thought she might want to have a career as a medical doctor or teacher. Then, in her third year of high school, she was invited to join the Science National Honor Society. At the honor society meetings, she learned that science is more than reading books to find the answers to questions. Instead, scientists answer questions by doing investigations.

That same year, Pearl Davis received an award for her student leadership and community involvement. She said, "It's a reminder of why I work so hard."



In her last year of high school, Pearl received the highest grades of all her classmates. She certainly would have many choices when it was time to decide on a college. At the time, Pearl wanted to attend a college that was close enough to home that she could live with her family. She thought if she was too far away she would miss her family and their support too much.

Then a university called Rensselaer Polytechnic Institute (RPI) invited her to become a student. RPI was in New York state, a few hours from home. Pearl knew she would have to live on campus and might not see her family for months at a time. As she thought it over, she began to realize that she could do it. She began to “dream bigger” about what college could be for her and decided to go to RPI for college.



During her first few days at RPI, Pearl felt homesick. She wondered to herself, "Am I supposed to be here? Can I do this?" Many of the other new students also came from far away. They were probably a little homesick, too. But soon all the first-year students met one another, ate meals together, did homework together, and became friends.

Pearl felt better after talking to the fourth-year students. They admitted that they felt the same way as Pearl when they were in their first year. But now they seemed so confident. They were doing well in their classes. Soon Pearl felt accepted and comfortable at RPI. In her second year at college, Pearl signed up to help the new first-year students get used to college.





Interested in learning how new medicines are made for people, Pearl chose to major in biochemistry. A major is the focus or goal of a student's college education. Most colleges offer many majors from which students can choose. Each major has its own list of classes the student must take and do well in.

As a biochemistry student, Pearl has to learn about living things, matter and how it changes, forces and energy, and some challenging math. Studying biochemistry would prepare her for a STEM career.

In one of her classes, Pearl learned about personalized medicine. Medicines are "personalized" when they are designed and made for just one patient. To do this, doctors have to learn as much as possible about the patient's inherited traits, where they live, and how they live.

At college, Pearl imagines her future designing personalized medicines. She might do the work at a pharmaceutical company. These are businesses that discover, invent, and make medicines. The medicines may be used to cure diseases or to stop them from ever making people sick. If Pearl wants to work at a company close to her family's home, that will not be a problem. New Jersey is home to more large pharmaceutical companies than any other U.S. state.



Personalized medicines can be inhaled, rubbed on the skin, or swallowed.

There are many kinds of jobs at a pharmaceutical company. Pearl's goal is to work as a researcher. What does that mean? After finishing her four-year college degree, she will continue school. It might take her another two to six years. That might frighten some students, but probably not Pearl.

As a researcher, she might help design new medicines or new ways to help sick people. She would work in an office with a laboratory. Labs, like the one shown, have lots of equipment and tools.

"I do see myself in a lab with the lab coat, with the goggles, pipetting and experimenting," Pearl says.



The researcher in the photo is using a pipette to move liquid from one tube to another.

Inspired by . . .

To be **inspired** by someone means they made us want to try something.

Dr. Patricia Era Bath, Eye Surgeon and Inventor

- Born in New York City, 1942
- Her mother bought her a toy chemistry set to interest her in science. Patricia went to college to study chemistry and then to medical school to become a doctor.

Neat Work

- Invented a tool using lasers to remove cataracts, which can cause blindness, from people's eyes
- Founded a way for eye doctors to help more people, called *community ophthalmology*. Her community program brought eye care services to where people live, work, and go to school.

Words of Wisdom . . .

"The ability to restore sight is the ultimate reward."



Pearl Davis was inspired to get into science by Dr. Patricia Era Bath, a Black eye surgeon and inventor. Pearl said, "Seeing somebody that looks like me making it that big is like, wait, like, I'm not limited to whatever I thought I was limited to, like, it's more there's more to what I can do."

In Pearl's first high school science class, she read about Antonie van Leeuwenhoek. Something about him fascinated her. She read those pages over and over.



Antonie van Leeuwenhoek

- Born in the Dutch Republic, 1632
- His father's family owned a basket factory, and his mother's family made fabrics. It is likely he was a curious and patient child.

Neat Work

- Invented microscopes with only one lens
- Used his microscopes to see living things no one had seen before
- Wrote letters to other scientists to describe how the tiny bacteria and protozoa looked and moved

Words of Wisdom . . .

"On these observations I have spent more time than many will believe, but I have done them with joy, and I have taken no notice of those who have said 'Why take so much trouble and what good is it?'"



Weather Watcher

Chapter

3

“Watch this,” Dan whispered. He carefully placed a straw into a tall cup of water. He covered the straw with a finger and took the straw all the way out of the cup.

His friends stood around him, eager to see what his newest trick was all about. It had to do with a scientific marvel Dan recently learned about: air pressure. But he didn’t have time to explain all of that.

Like a magician doing an act, Dan told the group, “On the count of three, water will come pouring out of my straw.” He held the

straw high in the air. “One, two, three!”

As Dan lifted his finger off the top of the straw, his friends oohed and aahed as water spilled out of the straw and back into the cup.



Some of Dan's friends asked to see how he did it. Other students chanted for Dan to do his trick again. But the school bell rang, and it was time for everyone to go home for the day. "Another time," Dan said, as he was met with a series of groans.

With his backpack snug around his back, Dan walked down the small streets of his hometown. It was his favorite part of the day because it meant he could be outside for the next several hours. In rain or sun (and sometimes even snow), Dan loved being outdoors. After all, the outdoors is where all the weather happens.



As he walked, Dan looked up at the sky. Sure enough, there they were: the clouds that the meteorologist had forecast earlier that day, when he said there was a high chance of rain.

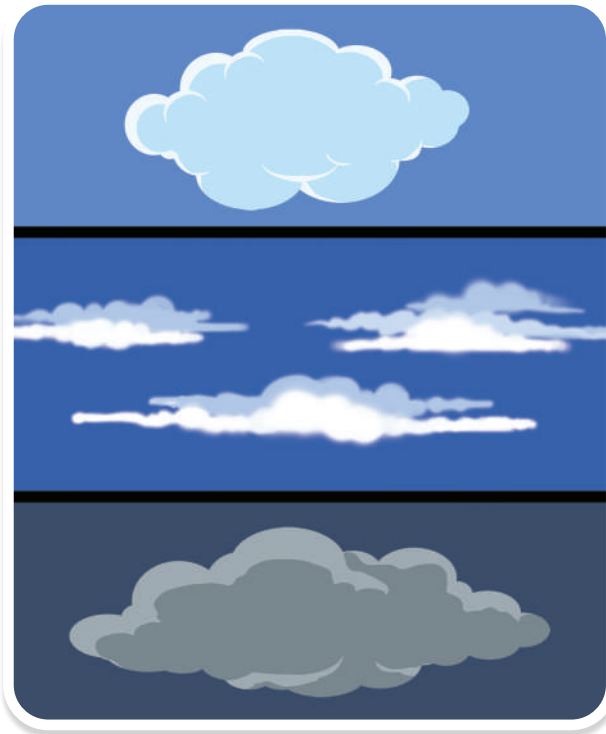


Dan began to pick up the pace, not because he was worried about the possibility of getting caught in the rain but because he wanted to be home in time to observe the weather in action!



Racing home, Dan tried to not get rained on. The sprinkles of water felt cool on his skin. When he got to his house, he ran up the steps, dashed to his room, and collected some of his favorite weather gadgets.

Dan grabbed his weather notebook, a magnifying glass, a pocket-sized weather guide, and some other things. He brought everything back outside to set up his portable weather station.



As the afternoon went on, fluffy white clouds continued to gather overhead, but there was nothing more than some rain here and there. Dan studied the sky, trying to identify all the types of clouds he saw. There were cumulus clouds, shaped like cotton balls, and cirrus clouds that were thin and wispy. But then something changed—the clouds grew darker, and their edges curled upward.

“It’s happening!” Dan exclaimed. “Cumulonimbus clouds!”

He scribbled notes in his weather journal, describing the towering thunderheads. Lightning flashed, followed by a distant rumble of thunder. Dan’s heart raced. He knew a storm was brewing. At first he was on the porch but he moved inside to a safe location as the storm approached.

Just then, Dan’s neighbor Lily ran over. “What are you doing, Dan?” she wanted to know. Dan let her in the house and they looked out the window.

“I’m tracking the weather,” Dan said. “See those clouds? They’re like giant cauliflower heads. This thunder and lightning happens when they get this tall have thunderstorms!”

Lily looked up, her eyes wide. “Wow! Can I help?”

“Sure,” Dan said. “You can help with counting.”

“Counting what?” asked Lily.



Just then, a flash of lightning lit up the sky, followed by a loud crack of thunder. Lily yelled and covered her ears.

Dan chuckled. "We need to count the seconds between the flashes of lightning and when we hear the thunder," he explained. "It will tell us how close we are to the storm. You do the counting, and I'll record the time."

Lily nodded. Lightning zigzagged across the sky. "One Mississippi, two Mississippi . . ." Lily whispered. She got all the way to ten Mississippi and then a loud boom echoed.

"The storm is about two miles away," Dan announced after analyzing his notes.

They repeated this process several times. "According to my data, the storm is moving closer to us," said Dan. "That means it's traveling east."



Dan felt a rush of excitement come over him at the idea that the storm was moving in closer. He hovered over a page in his weather guide filled with cryptic symbols—the language of the sky. To Dan, studying the weather was like deciphering a secret code.



“Why is the storm moving?” asked a soft voice. It was Lily. Dan was so preoccupied by his excitement over the storm that he had forgotten she was still there.

“The wind carries the clouds in different directions around the planet,” Dan explained, giving her a simple explanation that she

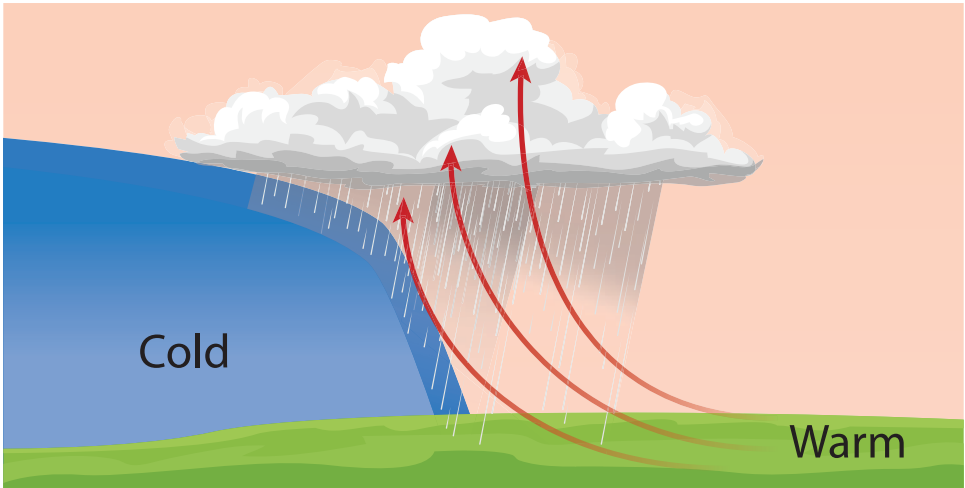


could understand.

“Wind,” he continued, “is like a silent messenger. It carries messages from distant places, whispering secrets about storms and weather.”

BOOM!

The rumbles of thunder were getting louder as the storm moved closer. Dan imagined thunderstorms as battles in the sky where cold fronts clashing with warm fronts. Thunderstorms erupted where the two fronts collided—a fierce dance of charged particles!



Dan’s weather journal overflowed with coded entries. But he suddenly paused as his neighbor Lily said, “It seems like I can feel the rumble of the thunder tickling my bones.”

Huh. With all the weather watching Dan had done, this was something Dan *hadn’t* thought about before. And Lily was right. At the sound of the next thunderous boom, the deep rumble shook the air.



Dan knew that sound travels by way of vibrations. He learned this from his years of music classes and playing instruments.

When he plays the piano, the little hammers inside the piano hit the keys and produce a vibration that makes a sound.



When Dan plays the clarinet, the air that he blows into it causes the reed to vibrate, which makes a sound.

When Dan plays the drums, the drumsticks strike the drum and produce a vibration and a sound.

Vibrations from sound are exactly why Lily can feel the thunder in her bones, Dan thought. He tried explaining this to Lily.



“How do you know all of this stuff about thunder sounds and storms, Dan?” Lily asked.

Dan blushed. “Well, I read about it in my weather books, and I listen to a lot of weather reports. Sometimes I just lie in bed, listening to the wind or the rain and wondering about the world and how it works.”

A smile came across Dan’s face as he watched Lily gazing up at the sky. He was glad they had the chance to observe the thunderstorm together. He knew she likely wouldn’t join him for all of his weather-watching quests. But he enjoyed getting to share his interests with her today.

After all, to him, the weather wasn’t just science; it was a language waiting to be discovered and understood—one raindrop, one star, one sunrise at a time.



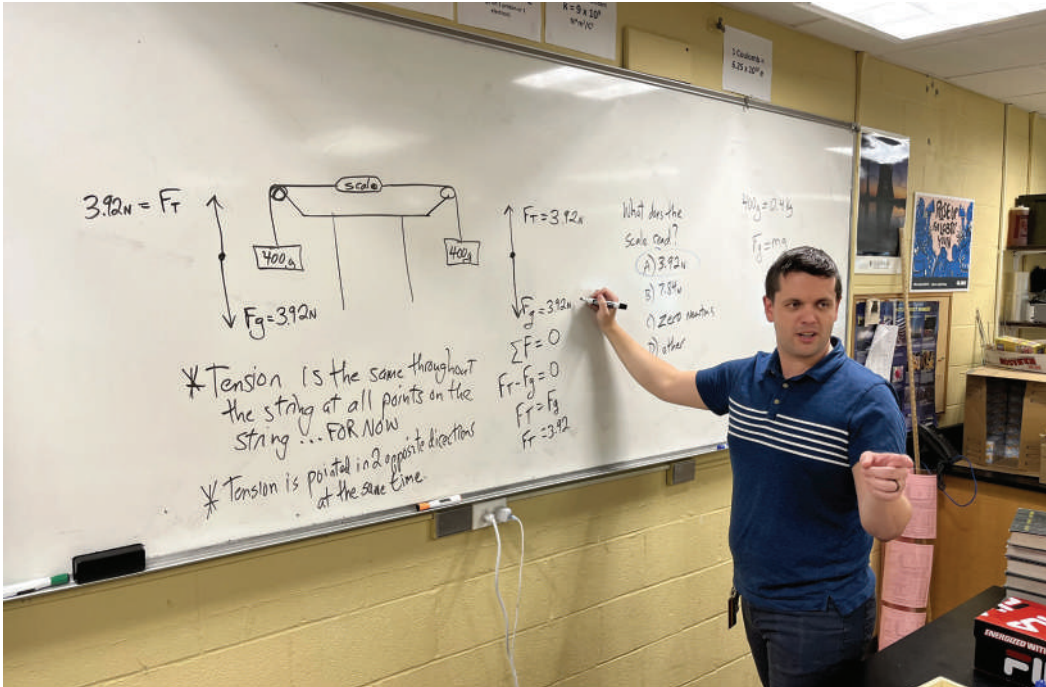
Daniel Longhurst: Teaching Tomorrow's Scientists

Chapter

4

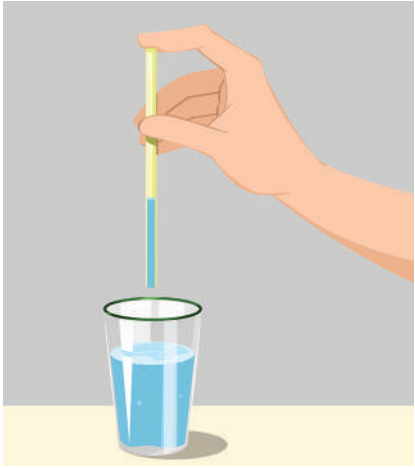
In the bustling halls of the high school where Mr. Longhurst teaches in a New York suburb, there's a classroom where wonders about the universe never cease.

Let's open the classroom door and take a look inside. You might be surprised at who you will see. Remember Dan, the storm enthusiast and weather watcher from the last chapter? Well, here he is now and all grown up!



Meet Daniel Longhurst! With a heart full of passion for the cosmos and equations, Daniel works as a dedicated high school teacher, teaching physics, astronomy, and math.

From a young age, Daniel has been intrigued by both the simple and the complex. His childhood was full of questions about how everything around him worked. Whether he was experimenting with drinking straws and water or making music, Daniel had a knack for exercising his curiosity. He felt like he was part of something bigger, and he wanted to know more about it.



Looking back, Daniel remembers how fascinated he was by all sorts of weather—something that turned into a lifelong love for meteorology. From eagerly watching weather reports and tracking rainstorms to figuring out how weather patterns fit together, Daniel’s early days exploring the natural world set the stage for his curiosity in science.

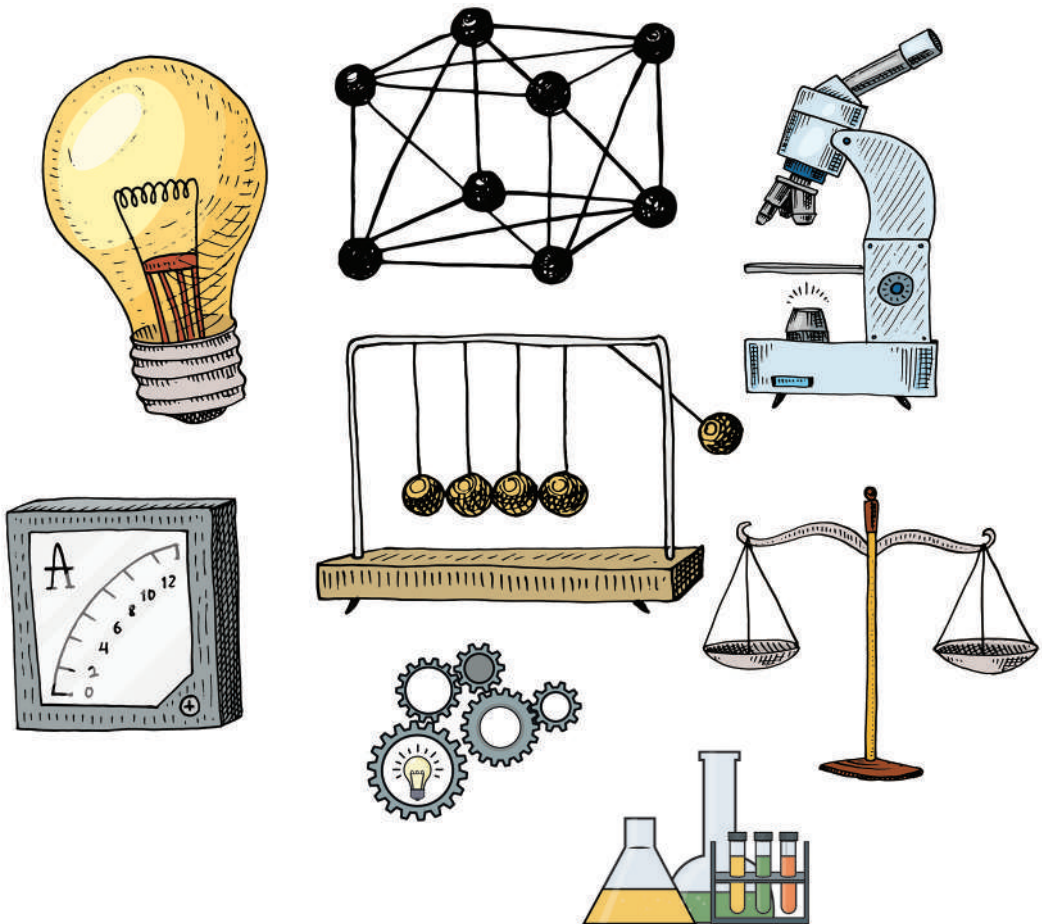


It’s no wonder that now Daniel is a teacher! He gets to share his passion for science and help others explore the world around them.



Daniel's journey into teaching was inspired by his high school chemistry teacher, whose enthusiasm and skill greatly influenced his career choice. During his junior year in high school, Daniel's chemistry class inspired his interest in science. This led him to imagine a future in teaching.

His interest in teaching grew during his senior year while taking physics. This steered Daniel specifically toward specializing in physics education. However, Daniel's path to becoming an educator was not a straight route. As a young student, Daniel had many interests, from foreign languages to architecture, music, and meteorology. He explored different things but eventually followed his heart to a career in education.



Daniel loved learning so much that he decided to get a master's degree in teaching at Union College. He was excited to become a great teacher. At college, Daniel learned a lot by helping other students in their science classes. His experiences there shaped his approach to educating students today.



Daniel has a particular teaching philosophy. He believes in using tools like math to help figure out how the universe works. He thinks it's important to really understand ideas, especially in space studies, where he teaches kids to think about the big questions, like "why" and "how." In his science class, Daniel makes sure everyone understands the math they need to know by starting with fun activities. This way, students get ready for exciting adventures in learning before they dive into being young scientists!

Daniel's philosophy about teaching is centered on making connections. To him, teaching is more than just sharing facts; it's about building strong bonds with students and fueling their natural curiosity. Whether he's uncovering the secrets of Kepler's laws or venturing into the endless possibilities of thermodynamics, Daniel's classroom is a place where minds come alive. He treasures understanding big ideas in subjects like astronomy, encouraging students to think about how scientific concepts relate to the world around them. In his physics classes, Mr. Longhurst uses a lot of hands-on activities right from the beginning so that students can gain a solid grasp of the concepts right from the beginning.



Beyond his professional life, Daniel has a rich background in music. His musical journey spans across various instruments, including the piano, clarinet, and saxophone as well as percussion, showcasing his diverse talents. Starting with piano lessons in first grade, he steadily honed his skills throughout his academic years.

Drawing parallels between music and science, Daniel recognizes how both disciplines provide structured learning experiences during school.

Among the hustle of textbooks and laboratory gear, Daniel finds peace in the seamless blend of music and science.



With proficiency in multiple instruments, he embodies the fusion of art and science, creating a symphony of creativity and curiosity.



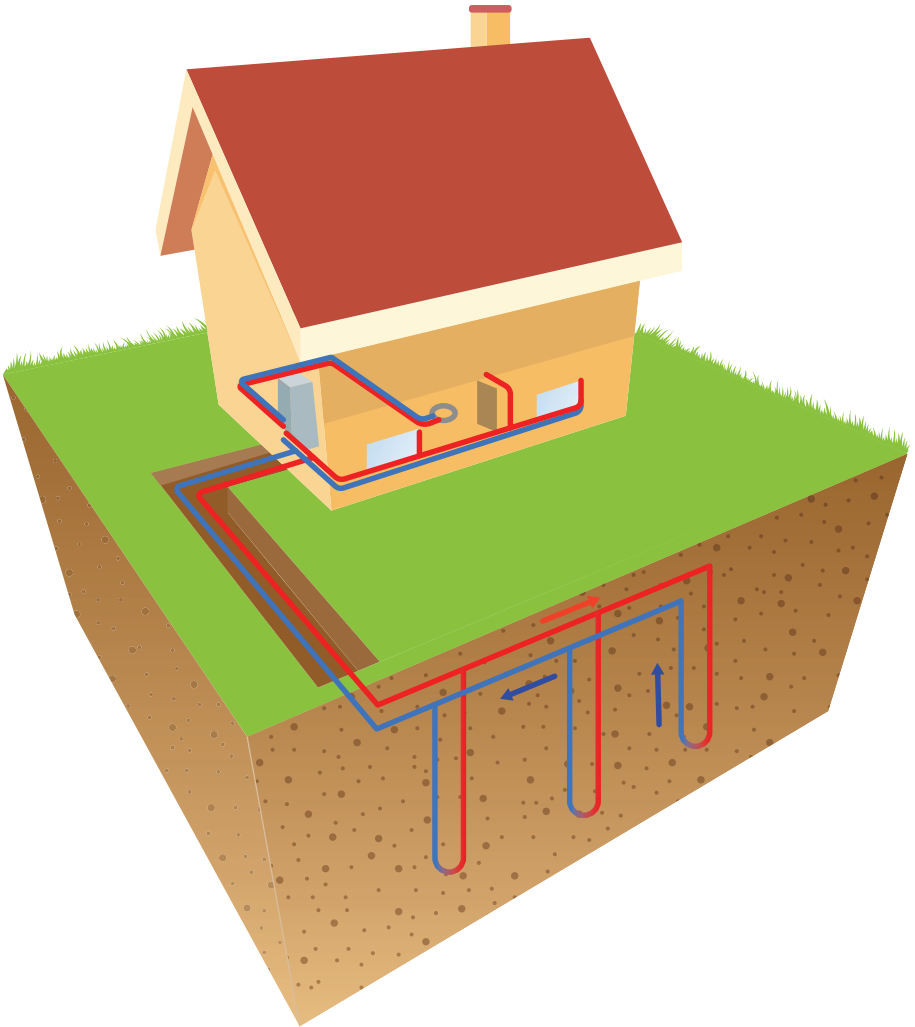
Daniel has his own interests in science beyond the classroom as well.

Daniel is fascinated by something modern and exciting: heat pumps! Heat pumps have been around for a while, but lately, they're making big news. Why? Because they're an efficient solution for heating and cooling homes. Most heating methods turn one type of energy, like electricity or gas, into heat. But heat pumps are different.



They use thermodynamics to move heat around.

Imagine you're at home, feeling chilly on a cold winter's day. Usually, you would turn on the heater. But what if there were a way to stay cozy and warm without using a ton of energy? That's where heat pumps come in. They're like magical machines that can both heat and cool your home while using less energy than traditional methods.



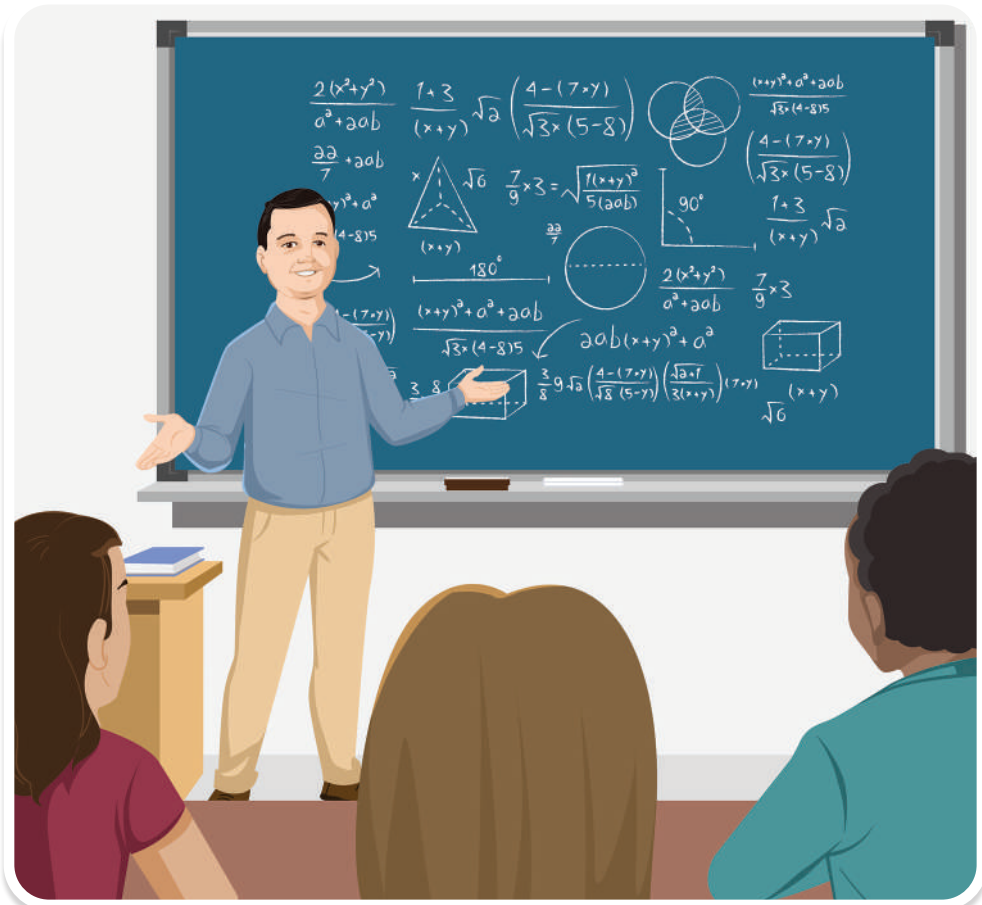
Instead of transferring heat from matter or other forms of energy, like a typical heater does, heat pumps move heat from one place to another. Heat pumps can even reverse the process and move heat outside to cool things down inside.

Daniel’s parents are installing a geothermal heat pump in their new house. It uses the natural heat from the ground to warm up the house, or it moves heat outside to cool down the house. There’s a lot of physics and engineering behind it!

Daniel loves learning about energy—how it’s made, stored, and moved around. To him, it’s like solving a giant puzzle!

Daniel is fascinated by legendary figures such as Isaac Newton, Tycho Brahe, and Johannes Kepler. Their groundbreaking discoveries form the foundation of the physics lessons he shares. He's also interested in modern scientific uses, like energy efficiency and heat pumps, showing his commitment to practical, real-world learning.

Daniel's journey is all about learning and loving education deeply. He encourages questions and discovery, aiming to inspire curiosity in his students. His teaching style stresses that science isn't only about remembering facts; it is also about understanding how the world works and exploring the endless possibilities that knowledge offers.



Daniel's classroom is special. It makes learning exciting and makes students want to learn more. Daniel doesn't just teach; he inspires. He plants ideas in his students' minds, helping them grow become scientists, engineers, and creators.

But Daniel's influence goes beyond the classroom. He's helping to shape the future. By showing the amazing parts of science and encouraging students to think for themselves, he gives them the tools they need to solve big problems in the world. Some students might become scientists, and others might choose different jobs, but they'll all remember Daniel's lessons as they move forward in life.



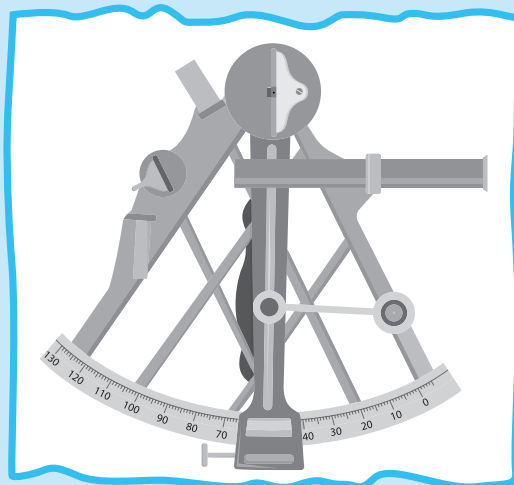
Inspired by . . .

To be **inspired** by someone means they made us want to try something. Daniel Longhurst was inspired by his high school chemistry and physics teachers. He was intrigued by the works of Tycho Brahe, Johannes Kepler, and Isaac Newton.

Tycho Brahe, Danish Astronomer

- Born in 1546
- Accurately measured the positions of stars and planets
- Built many instruments for observing the sky, including quadrants and sextants

INTERESTING FACT: He had many personal and professional challenges, including losing his nose in a duel with a fellow scientist.



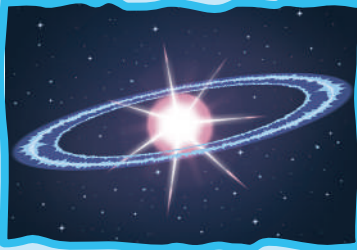
Sextant



Johannes Kepler, German Astronomer

- Born in 1571
- Proved that the motion of the planets around the sun is elliptical
- Observed a supernova (an event in which a star explodes) in 1604
- Paved the way for Isaac Newton's future work on gravity

INTERESTING FACT: His mother was put on trial for being a witch! Her life was spared because he was an advisor to the king.



Supernova



Isaac Newton, English Physicist and Mathematician

- Born in 1643
- Introduced the laws of motion and universal gravitation
- Developed theories on light
- Invented the reflecting telescope

INTERESTING FACT: He became known for his talent in building model machines, including a working model of a windmill that could grind grain.



Reflecting telescope

Who inspires you to find out more about the way things happen? Who has helped you figure out how something works?

Wings and Wonders

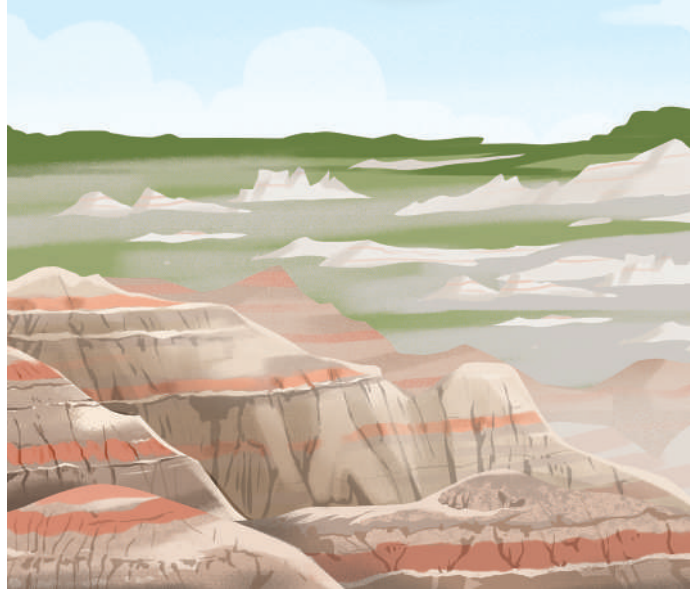
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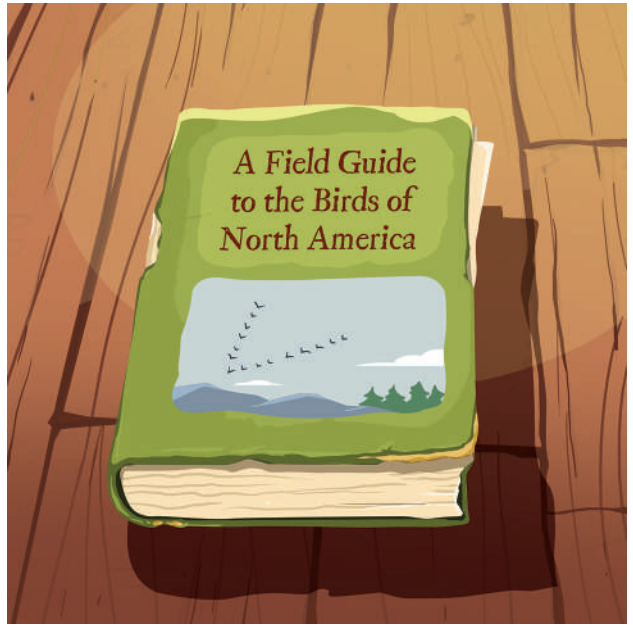
Kendrick Fowler is a scientist. He studies wasps. He traveled a lot with his family when he was young. He will tell you that when he was twelve years old, he traveled with his parents to the western parts of the United States—it was quite an adventure.

Kendrick and his family drove to Yellowstone National Park to see bison, geysers, and mountains. There, he bought a book that helped him understand some of the birds he saw. It was the *National Geographic Field Guide to the Birds of North America*.

He had his bird guide, a camera, and his binoculars. He used them when his family also drove to Badlands National Park, whose eroded hills and open plains had birds, insects, and mammals that Kendrick had never seen. Later at Devil's Tower, he continued his quest to identify the wonders of the natural world.



He knew in the fifth grade that he wanted to learn more about the animals and plants of the world around him. He grew up in the northeastern part of the United States. So, when he traveled out west, he saw environments quite different from those he had known.



Later as a scout, Kendrick enrolled in bird study. He heard a song from high in the trees. When the bird came into view, it was bright red. It made him want to see more beautiful birds.



Kendrick also took a trip with his grandparents to New England, north of where Kendrick lived. He traveled to the state of Maine.

At Acadia National Park, which is on the coast of Maine on the Atlantic Ocean, he was attentive to the birds he saw. Later, Kendrick enrolled in bird study at scout camp.





How did Kendrick become a Scout? Impressed by Kendrick's passion for exploring nature, his parents suggested he join the local Boy Scouts. They explained it could help him make new friends who shared his interests and deepen his

understanding of the outdoors and its wildlife. Intrigued by the idea, Kendrick eagerly embraced his parents' suggestion, already imagining the thrilling adventures that lay ahead.

Kendrick loved Boy Scouts. He became an Eagle Scout, a high honor! He received merit badges in bird study, cooking, insect study, citizenship, and many others.



His Eagle Scout project and high school project centered around birds.

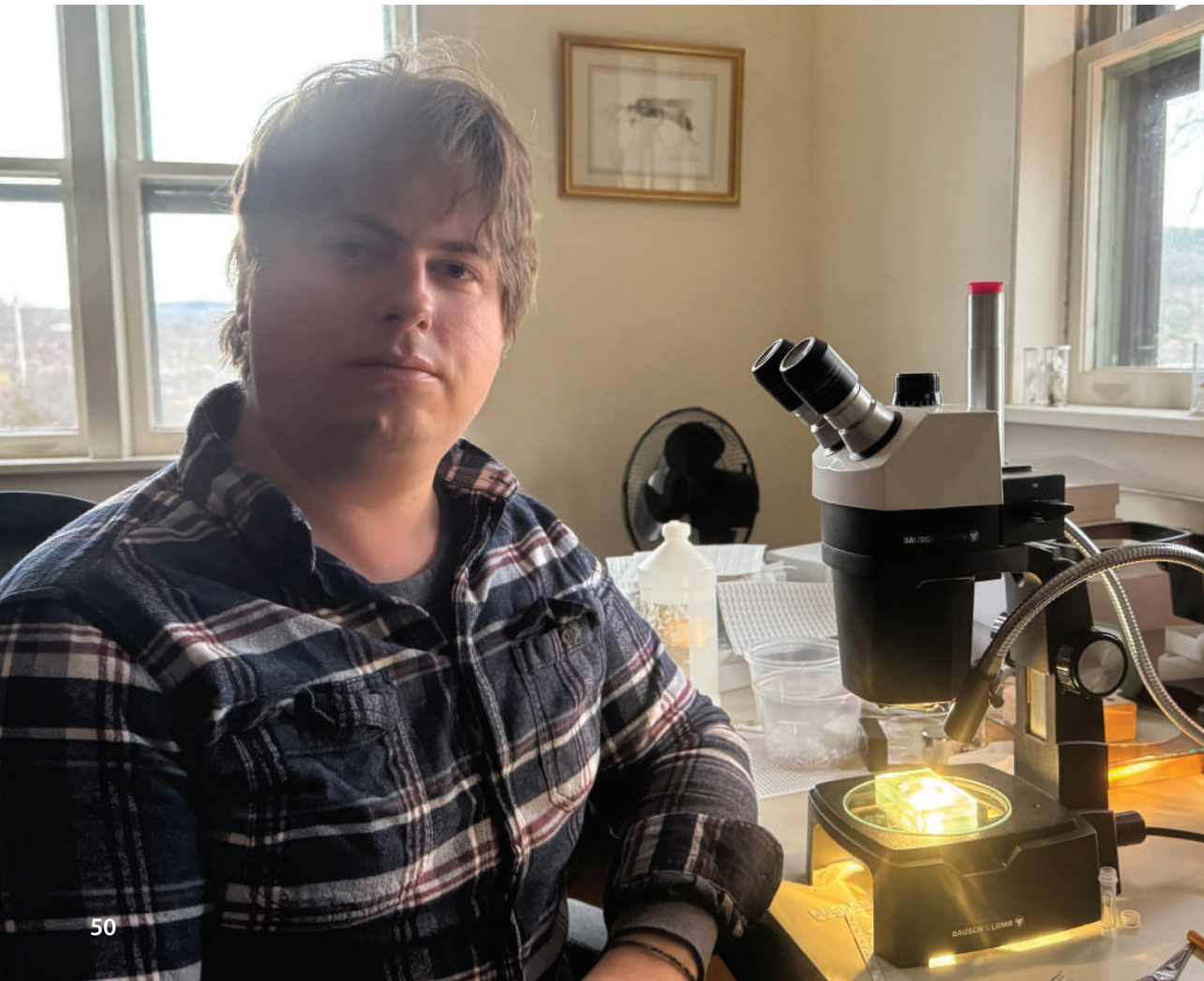
Kendrick Fowler: Buzzing over Wasps

Chapter

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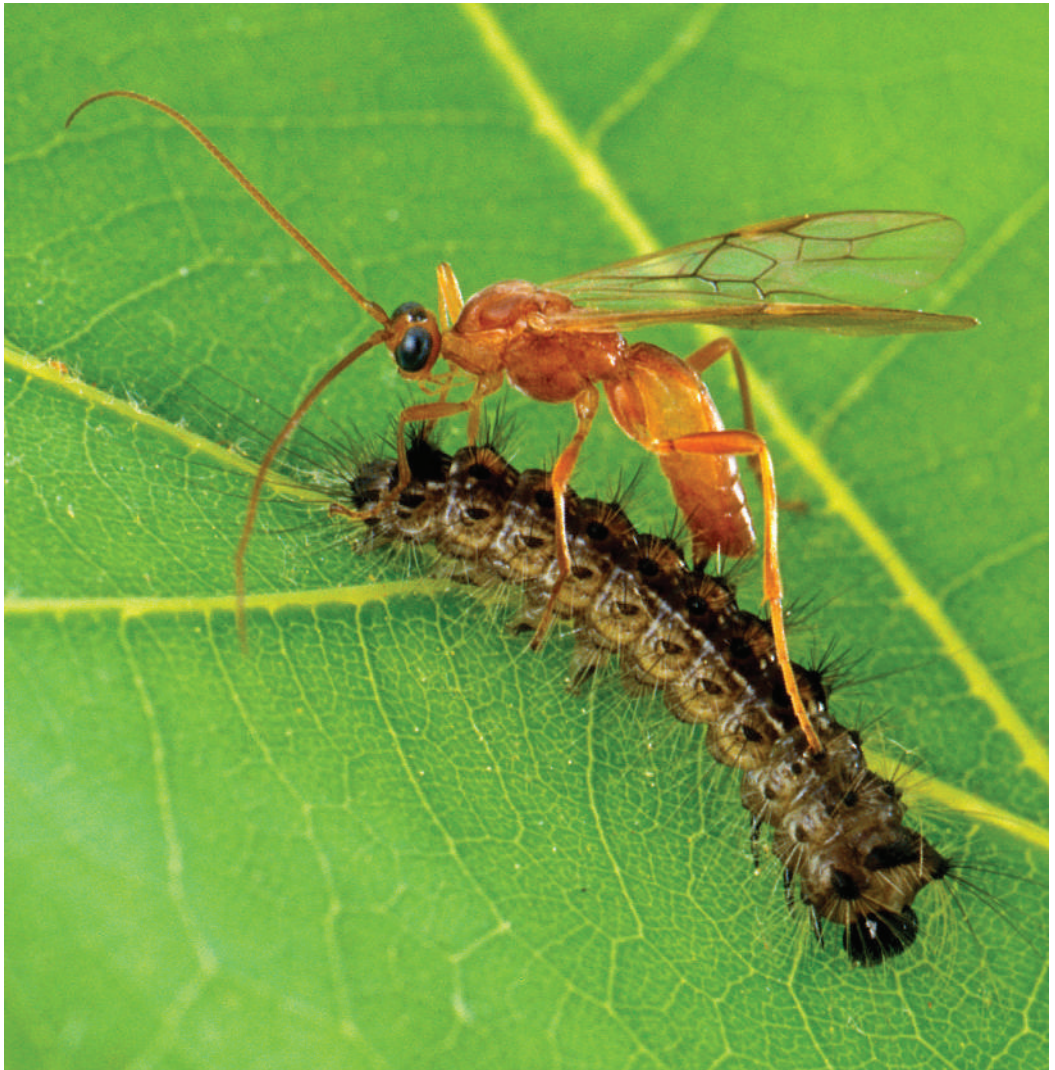
Now you can meet the real Kendrick. He's a scientist!

Kendrick Fowler is an entomologist. Entomologists are curious about member of the group of animals we call insects They spend their days studying insects in their natural habitats, learning about their behaviors and figuring out the role of insects in our ecosystems.



Kendrick spends his days studying parasitoid wasps. These tiny insects buzz around unnoticed due to their small size. In fact, some parasitoid wasps are as small as a grain of rice or a sesame seed! Unlike the wasps you might find buzzing around picnics, parasitoid wasps don't bother people.

What role do these wasps have in the natural world? These small wasps lay their eggs on unsuspecting insects or spiders. When the eggs hatch, young wasps emerge and obtain their nutrition from the animal.



Parasitoid wasps come in many shapes and colors. Some wasps have bright colors like red and black, orange and black, or yellow and black. These colors make them look like more familiar wasps, the kind that often sting people. This look-alike trait is called **mimicry**. Their appearance makes them look like dangerous insects, and it protects them by scaring away predators like birds and spiders. But not all parasitoid wasps have the trait called mimicry.



Some are all black or all brown. This may make them less visible to predators. This trait is called camouflage.



Kendrick spends his days trapping and observing parasitoid wasps. His research sheds light on the intricate web of life in nature, emphasizing the crucial role these tiny insects play in ecosystem agriculture, including farm ecosystems.

By gathering data, Kendrick helps farmers and scientists find ways to protect crops without using harmful chemicals. Kendrick shares his knowledge through engaging talks and workshops, inspiring young minds to appreciate the diversity and importance of these wasps. He encourages everyone to observe their surroundings closely so that they might discover the quiet work of parasitoid wasps contributing to the delicate balance of nature right in their own backyards.



Kendrick uses tools to study these wasps. First, he uses nets with superfine mesh to sweep through plants to catch insects. To pick out the wasps, scientists use special tools called



aspirators. An aspirator is a small vacuum. Using this tool, Kendrick can gently suck the insects into vials. Once caught, Kendrick puts the wasps into small cages for closer observation under a microscope.

Another cool tool is the Malaise trap, designed to snag flying insects and guide them into a bottle for further study.



Creature Feature!

One insect that captured Kendrick's interest as a child was a dobsonfly. This fascinating insect can grow as large as your hand! Male dobsonflies have big, mouthparts called *mandibles*; females have shorter but stronger ones.

As adults, their wings are covered in intricate patterns.

Although they can fly, they're not very graceful at it. Dobsonflies are nocturnal, meaning they're most active at night, and they are often attracted to lights. While they might look a bit scary, dobsonflies are harmless to people and are truly amazing creatures.



Kendrick is now a research scientist. His schooling played a major role in his scientific development. As Kendrick progressed through middle and high school, his passion for nature deepened.



When it came time for college, Kendrick chose to study science at St. Lawrence University. His goal was to learn how to safeguard nature and the countless species currently facing threats. The **biodiversity crisis** weighed heavily on his mind; species were and are vanishing at alarming rates due to habitat loss, climate change, and the global spread of diseases. Kendrick's commitment to understanding and protecting the natural world fueled his academic journey.



In college, Kendrick majored in **conservation biology**.

Conservation biologists seek to understand and address the threats to biodiversity. By understanding these threats, people can apply what they learn to protect nature and wildlife. Conservation biologists study how different animals and plants live, what they need to survive, and how they're affected by things like pollution and climate change.



In college, Kendrick also studied political economy, a field that examines the relationship between politics and economics. He realized that conservation is influenced by what society values. Conservation biology, politics, and economy are all intertwined.

Feature!

The Adirondack Park in northern New York state is more than six million acres of managed natural land. What makes Adirondack Park interesting is that it's a mix of land that belongs to private individuals and land that belongs to the government.

Back in the late 1800s, when the forests were logged, it caused big problems for New York City's water supply. Without the trees to soak up rainwater, there was too much runoff. This made the water dirty. The government stepped in to protect Adirondack Park. It wanted to make sure the forests stayed healthy to keep the water clean for everyone.

Parks like Adirondack Park do not just protect plants and animals. They also help make sure we have clean air to breathe and clean water to drink.



Recently, Kendrick has become fascinated by a concept called dark taxa. Taxa is word meaning a group of living things. Dark taxa are groups of living things that are abundant, diverse, and poorly understand by scientists. Scientists still have a lot to learn about them.

Though many kinds of wasps are considered dark taxa, let's look at another example. This is a picture of a scuttle fly. It is not a wasp, it is a fly, but the group is so little understood that scientist want to know more about them.



Scuttle flies are not well understood. But by learning about them and other dark taxa, scientists can develop a better idea of the complexity of ecosystems.

Even these little-understood groups are important to us. Kendrick encourages everyone to appreciate the amazing variety of life on Earth. There's so much to be discovered about insects, even in our own neighborhoods and parks. Kendrick hopes to teach others more about these fascinating creatures and why they're so important for keeping the environment healthy.

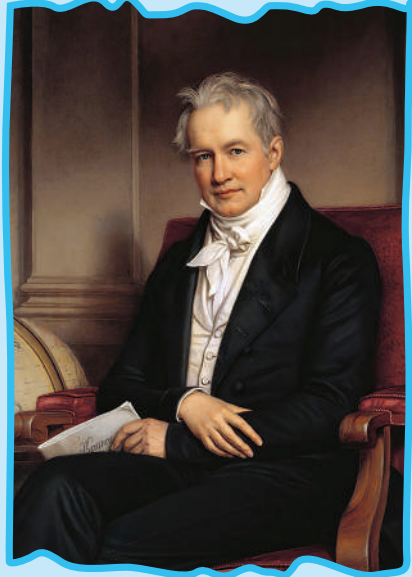
Inspired by . . .

To be **inspired** by someone means they made us want to try something. Kendrick Fowler was inspired by Alexander von Humboldt and his work in biogeography.

Alexander von Humboldt, German Naturalist

- Born in 1769
- Made significant contributions to our understanding of how life is distributed around the world
- Traveled extensively, especially throughout the Americas
- Discovered important fossils and new species of living animals
- Made discoveries that later supported the concept of continental drift
- Pivotal figure in the development of **biogeography**

INTERESTING FACT: Humboldt County in California is named after him in recognition of his contributions to our understanding of the natural world.





Kangaroos are found in Australia.



Cacti live in deserts.



Pandas are found in China.

Biogeography

- The study of where living things are found on Earth and why they are in that location is known as *biogeography*.
- Biogeography helps us understand the patterns of where plants and animals live.
- Scientists look at how animals and plants spread to different places.
- Scientists look at how animals and plants adapt to their environment.
- Scientists look at how changes in Earth, like moving continents or changing climates, affect where animals and plants can survive.
- By studying biogeography, we learn more about the amazing diversity of life and how to protect it.



Who inspires you to find out more about the way things happen?
Who has helped you figure out how something works?



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Daniel H. Franck

Subject Matter Expert

Martin Rosenberg, PhD

Teacher of Physics and Computer Science

SAR High School

Riverdale, New York

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