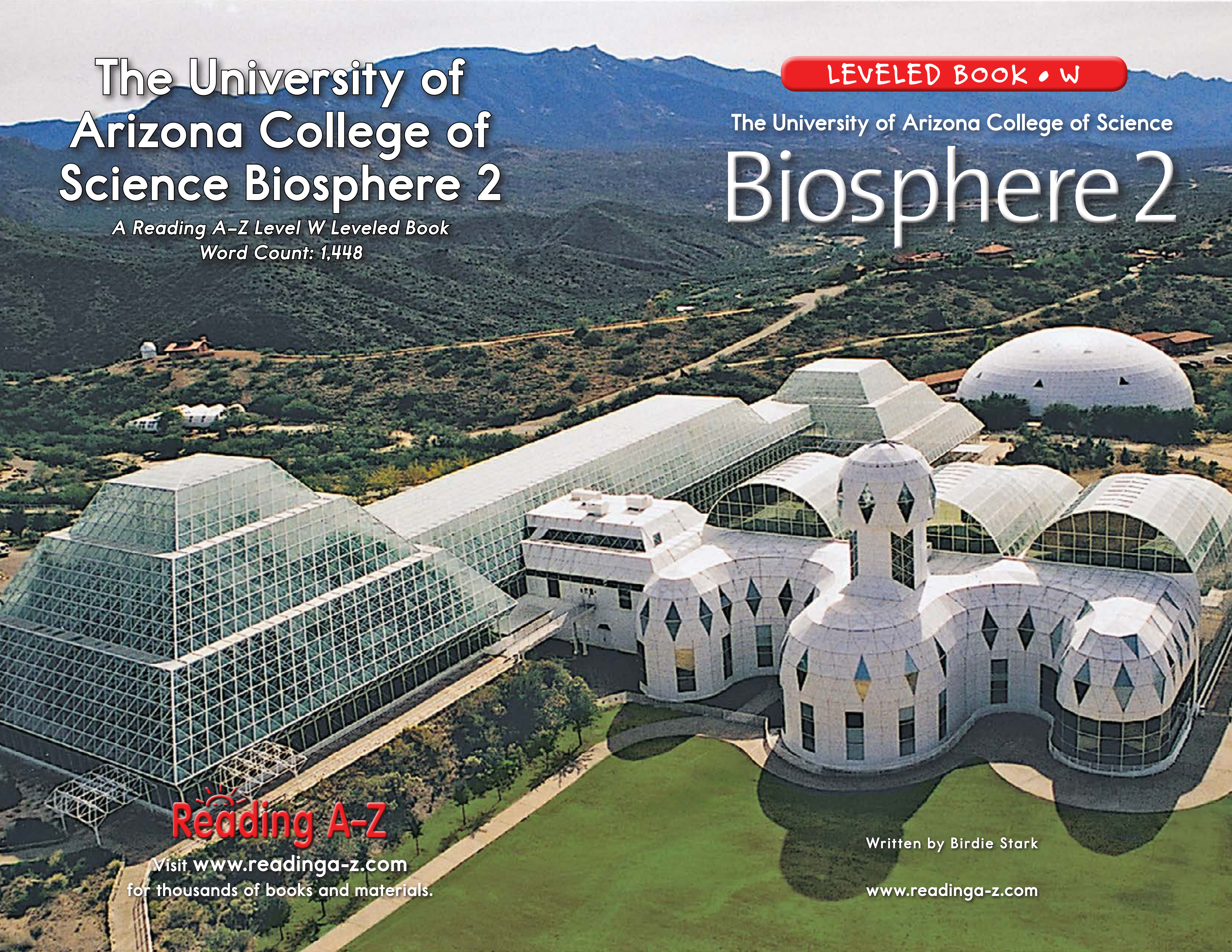

The University of Arizona College of Science Biosphere 2

A Reading A–Z Level W Leveled Book
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The University of Arizona College of Science

Biosphere 2

Written by Birdie Stark

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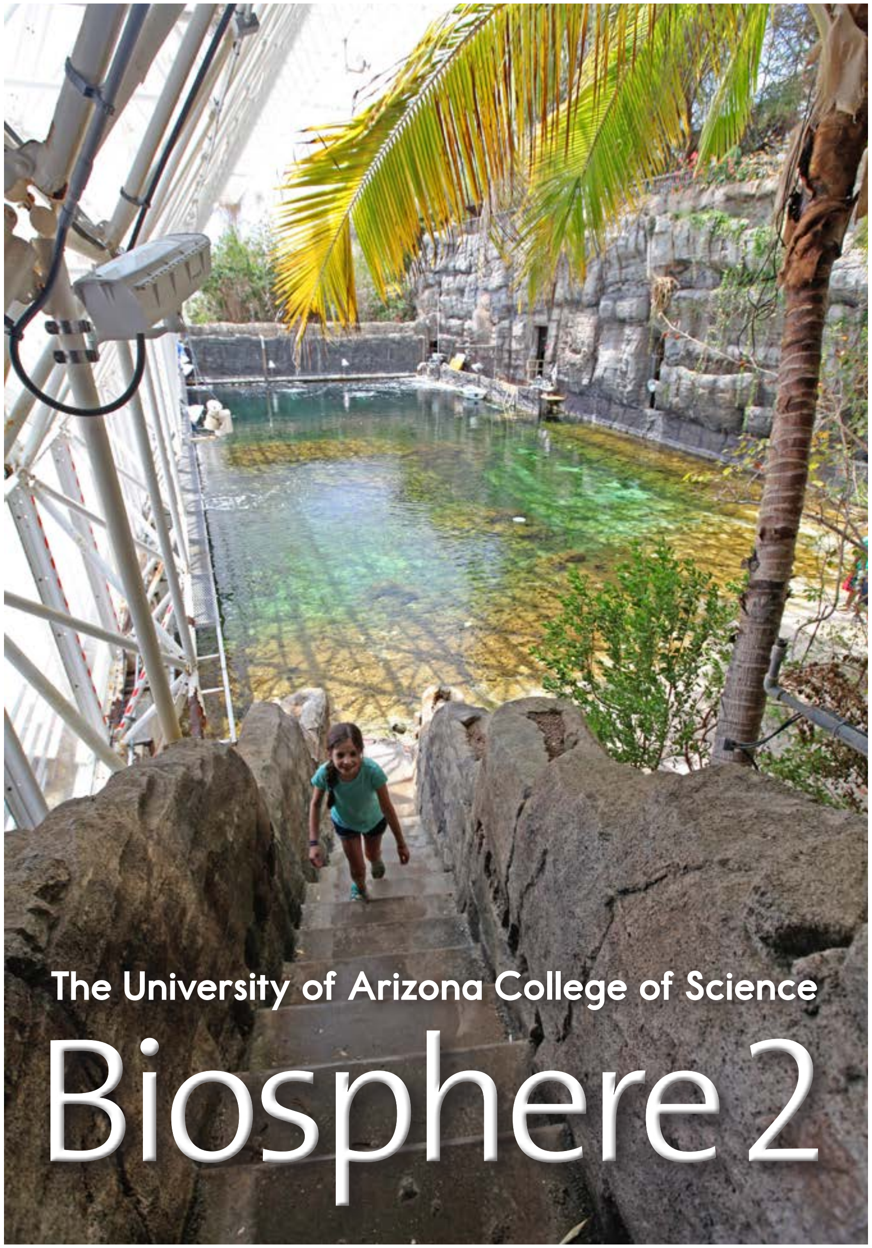

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Cover: The University of Arizona Biosphere 2 College of Science welcomes visitors to its 1-mile (1.6 km) round-trip tour. Returning multiple times allows visitors to see and learn more with every tour!

Title page: Steps connect the ocean biome to the rainforest.

This page: A suit worn and signed by the original Biosphere 2 inhabitants is on display in their original living quarters.

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Correlation

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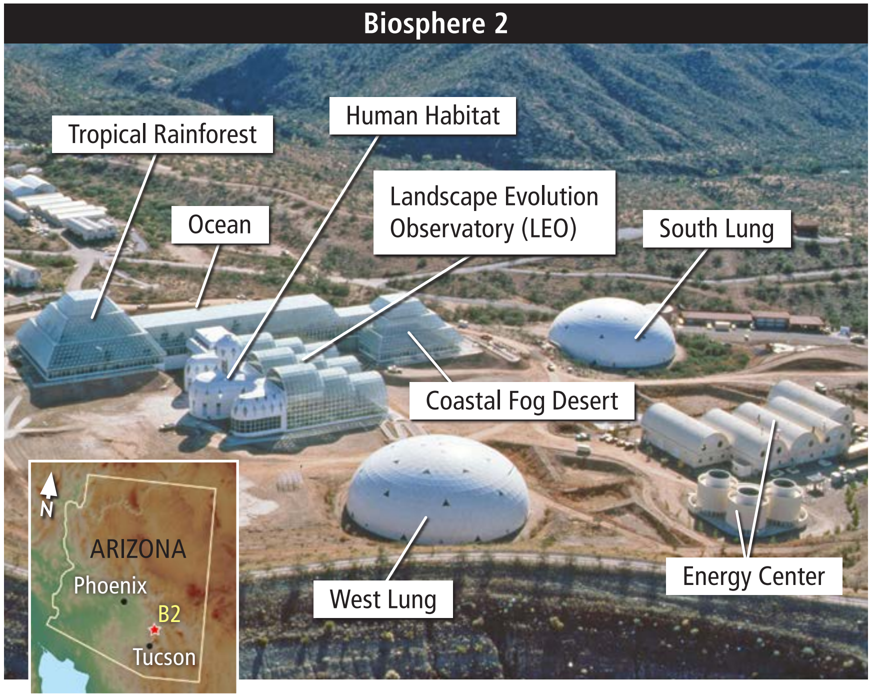

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That's me (Birdie), standing outside the tropical rainforest, which contains nearly one hundred different species of plants.

Introduction

Hi, I'm Birdie. I'm ten, and I'm from Tucson, Arizona.

Sometimes I wonder what it would be like to travel to another planet. Not just what it would be like when I got there, but how life would be during the trip. Would I have enough food to eat and air to breathe? Would I get along with the other people on the spaceship?

One group of scientists lived as people might on a giant spaceship. On September 26, 1991, they entered a place called **Biosphere** 2 (B2) and didn't leave for two years—that's 730 days!

John explains to me the many structures that make up B2.

Planet Earth is known as Biosphere 1. B2, which was designed to work like Earth, is three acres wide and in a big glass building—sort of like a gigantic greenhouse, deep in the Arizona desert.

One hundred thousand people visit B2 every year, and about ten thousand of them are students. Recently, B2's Deputy Director John Adams gave my mom and me a special behind-the-scenes tour.


John, Mom, and I make our way toward the Lung, which once kept air pressure normal in B2. Hey, wait up!

B2's History

On our walk to the dome, John explained B2's history. After men landed on the Moon in the 1960s, people wondered how much farther humans could venture into space. Even if astronauts had enough fuel to reach a distant planet, sooner or later they'd run out of food and **oxygen** . . . unless they could make more along the way. Could they?

That question inspired the designers of B2. Construction began in 1987 and finished in 1991.

B2 lacked a lot of things we Earthlings take for granted. With only three acres, the designers had to pick and choose what to include. Among other things, they chose a rainforest, an ocean, a desert, and a farm. They chose animals, including goats, pigs, chickens, and bush babies. Last but not least, they chose four men and four women.

Those eight people had to raise their own food. “It was a huge job getting everything from the ground and to the table,” John said, “and not all the farming succeeded. As a result, the people didn’t have enough calories and lost a lot of weight.”

Living inside B2 was tough for other reasons, too. Earth does all sorts of work for us—John calls these **natural services**. It’s work we depend on to stay alive, yet most of us take that work for granted. We’re often unaware of it until we need it done. Imagine if we had to pollinate all of Earth’s plants ourselves instead of relying on the wind and billions of insects—what a job that would be!

The original eight scientists that entered B2 in 1991 were ready to try a new way of survival.

Two of the original scientists prepare dinner in B2’s kitchen. All the food they ate was produced inside B2.

Inside B2, they couldn’t take those jobs for granted. Consider air. B2 is one of the world’s most tightly sealed structures, leaking less than ten percent of its air each year. In 1991, the plants inside B2 were supposed to generate enough oxygen to match the air outside B2.

Instead, the oxygen level kept dropping. The scientists inside started feeling exhausted. It was getting hard to move or even to remember their own names. Instead of doing experiments, they were just trying to survive.

Finally, oxygen was piped in from a big truck. That solved the air problem, but by then the residents were arguing. Although under stress, they stuck to the original plan and stayed inside for two years. The closed **ecosystem** didn’t work flawlessly as the scientists had hoped, but they gathered important data and learned lessons about how to do things better in the future.

B2 by the Numbers

- 7.2 million cubic feet (203,881 m^3) under sealed glass; 6,500 windows
- 91 feet (27.7 m) tall at its highest point
- Sealed from the earth below by a 500-ton (453.6 metric ton) welded stainless steel liner
- Thousands of miles of wiring, pipes, and ductwork

Once that experiment was complete, the scientists knew that B2 was still a great opportunity for some kind of research—but what?

In 2007, the University of Arizona began conducting research inside Biosphere 2. The focus of the science there shifted from outer space to Earth.

"We're going to go all over the world in just a few short steps," John said. "Are you ready for the rainforest?"

The Rainforest

Was I ever! We moved past trees so tall that they brushed the 91-foot (28 m) ceiling. The long, stringy brown roots of tropical vines hung down everywhere, looking like spaghetti.

"This isn't a real rainforest," John said. "It's a lab where scientists can control many **factors** we can't control in the outside world." To demonstrate, he made one quick phone call.


In the rainforest, research is still being done today.

"I can play weatherman inside B2," he said. Within minutes, it was raining.

Here the scientists take soil samples and measure the rain and root growth.

Soon, they will take all the rain out of the system and give the rainforest a three-month drought. Scientists predict that dry spells like this could happen as Earth warms. Creating one at B2 could help them know what to expect. In fact, much of the science at B2 today concerns changes to Earth's climate. However, as we walked out of the warm rain and headed toward the next **biome**, I wasn't thinking about climate change or **global warming**. I wanted to see the ocean!

The Ocean

We entered the ocean biome from a platform that looked down into 676,000 gallons (2.56 million L) of salt water. The water was warm—nearly 80 degrees Fahrenheit (27°C), and although B2's living creatures today are mainly plants, we saw colorful fish swimming there.

Then we walked up a corridor and onto the beach. Gentle waves—made by a machine, not by wind—lapped the shore, and I spotted little crabs. I even got to hold one.


Today, the people at B2 are transforming the ocean biome to look like the Gulf of California.

We left the beach and, at the back of the ocean biome, peeked in on a small mangrove swamp growing in the salt water. The air was humid until we passed through another door; then suddenly the air felt hot, dry, and familiar. We were back in the desert.

That's the magical thing about B2—with the turn of a doorknob, you move from one corner of the world into another. Our next stop wasn't another biome, though. It was a 50-foot (15.24 m) high lung!

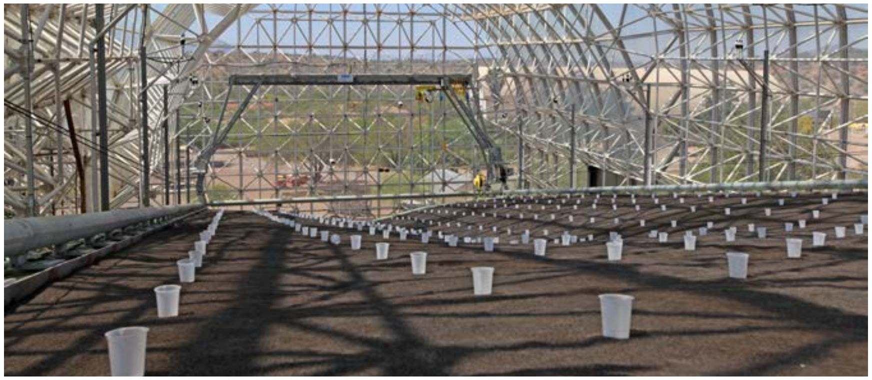

The outside of the lung (inset), and John and me inside the lung. This is one of two huge domes that were built to keep all of B2 from exploding!

The Lung

If you put too much air in a balloon, it pops. The same once applied to B2. **Air pressure** inside B2 built up as air expanded on hot days. To protect it, the engineers had to control that pressure, but how?

We headed through a hatch marked "South Lung Tunnel" and entered a huge room that echoed like crazy. Back when B2 was still sealed, the lungs (there are two, just as in your body) equalized air pressure inside the structure. Its ceiling is actually a rubber **membrane**, like a 40,000-pound (18,144 kg) circus tent without poles to hold it up.

So what does hold it up? Air pressure. During the day, the air inside B2 heats up and expands, pushing up the membrane. At night, the air pressure decreases and the membrane sinks down. When John opened the door, air whooshed out. We whooshed out, too, and continued on our tour.



Originally a farm inside B2, this room is now the LEO project, where scientists study landscapes.

Research Now

B2 scientists used to study how we might survive on other planets. Now, scientists at B2 look at living on this one with **climate change**. In the Landscape Evolution Observatory (LEO) project, where we headed next, they're trying to figure that out.

We entered the area that once was the farm. Here, scientists study how water interacts with land in three phases. In phase one—the current phase—they took more than a million pounds of basalt (crushed volcanic rock) and arranged it on three slopes. They can make it rain in here, too. Over time, the basalt will turn into soil. Scientists want to know how long the change will take and under what conditions.

Phase two sees how plants and water interact and how plants change the landscape's behavior.

Phase three looks at how changes in air temperature, moisture levels and **carbon dioxide** influence these massive hill slopes.

John knows that breaking down rocks may seem pointless to some of us. "It's really difficult for people to understand how these studies can be applied," he said.

The scientists at B2 understand, though. Just as B2 once gave them data about life in a closed ecosystem, now it tells them what to expect about life on Earth as our climate continues to change.

"If we can anticipate," John said, "then we can prepare, adapt, shift behavior. Hopefully, we could survive."

A Changing Climate

The climate is always changing, so why are people worried about climate change now?

By burning fossil fuels, we create greenhouse gases—gases, such as carbon dioxide, that trap heat in our atmosphere. Many scientists now say that Earth is getting warmer and has been for many years. That heat may lead to more severe weather (from hurricanes to droughts) and poorer quality habitat for wildlife.

Changes in one place can lead to changes elsewhere. Earth's air, water, and land are all linked to the climate; melting ice, for instance, leads to rising sea levels. Today, these changes are happening faster—and on a bigger scale—than anything modern humans have seen before.

Mom and I study the OmniGlobe in B2's lower habitat. It shows the effect that weather patterns have on all the planets.

A Lot to Learn

As a ten-year-old, I still have plenty more to learn about science, but I understand why we do experiments. We want to discover things we don't already know. After all, any experiment can teach us something. In the case of B2, we learned that no matter how much money we spend, we still don't know how to **engineer** a long-term system that will give us everything we need in order to live. Yet Earth provides these services for free. We can't take Earth for granted and survive.

In other words, B2 is great—but nothing beats B1.

Glossary

air pressure *(n.)* the force of air in the atmosphere (p. 12)

biome *(n.)* a community of plants and animals that occupy a specific type of habitat (p. 10)

biosphere *(n.)* the regions of a planet's surface and atmosphere that support life (p. 4)

carbon dioxide *(n.)* an invisible gas that is formed by the chemical breakdown or burning of organic substances, such as fossil fuels, and that is absorbed by plants during photosynthesis (p. 14)

climate change *(n.)* the long-term, lasting changes in Earth's weather patterns or the weather patterns of a region (p. 13)

ecosystem *(n.)* a community of living things together with their habitat (p. 8)

engineer *(v.)* to design and build things using science and math (p. 15)

factors *(n.)* facts or circumstances that contribute to a result (p. 10)

global warming *(n.)* an increase in the average temperature of Earth's atmosphere and oceans, especially one great enough to change the climate (p. 10)

membrane *(n.)* a thin layer of material that acts as a partition or lining (p. 12)

natural services *(n.)* Earth's natural functions that allow living things to survive (p. 7)

oxygen *(n.)* a gas that has no color, taste, or smell and that most animals need to live; plants and algae make oxygen during photosynthesis (p. 6)