

Tales of Life Science

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By Joan S. Wagner

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Lauren, Gavin, Grant, Hillary and Brady were walking to the park together. Hillary was babysitting her little sister, Olive who was dragging her stuffed beagle along.

“Stop dragging your beagle. You will hurt it,” said Hillary to her little sister, who kept pulling it along.

“Come on Hillary, how can you hurt a stuffed animal? It’s not alive,” said Grant.

This story is about what it means to be alive.

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Fraternal twins Eliza and Oliver become curious over how they are alike and different. Their curiosity was perked after reading a book given to them by their mother.

Using literature and games, the twins learn about heredity.

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Drew, Noah, Crystal and Caitlin were excited about their field trip to the Science Center because of the dinosaur exhibit.

“I can’t wait to see the dinosaurs,” said Noah.

“My friend Noe was there and she said they are very life-like. There is even a mama dinosaur with her babies hatching,” said Crystal.

During a field trip to a museum featuring dinosaurs, students learn how living things change and adapt to their environment.

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It was the first day of school and Mr. Hull was very excited about utilizing the pond, wetland and butterfly field students, faculty and the community built for the middle school. He and other science teachers in the building had collaborated on the development of an extensive curriculum for the middle school during the summer. The students at Mayville Middle School were as excited as the teachers.

This story is about ecosystems and how energy is cycled through it.

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We are Alike, Yet Different

Living things are all around you. Some are so tiny that you need a microscope to see them, while others can be easily seen. Some living things look alike and some look different.

This was the first page of a book that Eliza and Oliver's mother gave them. As fraternal twins, they became very curious about what makes them alike and what makes them different.

Cats and Dogs

Since they had a dog and a cat, Eliza and Oliver decided to compare their pets to see how they were alike and different.

"Some people may think cats and dogs are different from one another, but, actually, they have many things in common," Oliver told Eliza.

Though Eliza was reading a Harry Potter book, Oliver continued anyway. "Dogs and cats are alike because they both give birth to live young, produce milk, and care for their young."

Eliza looked up from her book.

"Ahh, you are listening."

"Well, I was enjoying my book until you began your talk about cats and dogs."

"I thought I made some good points."

"You did, but there are many more similarities you did not mention."

"Like what?"

"Well, you could add that their bodies are covered with hair or fur, both have an excellent sense of smell and can hear a wide range of sounds. They also move on four feet," Eliza said.

"So, put your book down and let's come up with differences between cats and dogs."

"Remember when our cat, Xavier, scratched my arm and made it bleed?"

"And made you cry."

"Well, I was only eight when I got scratched and it did hurt," replied Eliza.

"Though cats and dogs both have claws, cats have claws that go in and out."

"That is called retractable claws."

"Right, so there is one difference," noted Oliver.

"How else are they different?"

"Well, there must be differences in their DNA, but we can't see those differences without a DNA fingerprint."

"True, but it would be cool if we could."

Thinking of more differences, Oliver said, "Dogs and cats communicate differently."

"Right, I haven't heard a cat barking recently."

"Very funny!"

"So, what do you think makes us alike?" Eliza asked her brother. "I can definitely see our differences. We do not even have the same color hair, and I am taller than you, and smarter...oh, just kidding!"

"Well, we walk upright, have ten toes and fingers. We both can grasp things because of the placement of our thumbs. Dogs and cats do not have that trait. Without an opposable thumb, they can't grasp things like we can."

"It would be funny if they could; they could even open their own cans of dog and cat food!"

“That is a funny thought, Eliza,” Oliver replied. “Now, how are we alike? We are both human beings, or *Homo sapiens*—to use our scientific name.”

“Better known as the wise man. Though I think it should be changed to wise person.”

“Actually, the word *Homo* is from Latin and means human being,” said Oliver.

“Well, that sounds a lot better to me,” replied Eliza.

“I agree with you, but let’s not get distracted over the issue of boys vs. girls.”

The book that was given to Oliver and Eliza had a lot of interesting information about life and how living things adapt to their environments.



Walking Stick Insect

Now You See Me, Now You Don't

“Here is a puzzle for you,” Oliver stated. “What looks like a twig, but has legs and can move?”

“You must mean a walking stick. It’s an insect, and even though it looks like a twig, it’s an animal, not a plant,” replied Eliza. “Why do you think it has this trait?”

“That’s easy, looking like a twig provides the insect protection from becoming a tasty meal for another animal that likes to munch on insects. For a similar reason, soldiers wear camouflage clothing to protect them from being seen by their enemies.”

Smiling, Eliza said, “We could use a little camouflage from mom and dad when we do something they told us not to do!”

Oliver nodded.

Later that afternoon, Eliza and Oliver decided to play a camouflage game they found on the Internet. To play the game, they needed a large piece of wrapping paper with a design, white paper and black paper. They taped a four-foot by four-foot piece of wrapping paper to the floor. Using the template from the Internet, they cut out 10 butterflies that were black and 10 that were white. They used the same wrapping paper (as the paper taped to the floor) to cut out 10 wrapping paper butterflies.



Can you find the moth?

Directions:

1. Make and cut out 10 copies of the butterfly on the following page for each type of paper. (Black, white and wrapping paper)
2. Find a clock with a second hand or a timer. Have a person keep time or set the timer for 15 seconds.
3. Place all three types of butterflies in a small bag.
4. Close and then shake the bag so that all the butterflies get mixed together.
5. Dump all the butterflies onto the large piece of wrapping paper. Make sure they are spread out and are not on top of one another.
6. Have one person keep time. The other person is given 15 seconds to pick up as many butterflies as they can. The person will pretend to be a bird that likes to eat butterflies.
7. You can only pick up one butterfly at a time, and it must be placed in the bag before you can pick up another one.
8. How many black, white and wrapped butterflies did you pick up? Make a data table to organize the number of each type of butterfly that you pick up.

Directions:

1. Prepare the coins
2. Place all the coins in the paper cup.
3. Shake the cup and pour out the coins onto the floor or a table.
4. Copy the data table shown here onto a clean piece of paper.
5. Complete the data table by filling in the information that is missing.
6. Repeat steps 1-4 at least three more times, to determine the traits of other children in Chessie's family. Chessie has two brothers and one sister.

Coin Outcome: Chessie

- 1 Eye color is _____
- 2 Eye color is _____
- 3 Hair color is _____
- 4 Hair color is _____
- 5 Hair type is _____
- 6 Hair type is _____

Coin Outcome: Kiley

- 1 Eye color is _____
- 2 Eye color is _____
- 3 Hair color is _____
- 4 Hair color is _____
- 5 Hair type is _____
- 6 Hair type is _____

Coin Outcome: Hunter

- 1 Eye color is _____
- 2 Eye color is _____
- 3 Hair color is _____
- 4 Hair color is _____
- 5 Hair type is _____
- 6 Hair type is _____

Coin Outcome: Dylan

- 1 Eye color is _____
- 2 Eye color is _____
- 3 Hair color is _____
- 4 Hair color is _____
- 5 Hair type is _____
- 6 Hair type is _____

On the following page, color the picture of what each child looks like using the following rules:

EYE COLOR OF CHILD: 2 blue eye pennies (ee) = blue eyes

1 blue eye penny + 1 brown eye penny (Ee) = brown eyes

2 brown eye pennies (EE) = brown eyes

HAIR COLOR OF CHILD: 2 blond hair pennies (bb) = blond hair

1 blond hair penny + 1 brown hair penny (Bb) = brown hair

2 brown hair pennies (BB) = brown hair

TYPE OF HAIR: 2 straight hair pennies (SS) = straight hair

1 curly hair penny + 1 straight hair penny (CS) = wavy hair

2 curly hair pennies (CC) = curly hair

Eliza and Oliver colored in the pictures of the four children using the template their mom provided.

"Wow, we sure have a lot of variation with these three traits. No one is identical in Chessie's family," said Eliza.

You Have a Lot of DNA

Eliza and Oliver read more about DNA on the web. Eliza read out loud this time. “Your body is composed of trillions of cells. Nearly every cell in your body has the same exact DNA. In fact, each cell of a human body contains over 3 billion DNA base pairs. From these letters, scientists have identified about 25,000-30,000 genes. Here is a bit of trivia for you. If the DNA in all the cells of your body was spread out into a long ladder, it can reach the Sun and go back to Earth hundreds of times! Now that is a lot of DNA.”

A DNA Fingerprint

“I wonder what a DNA fingerprint looks like,” Eliza thought out loud.

Their mom interjected, “Though it is called a DNA fingerprint, it is not like a fingerprint from your hand. It looks like bar code.”

“Are DNA fingerprints just used for solving crime scenes?” Eliza asked.

“No, there are many uses,” replied their mom. “For example, scientists once debated whether a panda bear is part of the raccoon family and not really a bear. If you ever looked at a panda bear, you must admit that it does look like a raccoon. Scientists were able to use DNA fingerprints of panda bears and raccoons to settle the debate. Panda bears are indeed more closely related to bears and so are correctly classified as bears. However, scientists did learn that the panda bear’s cousin, a red panda bear, is more closely related to raccoons.”

“So, you can tell which organisms are related,” said Oliver.

“Right,” said their mom. “If we had a DNA fingerprint of your father and a DNA fingerprint from you, half of your DNA would match your father.”

“And the other half would match you,” added Oliver.

“Now you are catching on,” their mom said.

Oliver and Eliza’s mom found a picture of a DNA fingerprint to show them. She then read to them what the book said about how a DNA fingerprint is formed.

“A DNA fingerprint consists of different sized bands of DNA. Bands of DNA are formed in the following way:

- Scientists first cut up DNA molecules into smaller pieces. They do this with special molecular scalpels called enzymes. Just like enzymes digest your food, they digest or cut up DNA into smaller pieces.
- Cut up pieces of DNA are placed in the wells of a jelly-like substance called agarose gel.
- The agarose gel is placed in a fluid that carries an electric charge.
- An electric current is passed through the gel.
- A DNA fingerprint forms when the cut-up pieces of DNA move toward the opposite end of the agarose gel.
- Big pieces of DNA move more slowly than smaller pieces. Just like there are patterns of runners on a racecourse, a pattern of DNA bands form on the agarose gel. This pattern is what we call a DNA fingerprint or DNA profile.

Discussion Questions

1. What are at least three ways in which all living things are alike?
2. What are at least three ways in which living things differ?
3. What determines the traits living things have?
4. What are some ways in which living things adapt to their environment?
5. What did Darwin observe on the Galapagos Islands that helped him develop his theory of evolution? Explain.
6. Describe two ways in which DNA fingerprints can be used.
7. How can a person with brown eyes have a baby with blue eyes?
8. Create a Punnett square for two wavy-haired parents. Tell what the chance of having each hair type (straight, curly, wavy).

We are Alike, Yet Different Vocabulary

1. **Adaptation:** A trait that increases an organism's ability to survive and reproduce in its environment and develops over many generations.
2. **Agarose Gel:** A jelly-like substance used in gel electrophoresis to separate DNA fragments by size.
3. **Camouflage:** The ability of an organism to blend with its environment to avoid detection by predators or prey.
4. **Carnivore:** An organism that primarily eats other animals.
5. **DNA (deoxyribonucleic acid):** The substance of which genes are composed. The letters A,T,G and C correspond to names of the four nitrogen bases found in the nucleic acids that make up DNA: Adenine (A), Thymine (T), Guanine (G) and Cytosine (C).
6. **DNA Fingerprint:** A genetic profile of an organism using their DNA.
7. **Fraternal Twins:** Twins that come from two different eggs fertilized by two different sperm cells.
8. **Dominant Trait:** A trait that appears when at least one dominant gene is present. It can mask the presence of another trait.
9. **Gene:** A segment of DNA that carries instructions for a specific trait.
10. **Gregor Mendel:** An Austrian monk that lived from 1822–1884. He is known as the Father of Genetics for his experiments with pea plants.
11. **Heterozygous:** Having two different genes for a specific trait.
12. ***Homo sapiens*:** The scientific name of modern human beings.
13. **Homozygous:** Having two identical genes for a specific trait.
14. **Identical Twins:** Twins that come from a single fertilized egg that splits into two embryos.
15. **Incomplete Dominance:** A pattern of inheritance in which neither gene is completely dominant, resulting in a blended trait.
16. **Inheritance:** The genetic information passed on from parent to offspring.
17. **Law of Charges:** Like charges repel and unlike charges attract.
18. **Masked Trait:** A recessive trait that does not appear because a dominant gene is present.
19. **Naturalist:** A person who studies plants, animals, and other parts of the natural world.
20. **Prehensile Hands:** Hands capable of grasping objects, often due to opposable thumbs.
21. **Recessive Gene:** A gene that is not expressed when there is a dominant gene for the same trait. It is expressed only when two copies are present.
22. **Retractable Claws:** Claws that can extend and retract into the animal's paw.
23. **Trait:** A characteristic of an organism such as eye color.
24. **Transparent:** A material through which light can pass clearly.
25. **Variations:** Differences in traits among individuals within a population.

Next Generation Science Learning Standards Addressed in this Story

MS-LS1: From Molecules to Organisms: Structures and Processes

Disciplinary Core Ideas

LS1.A: Structure and Function

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

LS1.B: Growth and Development of Organisms

- Animals engage in characteristic behaviors that increase the odds of reproduction.

MS-LS3: Heredity: Inheritance and Variation of Traits

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.

LS3.A: Inheritance of Traits

- Genes are in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

LS3.B: Variation of Traits

- Because individuals possess two of each chromosome, they have two alleles for every gene—one from each parent. These versions of a gene may be identical or they may differ.
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.

Science and Engineering Practices

- Using Models
- Planning and carrying out investigations
- Constructing explanations and designing solutions
- Engaging in argument from evidence

Crosscutting Concepts

- Cause and effect
- Scale, proportion, and quantity
- System and system models
- Energy and matter
- Structure and function

Life is A'Changin

Drew, Noah, Crystal & Caitlin were excited about their field trip to the Science Center because of the dinosaur exhibit.

"I can't wait to see the dinosaurs," said Noah.

"My friend Zoe was there and she said they are very life-like. There is even a mama dinosaur with her babies hatching," said Crystal.

"Do you know, there is an animal in Indonesia that looks like a dinosaur. It is called a Komodo dragon," said Caitlin.

"Oh, they are awesome! I have seen them at the zoo," added Noah.



Komodo Dragon

Mrs. Marshall, their 8th grade teacher, led the class into the Science Center.

She said to her students, "Dinosaurs roamed our planet over 65 million years ago, way before people began to populate our planet. In fact, for about 200 million years, they were the major form of life. Now that is a very long time to be hanging out on our planet!"

"Did humans live then?" Drew asked.

"No," replied Mrs. Marshall, "People have been roaming Earth for a much shorter time. Scientists are still debating how long modern humans have been around. The best guess is that humans who look like you, your friends and family have been around for 50 thousand years or so. This may seem like a lot of birthdays, but compared to dinosaurs, humans are the "baby creatures" of planet Earth."

The Dinosaurs Rock!

"What happened to the dinosaurs? Why did they go extinct?" Crystal questioned.



The moment of impact 65 million years ago near what is now the Yucatan Peninsula. (NASA artist)



Chicxulub crater, a few days later. Note the inner ring. (NASA artist)

Their teacher saw this question as an opportunity for a lesson so she said, "Generally, living things die out when their environment can no longer provide them with the food and shelter that they need.

"I heard that an asteroid hit Earth and killed the dinosaurs," said Caitlin.

"Very good," said their teacher, "That is the accepted hypothesis by most scientists.

"Look," said Noah, "It explains what happened here."

"Why don't you read what it says to the class," said Mrs. Marshall since not everyone could see the display with the explanation at the same time.

So, Noah read the following, "The impact of the asteroid was like the explosion of 100 trillion tons of TNT, a billion times more powerful than the atomic bombs that destroyed Hiroshima and Nagasaki."