STRENGTHEN SCIENCE LEARNING

The NGSS Opportunity: Science = Thinking.

What do the Next Generation Science Standards require?

- **Clear and careful thinking** with concepts about each discipline of science.
- **Strategic thinking as students analyze complex situations**
- **Clear and focused communication** as students **respond to tasks** that require them to construct responses **to more rigorous questions and apply concepts, skills, and strategies in more challenging contexts.**

How will Next Generation Science Standards change science education?
It's about THINKING!

A Framework for K-12 Science Education:
Practices, Crosscutting Concepts, and Core Ideas

Scientific and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

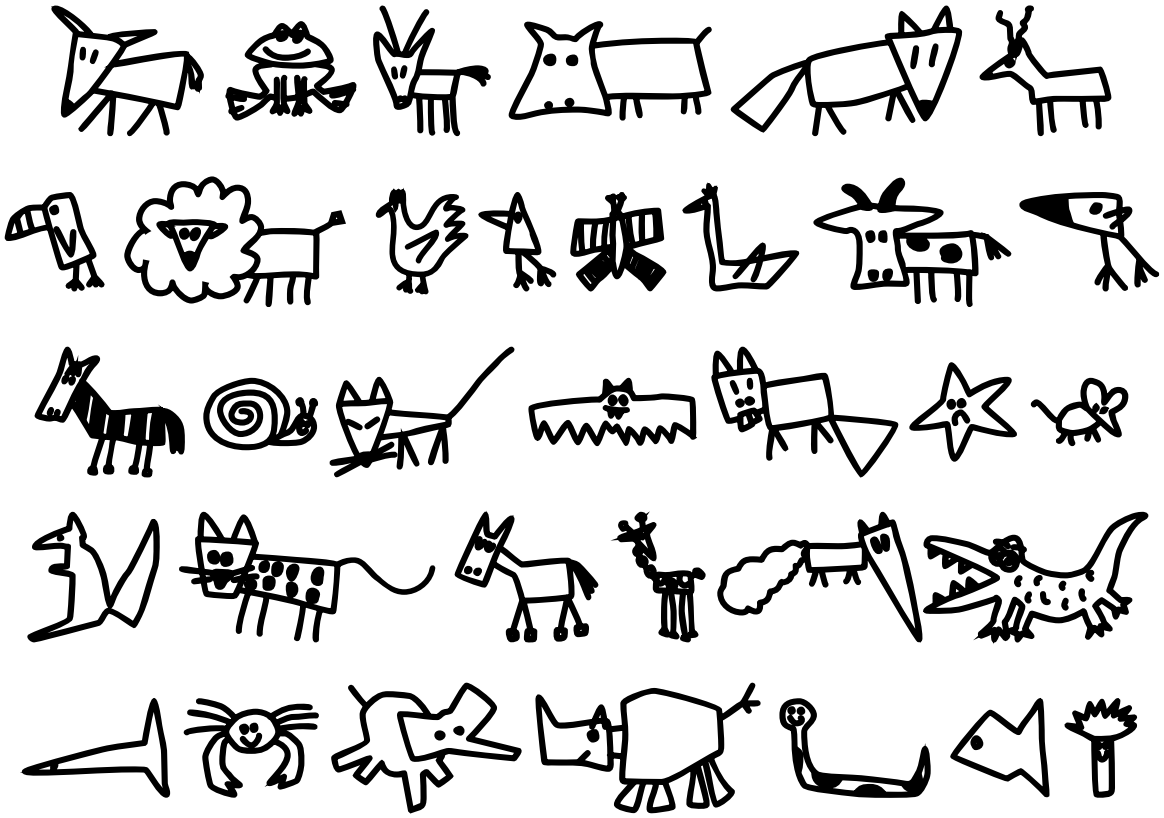
It's about LEARNING by
READING,
DOING, and
COMMUNICATING!

Crosscutting Concepts of Science—NGSS—apply to every part of science.

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

Source: A Framework for K-12 Science Education:
Practices, Crosscutting Concepts, and Core Ideas
http://www.nap.edu/catalog.php?record_id=13165

Analyze Animals



Concept: Structure and Function

Find an animal you like.

- What is a structure that helps it move?
- How does the shape of that structure help it—why is that structure the shape it is?

Find an animal that looks very different from the first animal.

- What structure helps it move?
- How does the shape of that structure help it—why is that structure the shape it is?

Think more:

- What is a vehicle people use to travel?
- What structures did engineers use to enable it to move?
- How do the shapes of those structures help it to me?

Connect Science and Reading to Learn.

Learning about Animals

CCSSR2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
Next Generation Science Cross-Cutting Concept: Structure and Function

Animals are wonderful. If you look closely at how they live you will find surprises. Watching animals is a job that scientists do. It is called making observations. They have learned a lot about animals.

Scientists learned about tiny animals. They have studied insects. They found that some insects have tools they use to live. They learned about the sawfly. The sawfly is just one animal they have studied.

Imagine what the sawfly is like. It is a fly but not like many others. They call it the sawfly because it has a kind of saw. It's not a real saw, but it looks like one, and it works like one. It is part of the sawfly. The sawfly uses the saw to make places where the eggs will be safe. It saws at plants to make a place to hide the eggs.

Some insects have tools that work just like scissors. The poppy-bee is one of them. It is a bee that makes its home in wood. This bee has a drilling tool, too. It uses the tool to dig into old wood.

Scientists observe birds to learn about them. They have seen birds use their bills to get what they need. So their bills are like tools. Some birds use their bills to cut into wood. They have sharp bills that can cut a hole in a tree. They drill the hole to get inside the tree where insects live. Then they eat them.

Every animal is amazing. Even dogs and cats can surprise you. The more you look at animals the more you will learn. Nature is full of surprises. Every part of every animal has a purpose. Scientists learn more about them every day.

EXPLAIN WHAT YOU LEARNED

1. Underline the most important information in each paragraph.
2. Write a short summary that tells what the passage explains. Include only the most important information.

Start your summary this way:
The main idea of the passage is _____.
Here is information that helps you understand that idea.
Then finish the summary. Include the information that helps explain the main idea.

Exceed!

Make your report a booklet or exhibit with pictures or diagrams with captions.

Animal Science

CCSSR2. Determine **central ideas or themes** of a text and analyze their development; **summarize** the key supporting details and ideas.

As I think back about my high school days, I realize that I got my start on my career then. My biology teacher was showing pictures of animals. As she showed them, she asked: what do notice about each animal? List three parts you see. Describe the size and shape of each. Then she said, each of these has a purpose.

She explained structure and function. The structure—the shape of an animal's parts enables the animal to live. She explained that if you look at an animal's ears you might think you can guess why they are that size and shape. Then you need to observe the animal to confirm your guess. For example, you might think that an elephant has large ears to hear better. But that's not the reason for that large structure. What's the reason for the large ear flaps elephants have? We'll figure that out at the Zoo.

On our field trip, I watched elephants. I noticed they flapped their ears a lot. It was 90 degrees that day. I saw them cooling themselves—that's what I figured out. They flapped their ears to get cooler. Later I researched elephants on the Internet. I found that they have a lot of blood vessels in their ears. When they flap their ears the air cools the blood. That blood goes through their circulatory system into their bodies and helps cool the elephant. That large structure helps them live in a hot climate. I learned that observation is a very important step to drawing conclusions in science.

Next, I observed squirrels in our neighborhood. I discovered another structure and function relationship. They have long furry tails. At first I inferred that the tails are there to help them climb, but I didn't see them using their tails to hang on to the branches of trees. They used their feet for that—I saw that they use their claws to grab the branches. So that structure helps them climb. But why do they have those tails? They waved them back and forth as I watched, but I did not see them using the tails to hang on to anything. Then I researched the squirrels. I found that squirrels move them to balance themselves as they rush up and down and across the trees.

I made better guesses about bird feet. Of course ducks have webbed feet to swim. But then I noticed that woodpeckers have their toes set two in front and two in back, while most have four in front and one in back. I guessed that they had their toes that way so they got more traction, they could hold onto branches more strongly. They need that support because they are using their bills to drill into the tree. I checked my guess about the function of that structure on the Internet, and I found I was correct.

Today, I am a science researcher. Right now I'm in Brazil, learning more about endangered species. I still use the strategies I learned in high school. You can find my discoveries on the Internet.

This is a nonfiction passage. It has one big idea, and each paragraph helps explain it.
Each paragraph tells a sub-topic, part of learning about the topic of the passage.
Re-read each paragraph. After you read each one, underline what you think the most important information in it is.
Then on another page make a list. List the idea each paragraph explains. For example, paragraph 2 uses information about elephants to help you learn that scientists need to observe, not just make guesses.
Then read your list: what does the writer want you to understand?
That is the main idea or central idea—that the information and related ideas support.

What important ideas did you learn about animals?

Idea	**Example**

Apply those ideas.
Invent an animal that lives on another planet.
It's a warm and watery place.

Explain how it has adapted to live on that planet. Write about the animal. Include each of the ideas you learned to explain how it lives.

SsTREAM IT
Science
Social Science
Math
Technology
Reading

You'll use science, technology, reading, engineering, art, and math to design a great new…birdhouse, bridge, playground, park, car—anything you want to design.

Choose something you'd like to design.

_____

List what you want it to look like and the parts you'll include.

Read about this kind of thing—use the Internet to find examples.

Look at your list and add more to it based on what you read.

Then design it—make a blueprint.

Go farther—make a model!

How will I increase science thinking progress?

__Focus on ideas.

__Ask students a BIG question they will focus on as they read, do, and report learning.

Students…

__ make science “alphabet” booklets
__illustrate science glossaries
__analyze data
__design inventions
__build models
__exhibit what they learn
__write their own science booklets
__present science demonstrations
__visit online science site and report what they learn
__watch a science program on TV and report what they learn

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