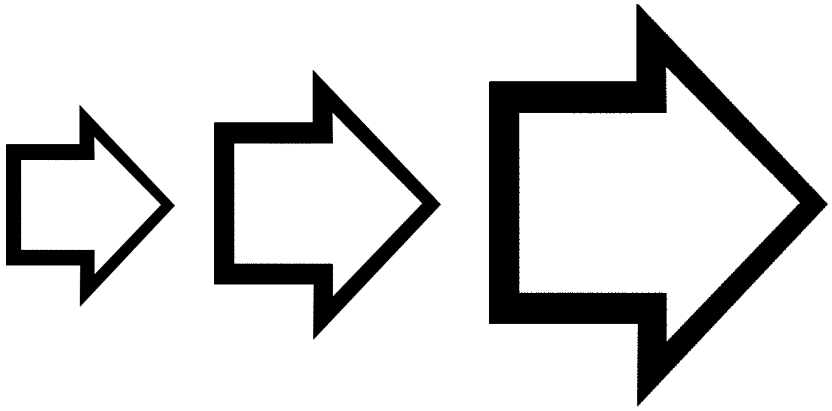
Expand Learning Progress



The NGSS Science Quest

Polk Bros. Foundation Center for Urban Education
Teacher.depaul.edu

How do you learn science?

➔ Focus

➔ Explore

➔ Examine

➔ Explain

What do the Next Generation Science Standards require?

Ideas that students learn by using practices that scientists use.

What's the change from ISBE Science?

Here are the main ISBE science content standards:

12A. Know and apply concepts that explain how living things function, adapt and change.
12B. Know and apply concepts that describe how living things interact with each other and their environment.
12C. Know and apply concepts that describe properties of matter and energy and interactions between them.
12 D. Know and apply concepts that describe force and motion and the principles that explain them.
12E. Know and apply concepts that describe the features and processes of the Earth and its resources.
12F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.

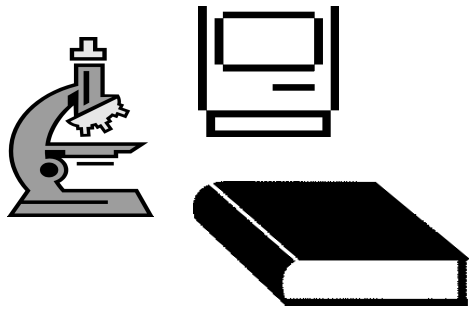
What four words are in each standard?

Good news: ISBE emphasized concepts!

Better news: NGSS emphasizes thinking.

How will Next Generation Science Standards change science education?

It's about applying ideas.



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

What do students explore with those concepts?

The world and the universe.

- What is.
- What was.
- What could be.

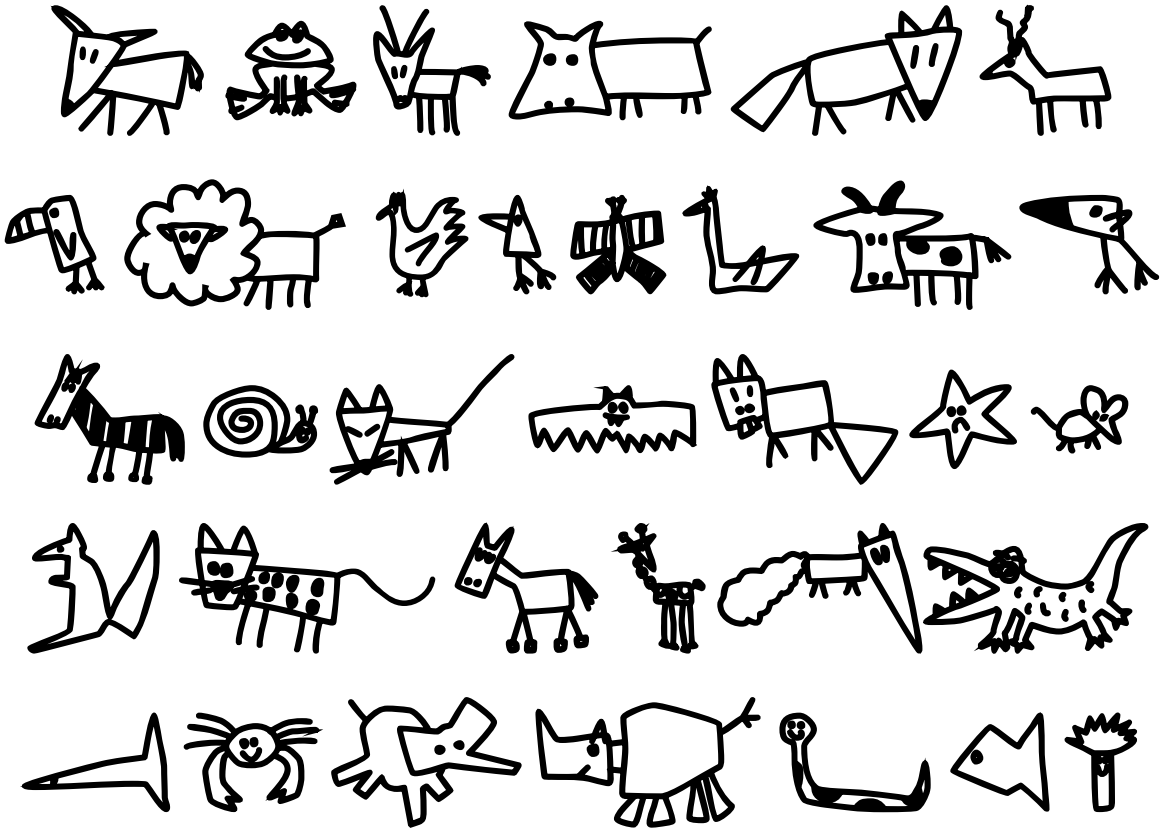
Physical Sciences
PS1: Matter and its interactions
PS2: Motion and stability: Forces and interactions
PS3: Energy
PS4: Waves and their applications in technologies for information transfer

Life Sciences
LS1: From molecules to organisms: Structures and processes
LS2: Ecosystems: Interactions, energy, and dynamics
LS3: Heredity: Inheritance and variation of traits
LS4: Biological evolution: Unity and diversity

Earth and Space Sciences
ESS1: Earth's place in the universe
ESS2: Earth's systems
ESS3: Earth and human activity

Engineering, Technology, and Applications of Science
ETS1: Engineering design
ETS2: Links among engineering, technology, science, and society

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?

Scientific and Engineering Practices

This is what scientists and engineers do.

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

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

Inventors use practices to apply concepts!

What practices would scientists have used to design these inventions?

Inventions of the 1800's

1800 the battery 1810 the first gas light 1810 the tin can 1814 the first steam locomotive 1823 the mackintosh (raincoat) 1824 the first toy balloon 1824 modern building cement 1827 the modern matches 1829 the typographer 1829 Braille printing 1830 the sewing machine 1834 paper-strip photographic paper 1835 the revolver 1835 the wrench 1836 the propeller 1837 the telegraph 1838 Morse code 1839 a bicycle 1839 rubber vulcanization 1840 the blueprint 1841 the stapler 1842 the first grain elevator 1843 under-ground rail travel 1843 invents the facsimile 1846 first use of anesthesia for tooth extraction 1848 the dental chair 1849 the safety pin 1850 the refrigerator	1851 the mechanical elevator 1854 the principles of fiber optics 1857 the Pullman sleeping car 1858 the rotary washing machine 1862 the machine gun 1866 dynamite 1868 tungsten steel 1873 barbed wire 1876 the microphone and telephone 1877 the phonograph 1878 the first practical electric incandescent light bulb 1880 a form of toilet paper 1880 the modern seismograph 1881 the metal detector 1884 the mechanical cash register 1884 the fountain pen 1884 the first gasoline-fueled, spark ignited, piston-engine car 1885 the petrol engine and the motorcycle 1886 the dishwasher 1887 radar 1888 the alternating current motor 1888 the pneumatic tire 1891 the escalator 1892 the internal combustion engine 1893 the zipper 1896 the rubber heel 1898 the diesel engine 1898 the roller coaster 1899 the motor-driven vacuum cleaner

Inventions of the 1900's

1900 the first tractor 1902 the polygraph machine 1902 the air conditioner 1902 neon light 1903 the first gas motored and manned airplane 1903 crayons 1904 teabags 1906 cornflakes 1906 sonar 1907 the first synthetic plastic called Bakelite 1907 color photography 1908 cellophane 1910 the first talking motion picture 1911 the first automobile electrical ignition system 1912 the first tank 1913 stainless steel 1914 the gas mask 1922 insulin 1923 the iconoscope (cathode ray tube) 1923 the traffic signal 1924 the dynamic loudspeaker 1925 the mechanical television 1926 liquid-fueled rockets 1927 a complete electronic television system 1928 bubble gum 1928 penicillin 1929 the car radio 1930 scotch tape 1930 the frozen food process 1931 the electron microscope 1932 Polaroid photography 1933 frequency modulation (FM radio) 1935 nylon 1937 the photocopier 1937 the turbo jet 1938 Teflon 1938 the ballpoint pen 1939 the first successful helicopter 1939 the atom bomb	1941 the first computer controlled by software 1942 the first electronic digital computer 1942 the turboprop engine 1946 the microwave oven 1947 the transistor 1948 Velcro 1951 the first videotape recorder 1952 the bar code 1953 the first musical synthesizer 1954 the solar cell 1956 the hovercraft 1958 the laser 1959 the microchip 1965 the compact disc 1965 kevlar 1969 the V/STOL Harrier jet 1969 –ARPAnet, the predecessor of the Internet 1970 the jumbo jet 1971 the liquid crystal display (LCD) 1971 the microprocessor 1972 the first video game, Pong 1973 the Ethernet (local computer network) 1974 the post it note 1976 the space shuttle 1979 cellular phone 1979 the Walkman 1981 IBMPC invented 1984 Apple Macintosh invented 1985 the Windows program 1986 the high temperature superconductor 1988 the Doppler radar 1990 the world wide web/internet protocol (HTTP) and www language (HTML) 1995 DVD (Digital Versatile Disc or Digital Video Disc) invented

What's next—what inventions will be on the timeline for the 2000's?

Which science concepts and practices would these tasks apply?

Design a birdhouse.

Construct a bridge.

Invent a way to purify water inexpensively.

…

Add more—what else could students plan, construct, design that would strengthen science and show them the career connections.

Who needs to learn NGSS Ideas and Skills?
Anyone who wants one of these jobs.

Chicago Science Jobs 2015

CCSSR1 Competence: Locate information in a data table.

Choose a job you would like to have.
List kinds of skills you would need to have to do that job well.

Science Career Area	Chicago Area Jobs	Hourly Wage
Aerospace Engineers	330	$ 49.81
Atmospheric and Space Scientists	280	$ 32.73
Biochemists	410	$ 38.98
Biological Technician	480	$ 20.83
Chemists	1,250	$ 34.05
Community Health Worker	2,650	$ 18.96
Computer Hardware Engineers	850	$ 47.97
Conservation Scientists	70	$ 38.51
Dietetic Technicians	1,200	$ 12.21
Dietitians and Nutritionists	1,500	$ 25.87
Electrical Engineers	3,590	$ 45.60
Emergency Medical Technicians and Paramedics	6,840	$ 28.18
Environmental Engineers	760	$ 41.76
Environmental Science Health Technicians	900	$ 19.42
Environmental Scientists and Specialists	1,070	$ 40.66
Family Doctors	1,940	$ 69.77
Forensic Science Technicians	280	$ 39.20
Health & Safety Engineers	500	$ 33.87
Medical (Research) Scientist	980	$ 40.72
Occupational Therapists	3,190	$ 37.48
Pharmacists	7,090	$ 55.21
Pharmacy Technicians	10,510	$ 13.94
Registered Nurses	69,750	$ 35.35
Zoologists Wildlife Biologists, Soil & Plant Scientists	120	$ 31.77

If you don't find a job you want on this list, look at the complete list at
http://www.bls.gov/oes/current/oes_16974.htm#%284%29

Extended Day/Learning Center
Science Task Inventory

What activities do we/will we include to strengthen science learning?

NGSS Component	Tasks
Planning and carrying out investigations	
Analyzing and interpreting data	
designing solutions (for engineering)	

They ALL require this practice: obtaining, evaluating, and communicating information

What is the NGSS connection to Common Core literacy? Read to learn, write to explain!

The following statements list the focuses Writing standards that relate to communicating science, which is an NGSS competence.

WRITING!

Research to Build and Present Knowledge

7. Research to respond to a focus question.
8. Integrate information from different kinds of sources.
9. Support research and analysis with evidence.

Production and Distribution of Writing

4. Make it coherent and clear—well organized.
5. Plan it then revise it.
6. Use technology to "publish" it

For the complete standards, go to
http://www.corestandards.org.

THE PARCC PLUS:
PARCC has restored writing as an important way to communicate.

This list is based on the list PARCC gave to item writers—it includes kinds of texts that students may find on PARCC.

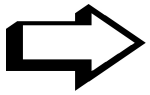
Adventure story	Autobiography	Biography
Book review	Brochure	Character Sketch
Description	Diary (of a character or actual person)	Encyclopedia entry
Essay	Explanation (combined with diagrams or illustrations)	Fable
Fantasy story	Fiction	Folktale
History	Historical Fiction	How-to-do-it article
Humorous story	Legend	Letter
Magazine article	Myth	Narratives of science experiments
Opinion statement	Pamphlet	Persuasive essay
Persuasive letter	Play (dramatization of a story or history)	Poem
Realistic Fiction	Report	Review
Report	Review	Short Story
Science article	Science report	Science fiction
Sequel	Speech	Travel guide

PLUS
Your students can construct an exhibit!

How do structures enable birds to fly?

Structure	Function--How it helps them fly	*How people have adapted this to design airplanes.*

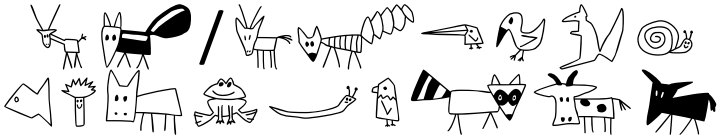
How do fish swim? What are your ideas?



OBJECTS AND IDEAS

A guide to organizing an in-school

PLACE FOR WONDER



A SCIENCE EXPLORERS MUSEUM IN YOUR SCHOOL

What is a Place for Wonder?

IT IS A MUSEUM!

It is a hands-on and minds-on museum.

It is a special place for topic-focused learning.
Ideally it will be located in your school library, but it can be any place in the school where all the students will have access to it.

Have students participate in setting up the Place for Wonder. In fact, you can organize "alternative assessments" of their science knowledge and skills by having them contribute materials to the museum.

STEP 1: Choose a topic.
It could be any topic from science. We recommend that you start with topics that you are most familiar with--and that are central to the science curriculum. For example, you could focus on birds, which are relevant to the curriculum at many grades, as students learn concepts of adaptation, classification, and interdependence in habitats.

You can set up materials that illustrate a theme that is interdisciplinary--such as Chicago transportation, which could combine science (the technology of travel), geography (the patterns of travel), and history (how travel has changed).

Step 2: Identify important ideas.
What ideas do students need to learn about this topic? You can find them on the Next Generation Science website, and you can identify them collaboratively with teachers from different grade levels. You can start with a Next Generation cross-cutting concept or start with the idea and then identify the concepts your exhibit will emphasize in labels and questions.

Step 3: Plan the exhibit.
Think of objects and/or illustrations that could help students envision those ideas--make those ideas three-dimensional. You can use objects or make models--or combine them.

What kinds of objects and illustrations could you get?

Everyday objects can illustrate a topic. For example, you can illustrate transportation with models of trains, cars, and other forms of transportation.

Encourage students to make models or bring in objects for the place for wonder. *Add photos and books.*

What else? Ask students to find objects and photos that relate to the ideas.

Step 4: Make Concepts Clear
Look for ways to combine the objects so they help students see concepts clear.

Step 5: Use labels to ask questions.
The point of a Place for Wonder is that the objects and illustrations themselves help learners answer questions and that the objects give students a reason to read and write. You can design an activity that gets students to look, draw, and think, or you can write a question that gets them to focus and find information visually.

Write questions for labels that help the children see those answers independently.

Step 6: Challenges and projects.
Have students contribute to the Place for Wonder. You can work in partnership with teachers, and that teacher's class could contribute a part of an exhibit or the whole exhibit.

Step 7: Keep Adding
Add more questions, add illustrations that students draw, add more objects that students collect or make.

Involve students in making up questions that can be answered by "reading" the objects and illustrations in the exhibit.

Step 8: Make a traveling exhibit.
When it's time to deal with another topic, put your exhibit on tour. Send it to interested classrooms. Ask the classes to continue to contribute to the exhibit, so that when it returns it has expanded.

Step 9: Start over--make another exhibit.
Be sure to vary the kinds of materials and activities that the students work with in each exhibit so that they continue to learn different skills as they learn about different topics.

Expand Progress: Peer to Peer Presentations.

Share Strategies

What is the focus of the presentation?

_____

What are the most important ideas you want to communicate?

_____

_____

_____

What materials will you use?

_____

_____

What are the parts of your presentation?

How will you start? _____

Explanation/Demonstration/Activity(ies):

Conclusion: _____

Parent Workshop Planner

Focus: _____

Outcomes—What will the workshop result in?

Parents will know more about _____

_____

_____

Parents will be able to _____

_____

_____

Date and Time:_____

What administrators, teachers, school staff will participate?

Person	Workshop Role

Who will facilitate? _____

Who will present? _____

How will we invite parents?

_____

_____

_____

_____

How we will remind participants about the workshop:

_____

_____

Materials: What will they receive?

_____

_____

Activities: What will participants do?

_____

_____

_____

_____

Follow up: How we will follow up on the session

_____

_____

_____

Parent Workshop Evaluation

¿Qué tan útiles fueron estas secciones de este taller?
How useful were these parts of the workshop?

	Nada Útiles Not Useful	**Medio Útiles** Somewhat Useful	**Muy Útiles** Very Useful
Presentaciones / Presentations			
Discusiones / Discussions			
Materiales / Materials			

¿Cuáles fueron las ideas o la información más importante para usted?
What were the most important ideas or information you gained?

¿Que acción va a tomar usted basada en la sesión?
What will you do based on this session?

En una escala de 0 a 5, con 0 siendo lo más bajo y 5 siendo lo más alto ¿qué tan útil fue este taller?
On a scale of 0 to 5, how useful was this workshop?

_____