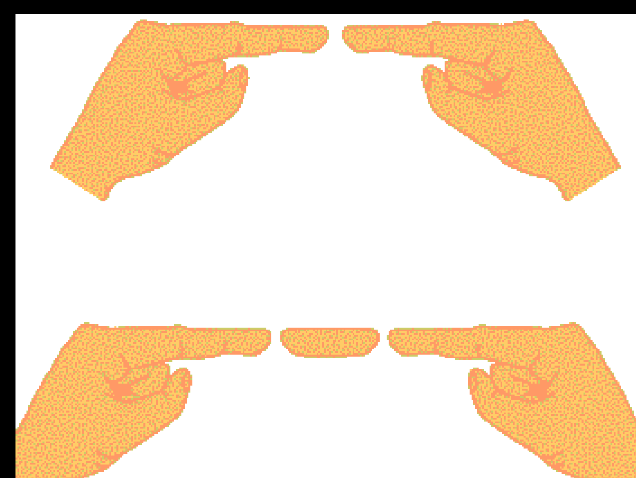
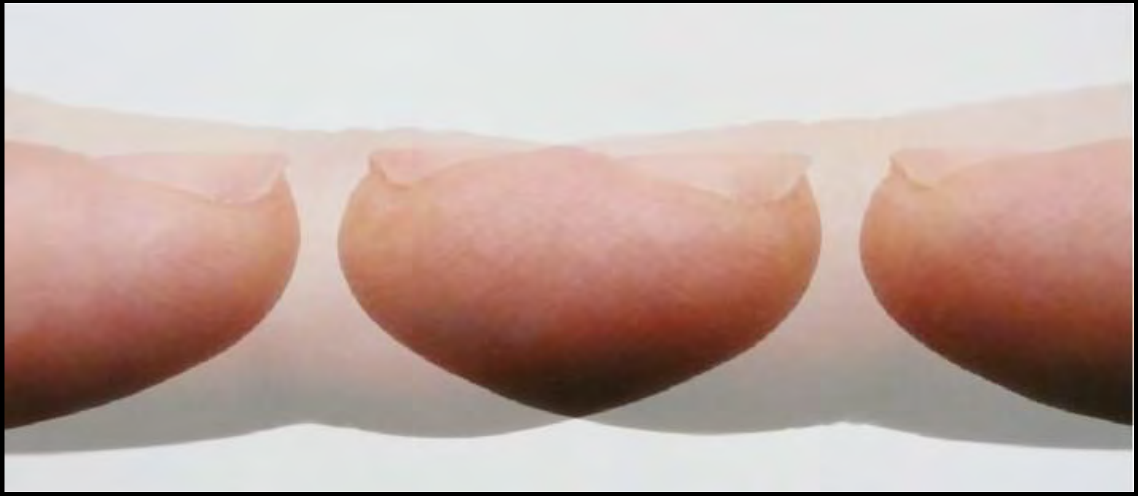
Binocularity

1. Hold your two hands approximately 12 inches in front of you at eye level with your palms facing you.
2. Point your index fingers towards one another leaving approximately 2 inches between them.
3. Stare at a blank wall or space in the distance without moving your hands and without focusing on your fingers.



Your Extra “Floating” Finger?

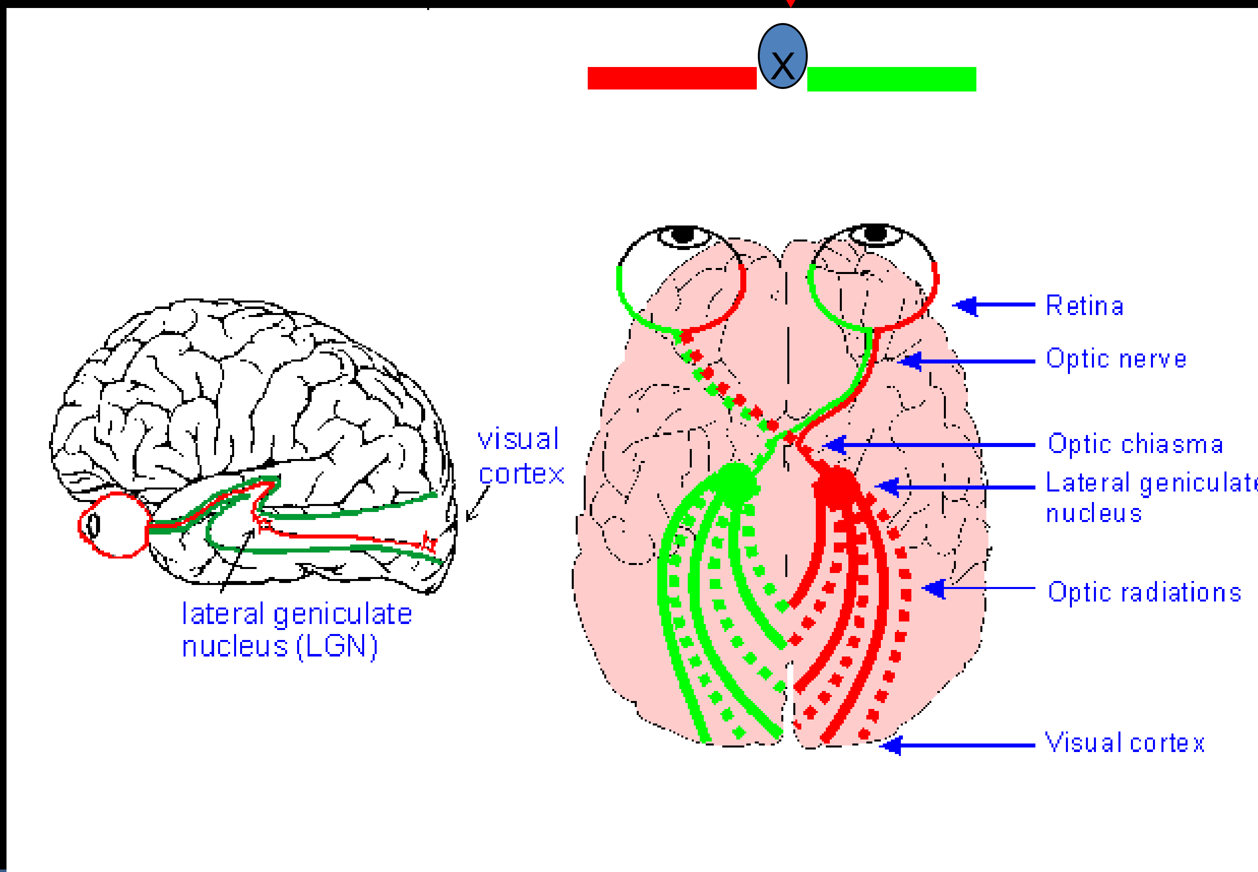
4. **What you will see:** Between your two index fingers, you should see a “new” smaller finger with two rounded ends floating in between the others.
5. Try this illusion with your two index fingers actually touching each other and you should see a solid finger wedged *in between* your two index fingers.



S.T.E.M.

A Hole in Your Hand Illusion

Both of your eyes see the same thing, but from two slightly different visual fields. Your brain must combine two slightly different "pictures" (perspectives) in order to see *depth*, to see *3 dimensions* and to judge *distances.* The side of the tube has interfered with that process.



What K-12 Teachers Must *Learn*

Science and Engineering

Practices

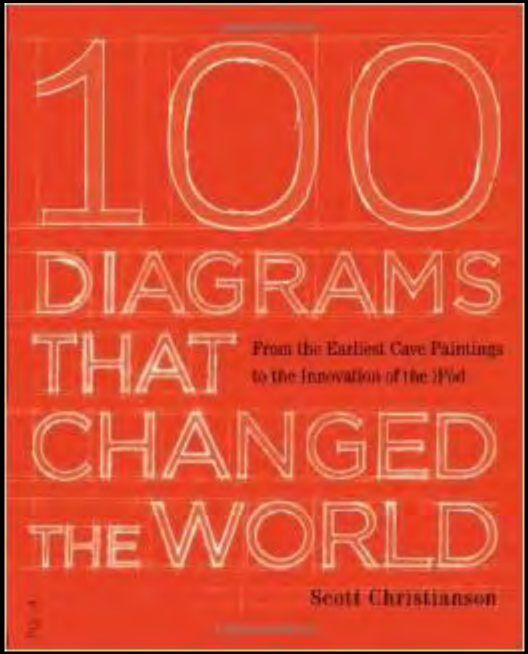
NGSS: An Intimidating Proposal?

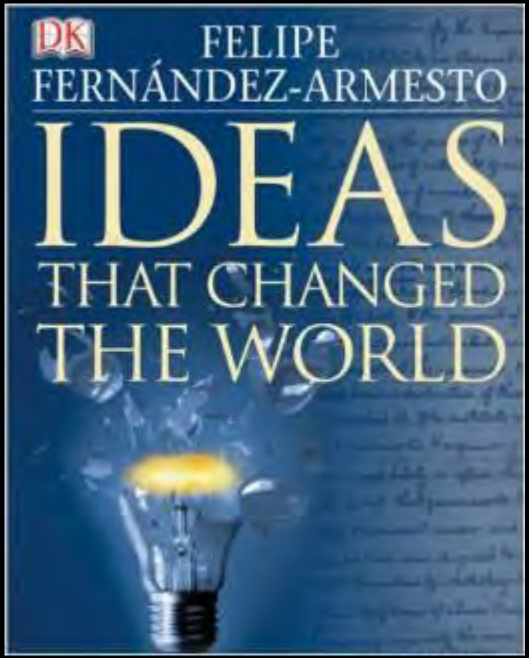
Design

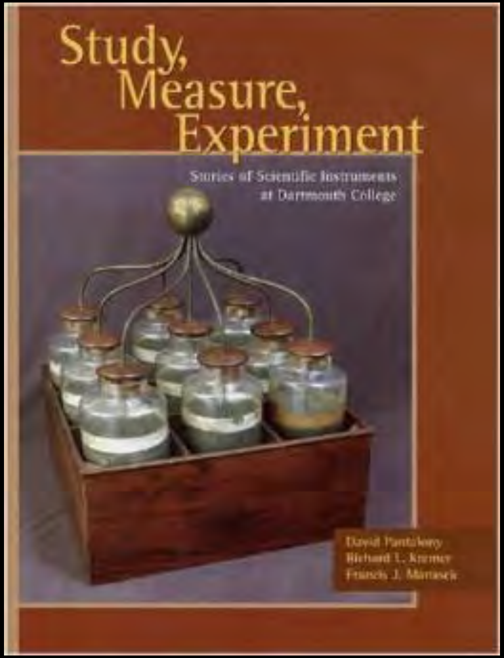
and

Engineering

STEAM
Science - Technology - Engineering - Art - Math







- All *ideas* begin with a vision/visual image (a mental picture → drawing).
- All *engineering* begins with a design (→ diagram graphic representation of the initial idea).

S.T.^{2}R.E.A.M.

Science

Technology (and **Thematic** trans-disciplinary instruction to extend student learning)

Reading and Language Arts

Engineering (“**Design** *and* Engineering”)

Art

Mathematics

(Maximizing connections and sensory experiences)

NEXT GENERATION SCIENCE STANDARDS

What K-12 Teachers Must *Learn*

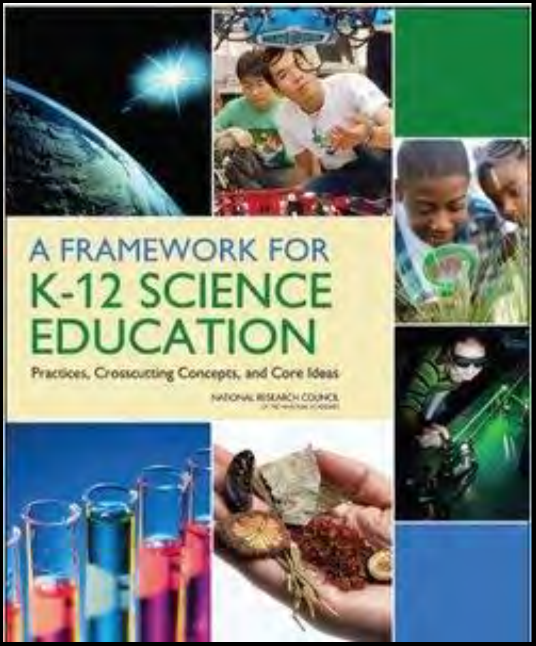
Science and Engineering

Practices

Elementary Science Teachers with College Coursework in Various Science Disciplines, by Grade Range

	Percent of Teachers	
	Grades K–2	Grades 3–5
Life sciences /Biology	92	87
Earth/space science	66	65
Chemistry	47	47
Physics	31	34
Environmental science	33	34
Engineering	1	2
Science education	88	91
Student teaching in science	72	68

A Framework for K-12 Science Education



- Children are born **investigators**
- Understanding builds **over time**
- Science and Engineering require both **knowledge** *and* **practices**

Learning Progressions

1. **One disk** + straw → Spinning top →

↓

2. **Two disks** + straw → a wheel-and-axle system

↓

3. **Four disks** + straws → a pair of two wheel-and-axle systems

↓

Large disks vs small disks
Cardboard cart vs tongue depressor cart

↓

4. **Create your own cart** (applications, math, design, engineering, art)

Engineering

- **Creating solutions to *problems* (the work of *engineers* who "engage in a systematic practice of design to achieve solutions particular human problems" -** *NRC, A Framework for K-12 Science Education, 2012, page 11)*
- **The success of their solution(s) is determined by how well or satisfactorily it solves the problem *(criteria)***
- **Solutions are *limited* by *constraints* (e.g., the available materials, time, budget/costs, tools, conditions, etc.,) and solutions do not occur in a "light bulb experience." Instead, they require a deliberate, thoughtful, systematic design process**

Engineering

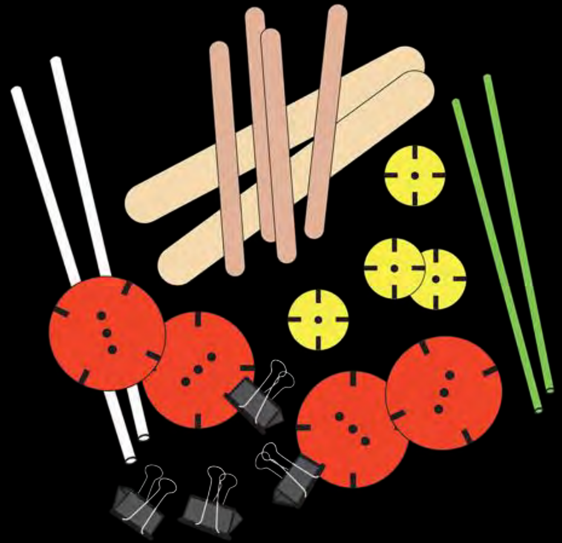
Engineering challenge: Build a spinning top.

1. *Criteria:* **construct a spinning top that spins for seven seconds or more.**

2. *Constraints:* **(a) use only the materials provided, (b) you can spin your top using only your hands, and (c) five minutes to construct and test your top.**

Use the following items:

- Stirring straws
- Large plastic disks (red)
- Small plastic disks (yellow)
- Scissors
- stopwatch



Engineering

Conduct a formal investigation to answer the following questions:

- Where should the disks be *placed* on the stirring straw in order for the system to spin?
- Will the top spin longer if the disk is placed closer or further away from the bottom of the system?
- How long will the disk spin if it is placed on the straw
  - ½ inch from the bottom
  - 1 inch from the bottom
  - 2 inches from the bottom
  - 3 inches from the bottom, or
  - 4 inches from the bottom?

(record your data: What is the optimal design?)

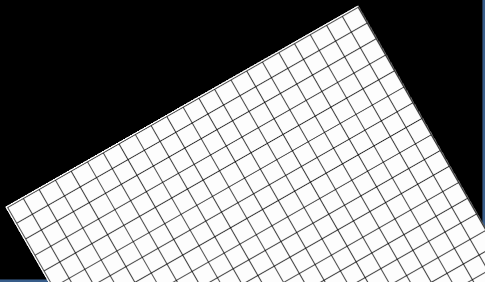
Engineering

1. What seems to be the optimal distance to place the disk from the bottom of the straw to get the top to spin the greatest amount of time?

2. Will a larger disk spin longer than a smaller disk placed the same distance from the bottom of the straw?

3. If additional disks are added (more mass) to the spinning system, will the amount of time that it will spin increase or decrease?

4. record your data



1. Do the tops spin in a predictable pattern?
2. How could you find out?

SPINNING TOP MUSEUM Catalog PAGE 1

www.topmuseum.org (262)763-3946 thetopmuseum@hotmail.co


www.topmuseum.org
1. Choral pump top. Metal body.


www.topmuseum.org
2. Circus pump top.


ww.topmuseum.org
3. Set of 5 flipover tops.


www.topmuseum.org
4. Set of 4 bug tops.


www.topmuseum.org
5. Set of four optical illusion finger spinners.


www.topmuseum.org
6. Train pump top.


www.topmuseum.org
7. Set of 4 cut-out wood spinners.


www.topmuseum.org
8. Set of 2 wood illusion tops with penny center.


www.topmuseum.org
9. Box of 5 tops + blank disks: flipover, block top, illusion tops, magnet top.


www.topmuseum.org
10. Set of 10 wood blank tops.


www.topmuseum.org
11. Set of plastic tops


www.topmuseum.org
12. Duncan wood yo-yo, specify color


www.topmuseum.org
13. Set of 10 Top Museum Postcards


 # 14. Optical top set
www.topmuseum.org


www.topmuseum.org
15. Set of 15 tops with box.


www.topmuseum.org
16. Set of 4 wood peg tops

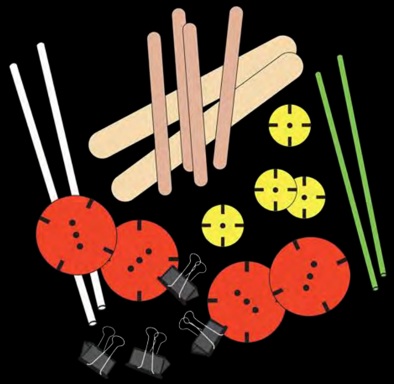

www.topmuseum.org
19. Set Assemble tops

Engineering

Engineering challenge: Build a **wheel-and-axle system** (transferring your knowledge from the spinning tops).

1. ***Criteria:*** construct a wheel-and-axle system that rolls at least 24 inches.

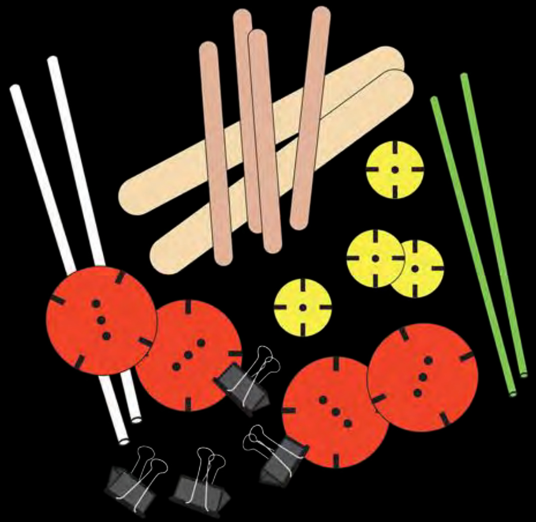
2. ***Constraints:*** (a) use only the materials provided, (b) your wheel-and-axle system must roll 24 inches on its own after one small push, and (c) you have 5 minutes to construct and test your wheel-and-axle system.



Engineering

Your wheel-and-axle system can be made with the following items:

- 2 Stirring straws
- 4 Large plastic disks (red) or
- 4 Small plastic disks (yellow)
- 1 pair of scissors

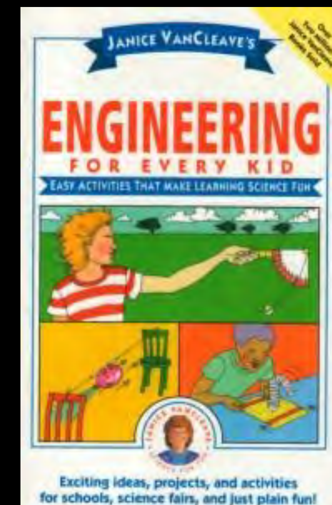


Step #1

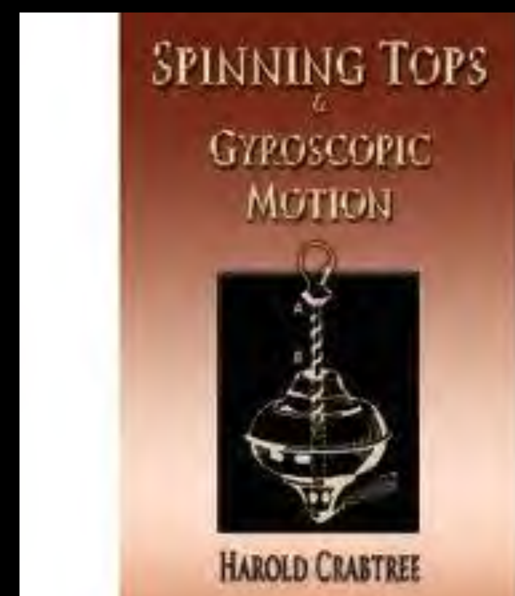
Engineering

Your wheel-and-axle system can be made with the following items:

- 2 Stirring straws
- 4 Large plastic disks (red) or
- 4 Small plastic disks (yellow)
- 1 pair of scissors



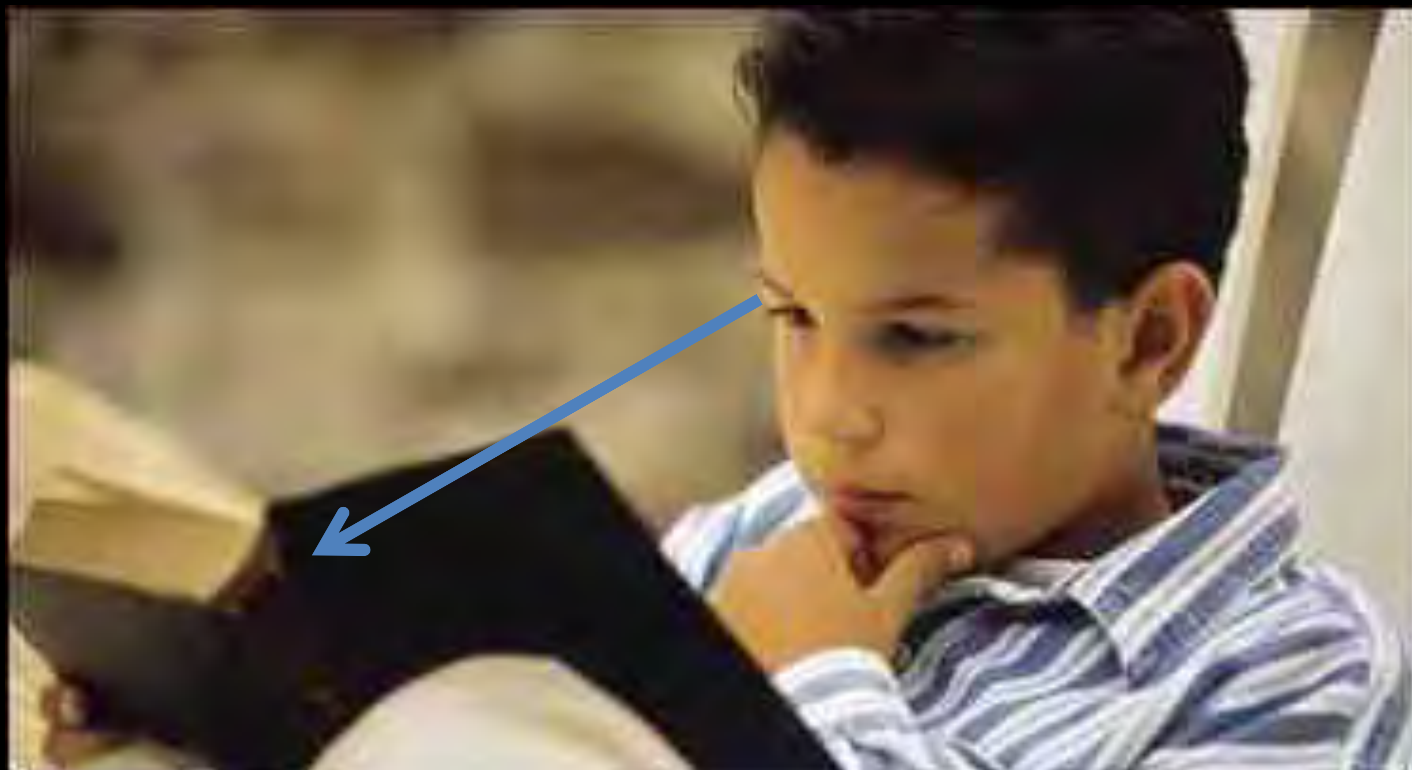
Step #1 - Research the problem/challenge (What is a **wheel-and-axle system**? What are its constituent **parts**? How do the parts work together? What is a **bearing**?) *



*** CCSS –E/LA Standards application**

Reading Informational Text at grade level

Reading comprehension goes from the learner *to* the page not from page → learner



What the learner *already knows* determines text comprehension.

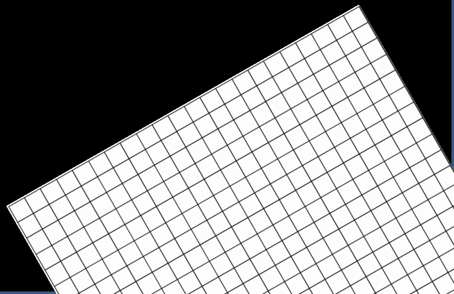
Engineering

Construct the wheel-and-axel system (Investigate the accompanying questions and *record your data using centimeters.)*

1. Insert a green stirring straw through the center hole in a red or yellow disk (identical to your spinning system) and roll it on the table. What happened?
2. Add a *second disk* of the opposite color at the other end of the straw and roll your wheel-and-axle system on the table. What happened? Why?
3. Place two disks of the same color at each end of the straw (now your former “spinning top” system has *two* disks at the opposite ends of the straw instead of just one).
4. Now roll your wheel-and-axle system on the table. What happened when a second disk of the same size was added? Why?
5. Will two large red disks in a wheel-and-axle system roll farther than two small yellow disks? How could you find out?

Engineering

If ***an additional wheel*** is added to the 2-wheel-and-axle system, **will it go further** when the same amount of force is exerted? **Predict** what will occur, write down and then test your **prediction.** Were you correct?



The Science of Learning

Instead of saying:	Use MINDFUL LANGUAGE by saying:
"Let's look at these two pictures."	"Let's COMPARE these two pictures."
"What do you think will happen when…?"	"What do you PREDICT will happen when…?"
"How can you put those into groups?"	"How can you CLASSIFY…?"
"Let's work this problem."	"Let's ANALYZE this problem."
"What do you think would have happened if…?	"What do you SPECULATE would have happened if…?"
"What did you think of this story?"	"What CONCLUSIONS can you draw about this story?"
"How can you explain……?"	"What HYPOTHESES do you have that might explain...?"
"How do you know that's true?"	"What EVIDENCE do you have to support…….?"
"How else could you use this…..?	"How could you APPLY this ……..?"

Engineering

Engineering challenge: **Build a cart** **(based on the knowledge you gained from the wheel-and-axle system).**

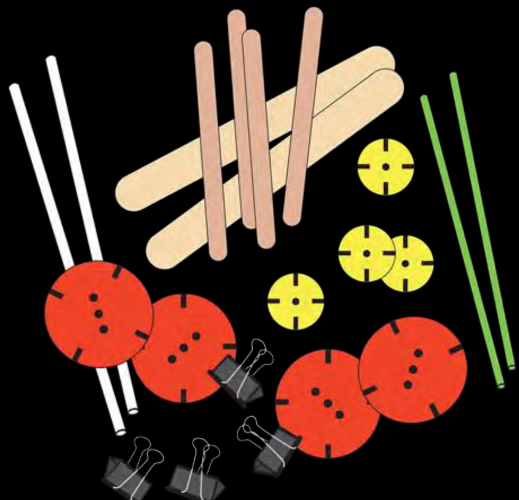
Criteria: **design and construct a 4-wheeled cart that moves from one place to another (rolls 24 inches).**

Constraints: **(1) use only the materials provided, (2) your cart must roll 24 inches on its own given one small push, and (3) you have 10 minutes to construct your cart, and run your 1st test measuring the distance.**

Engineering

"Build a cart" materials (in baggie):

- 2 green stirring straws
- 1 drinking straw
- 3 x 5 file cards or 4 X 5 piece of cardboard
- 4 large (red) *or* 4 small (yellow) plastic disks
- 2 tongue depressors
- 4 small binder clips
- 1 pair of scissors
- Scotch tape
- 4 clothespins
- Cardboard ramps



You will also need:

- 1 measuring tape

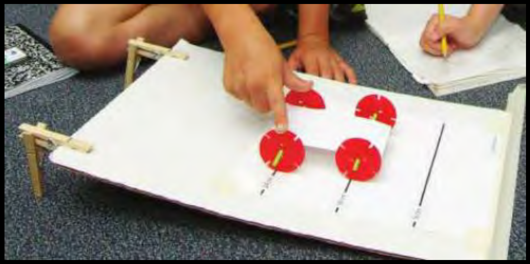
Engineering: Building a cardboard cart

1. Cut a piece of cardboard into a 5” x 4” rectangle
2. With a pencil, draw a line 2 cm (the width of a tongue depressor) from the edge of the two longest sides of the rectangle. Fold on the lines of the cardboard.
3. Place a tongue depressor on the inside of the folded part of the cardboard. It should create a 90 degree angle with the base of the cart. Use two binder clips to secure each tongue depressor.
4. Slide a clear 4 inch drinking straw through the rounded “loop” on the bottom of the binder clips.
5. Slide a green stirring straw all the way through the clear straw.
6. Place a disk onto the (4) ends of the 2 green stirring straws. (You should now have a four-wheeled cart. Decorate your car if you wish.)

Engineering: Making a Ramp

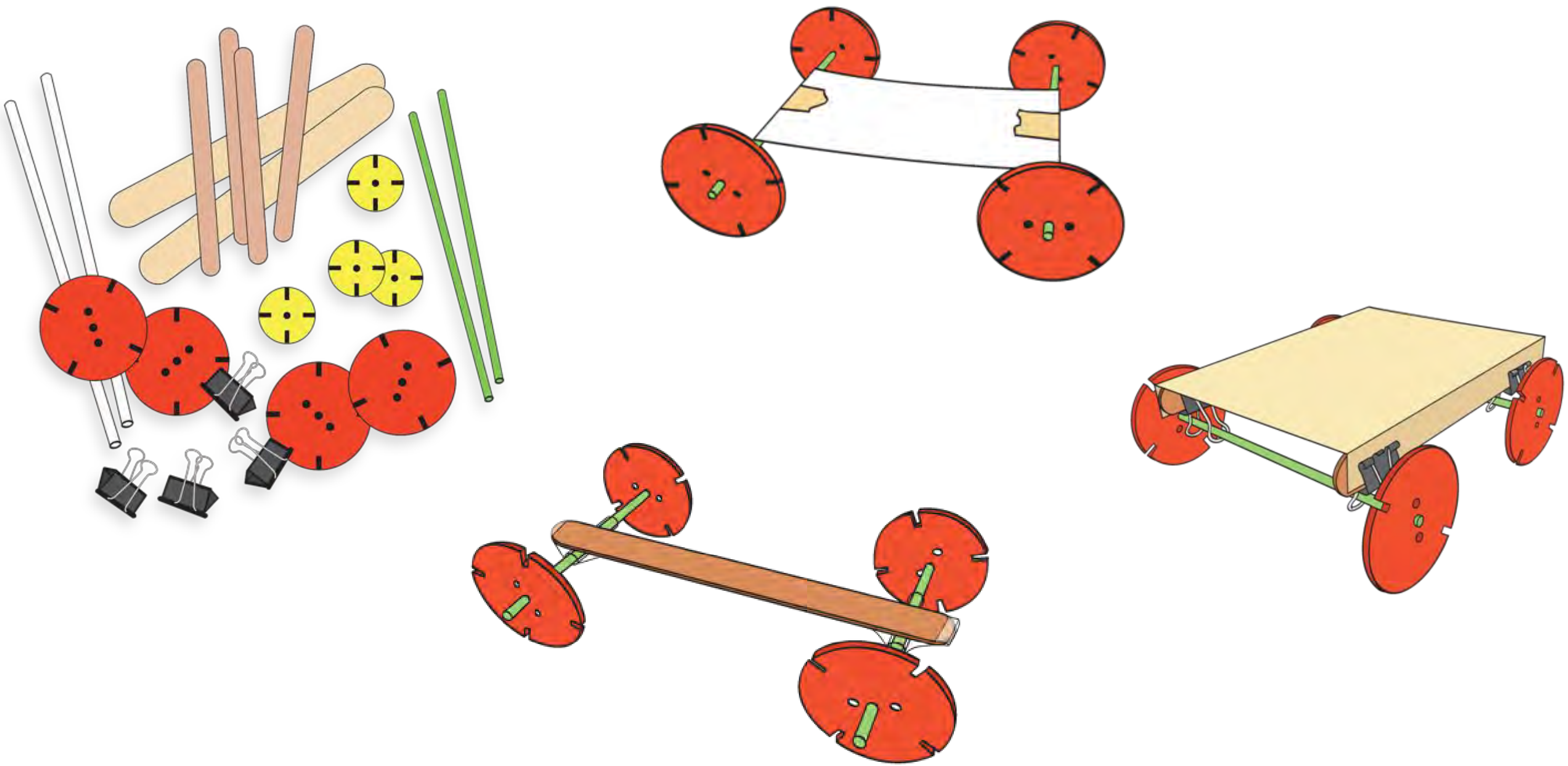
1. Cut a piece of cardboard approximately 15 cm X 45 cm
2. Measure and mark the points on the ramp that are 6 cm, 12 cm, and 24 cm from the bottom.
3. Holding the top of the ramp, attach two clothespins to the top end of the ramp.
4. Place the ends of each of these clothespins into the "mouth" of two more clothespins making a right angle (L-shape) leg to hold up the ramp.

(Your ramp should be stable and ready to use).



In-depth Investigations and Connected Learning Progressions

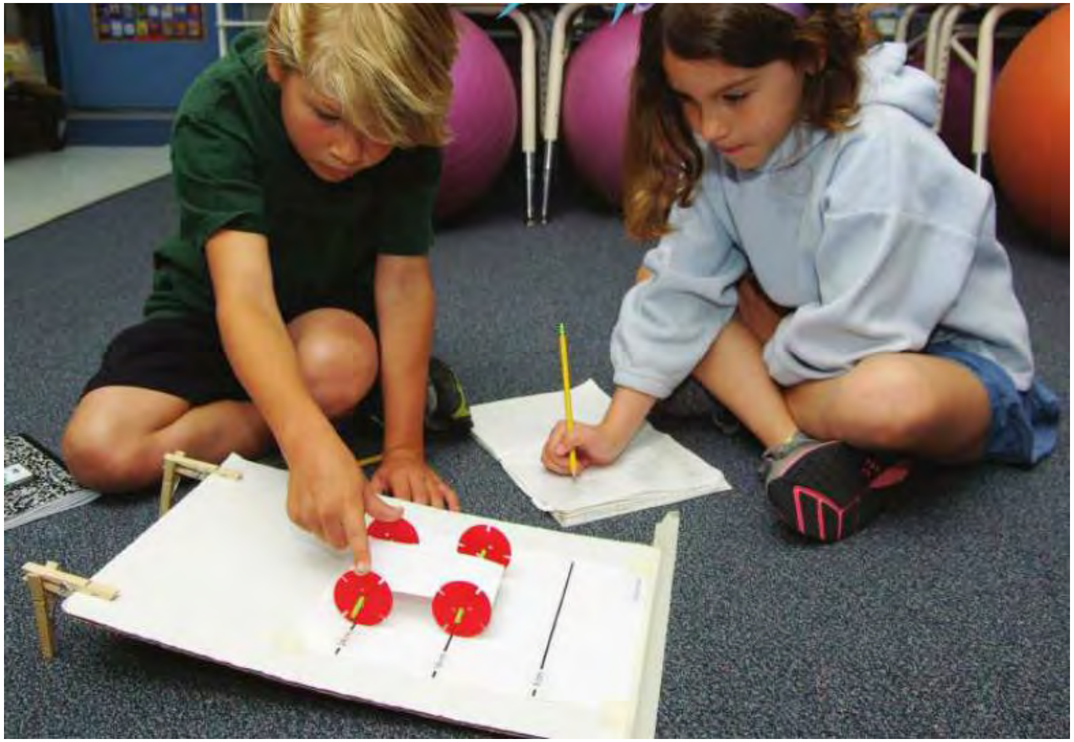
<u>Part 1</u> - Students tackle an engineering challenge:
"Design a cart that will roll from one place to another."



In-depth Investigations and Connected Learning Progressions

Part 2 - Students improve their design

Redesign their cart to meets new constraints: Rolling distance (incorporating CCSS-Math)



In-depth Investigations and Connected Learning Progressions

Part 3 – Investigating start positions (Cross-cutting Concept: cause-and-effect)

Students design and conduct an investigation using their carts to find out how start position affects distance

"One characteristic of high-performing schools is an emphasis on teaching non-fiction writing."

Reeves, D.B. (2003). High Performance in High Poverty Schools: 90/90/90 and Beyond. Center for Performance Assessment. Denver, Colorado)

Engineering

How to build a tongue depressor cart:

1. Cut a clear straw into four *2-inch segments.*
2. Cut a green stirring straw into two *3-inch segments.* Make a ½ inch diagonal cut at each end of the green straws (easier to insert into the disk).
3. Slide the green straw *inside* the clear straw.
4. Slide 4 red disks *or* 4 yellow disks through the end of the green straws (3/4 inch)
5. Tape the axle systems to the bottom of the tongue depressor. Test to make certain that the wheels rotate.

- You should now have a functioning cart

Teaching Creativity and Innovation Through STEM and STEAM

How can we plan daily classroom experiences to meet the goals of STEM?

STEM education…

The easiest way to incorporate play and STEM into your curriculum is to identify the STEM in the content and activities that you are *already* teaching.

Some content *is* “STEM,” but not labeled as such, while other content *lends itself towards* STEM and play with just a few modest modifications.

Re-engineering: Humpty Dumpty

Humpty Dumpty's friend, the local fortune-teller, has predicted "a severe fall accompanied by multiple injuries."

Mr. Dumpty recently saw you and your engineering expertise featured on the Six O'clock News. Design an engineering solution for him.

Re-engineering: Humpty Dumpty

Engineering solutions for Humpty Dumpty...

- A light-weight titanium helmet
- A full-body padded suit
- A thick foam pit at the base of the wall
- A seat/seatbelt system securely fastened to the wall
- A “tip-o-meter” that sets off a siren when he leans 5-10 degrees in any direction
- Attach him to a motion-activated parachute
- Place him inside a 360-degree rubberized geodesic frame

Re-engineering: The Three Little Pigs

NGSS:
"…develop a simple sketch, drawing or physical model to illustrate how you would solve this problem." (Achieve, Inc., 2013)

Problem/situation: **You have received an urgent text message from the Three Little Pigs, who are exasperated with "little pig-provocation" by their neighbor the Big Bad Wolf. You have been asked to engineer two safeguards to prevent further persecution from the Big Bad Wolf.**

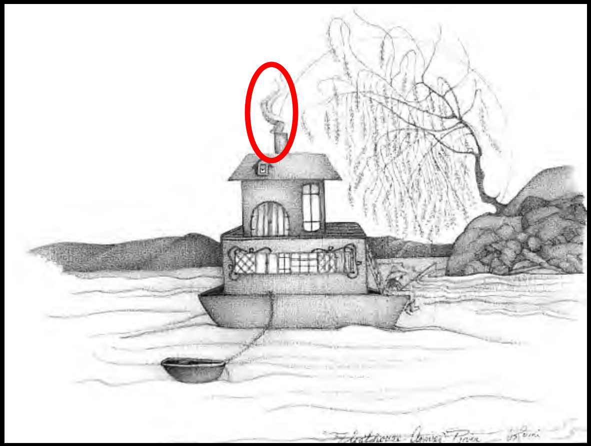
What design and engineering solution can you propose?

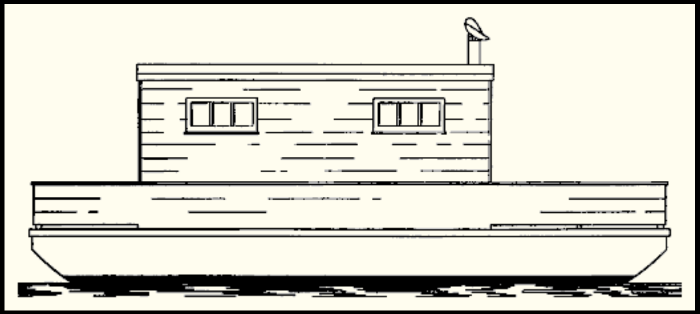
Re-engineering: The Three Little Pigs

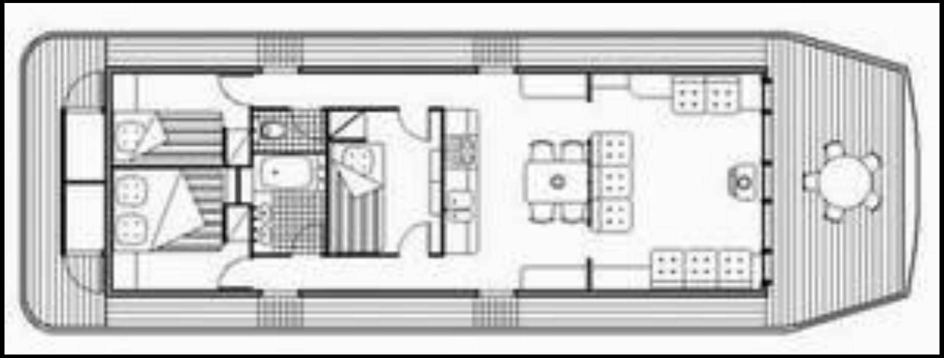
1. A house with an aluminum rooftop.
2. Replace the chimney with a central heating system
3. Wolves are afraid of snakes, so around the house…
4. Wolves are afraid of water, so install a motion-sensitive automatic water sprinkling system.
5. Build a solar-powered environmentally friendly fan that blows air *away from* the house, when the wolf blows air *towards* the house
6. Build a house with a 35° angle rooftop (too steep).
7. Wolves are afraid of water, so build a houseboat and position it 20 yards from the shore.

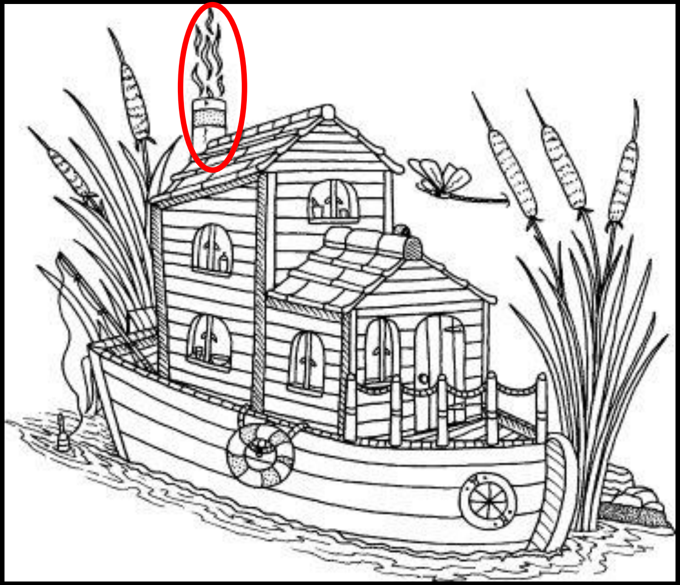
Houseboat Solutions for the Three Little Pigs

"Arte/Scienza"









Only Your Imagination Can Set a Limit on Your Creative Thinking

Combine…

Engineering + Art + Visualization +

VST + Math +

following oral, written and *visual* directions

Origami

Guest Editorial

Minds, Models, and Maps

By Kenneth Wesson

"Every child is an artist. The problem is how to remain an artist once he grows up."

— Pablo Picasso

The solar system is too large to bring to school. Mammalian life cycles stretch well beyond the academic year, and tiny organisms are too small to examine closely. Prehistoric animals are, well, "prehistoric." However, the forever fascinating world of science from the massive to the minute, of today and of years long gone, opens immediately to all students by way of sketches, models, simulations, maps, and other visual learning devices. Collectively, they allow young learners to make cognitive leaps from the intangible to the comprehensible.

learning. Once we "recognize" an object, separating image from name and the name from function becomes next to impossible. Vision is so central to factual certainty that our initial sensory impressions, and eventually our overall cognition, are validated by our eyesight. As we so often hear, children assure others that "I saw it with my own eyes!" underscoring a pinnacle in experiential confidence that cannot be humanly exceeded.

Visualizing is integral to reading for comprehension. To understand what they read, students must rely heavily on the "picture-making" mechanisms in the visual cortex in order to extract meaning from the text. The association cortex is charged with the task of making sense of the incoming visual information. Learners can only make sense of abstract information based on preexisting internal

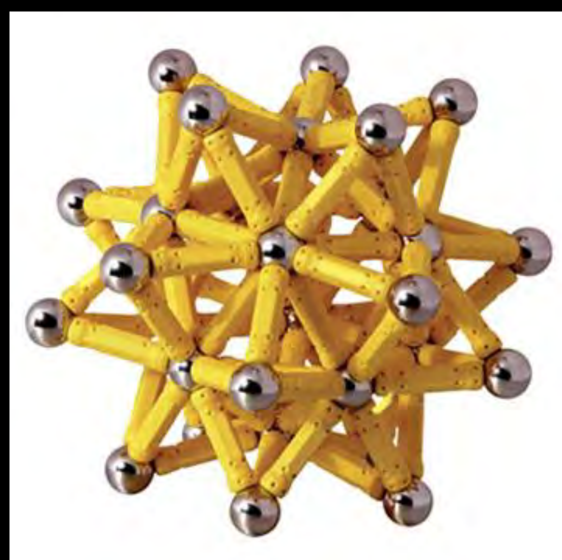
(This issue of *Science and Children* received **the 2011 *Distinguished Achievement Award*** recognizing it as **the Best "One-Theme Issue"** for an American Educational Journal in 2011)

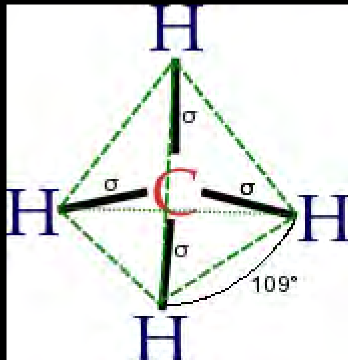
Transfer

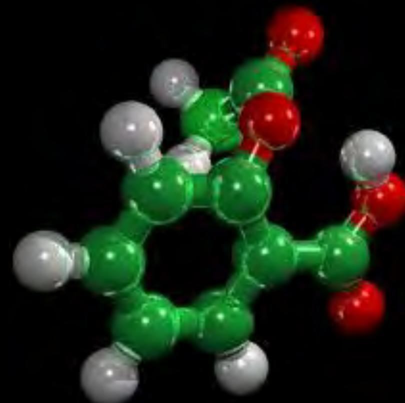
- Transfer is facilitated by knowing the **multiple contexts** under which an idea **applies** (i.e., effective transfer is inextricably linked to the conditions for applicability; **rote learning** rarely transfers.)

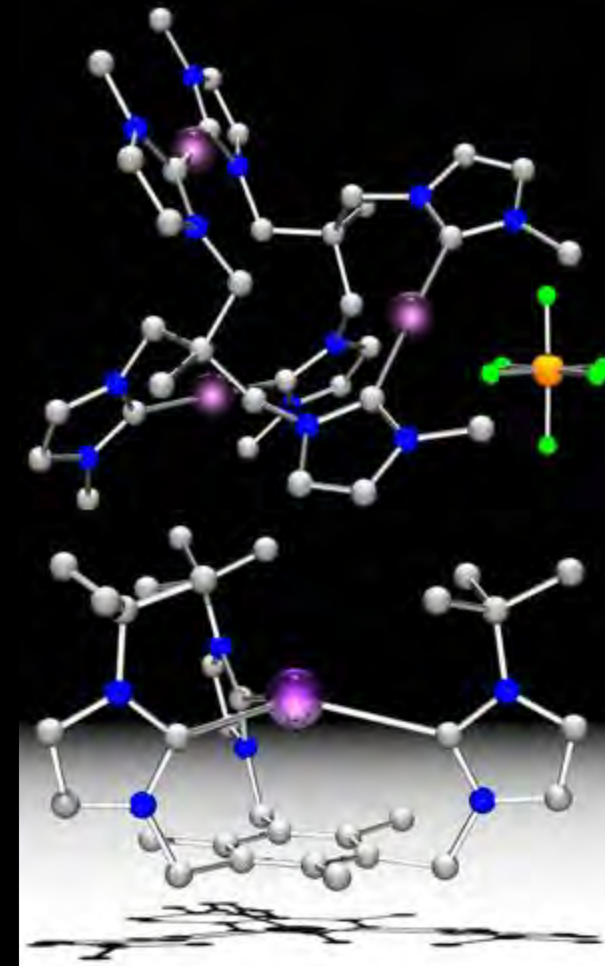
- New learning depends on **prior learning** and **previous learning** can often *interfere* with new content that is being taught.

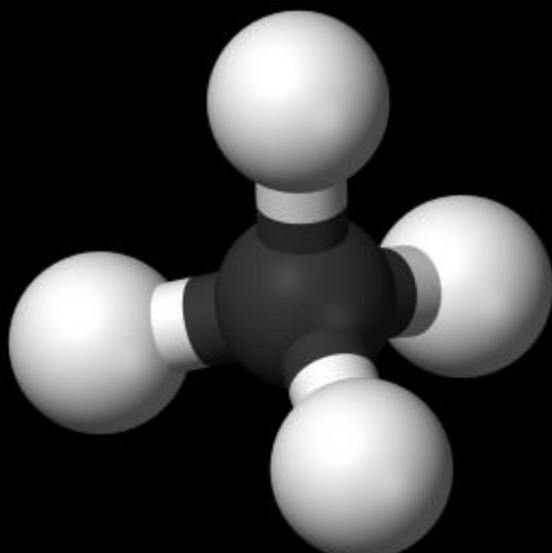
College Preparation Begins Well Before High School



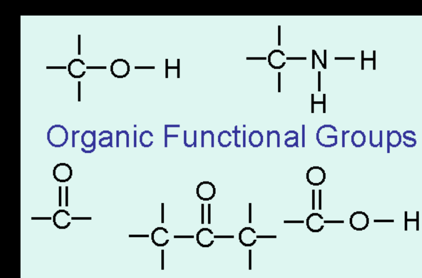








Methane




CAMPHOR
A chiral molecule with a Molecular formula:
5
6
Second Nature Member
Chaz Balbozar
Second Nature Member
Horace Moody


TechCrunchTV
Share
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Info
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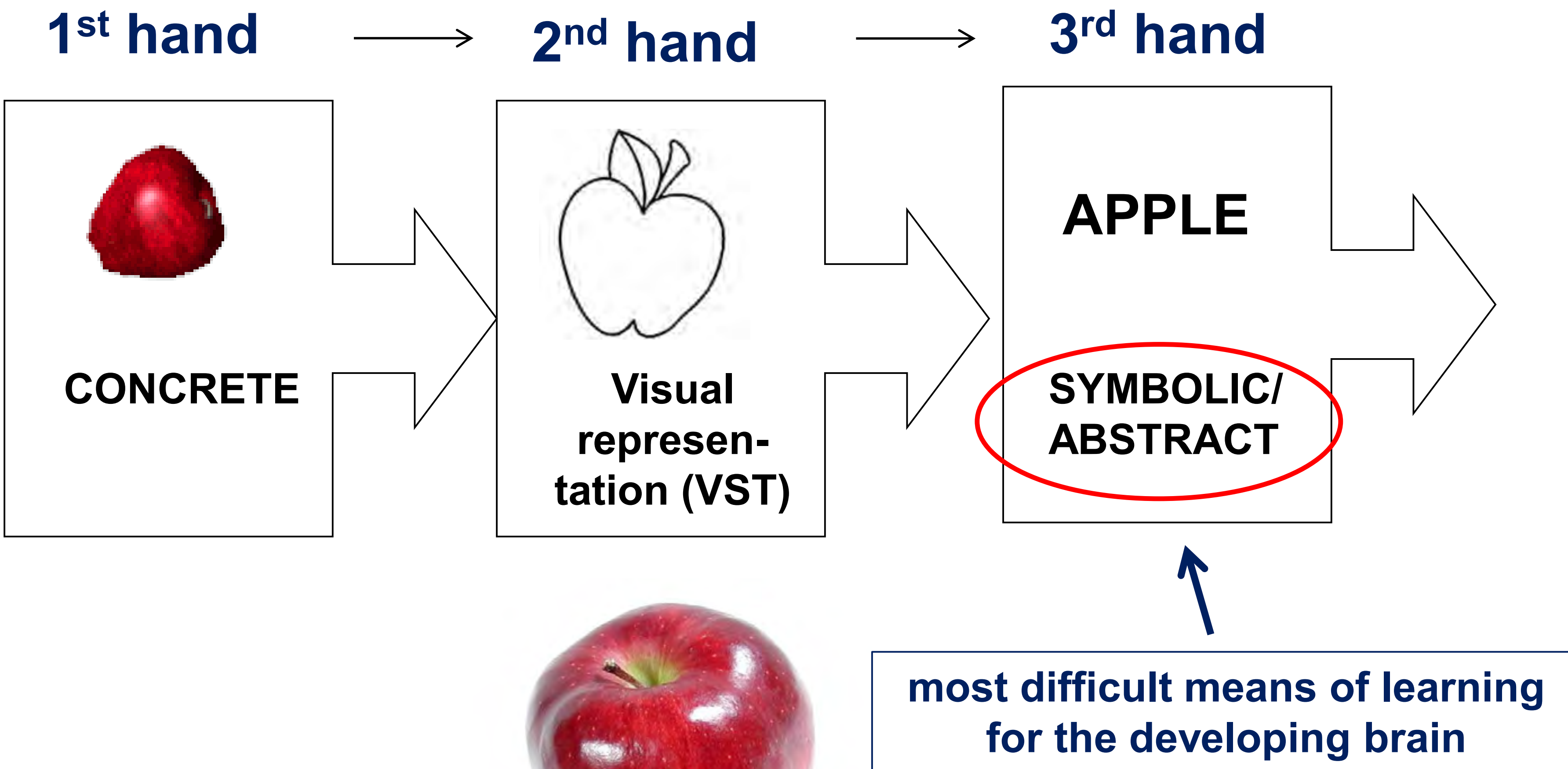
01:29

The brain moves best from ***meaning***-to-print, rather than from ***print***-to-meaning



Cognitive Rehearsals

(→ consolidation)

When playing with *objects,* learners are simultaneously manipulating/*playing with ideas* (internal dialogues attach words and meaning to actions – the “mind’s eye”) building the brain’s fundamental circuitry

Exploring and experimenting involve examining relationships, interactions and systems, where learners formulate their own personal “theories” (mental constructs)

Thinking is a cognitive *rehearsal* for discourse

Discourse is a cognitive *rehearsal* for writing (phonological loop or “inner voice”)

Cognitive Rehearsals

“You can't make the *words* or *ideas*

come out of your *pencil,*

until you can get them

to come out of your *mouth.”*

-- CO Master Teacher Eileen Patrick

Cognitive Rehearsals

Playing with objects and ideas, exploring and experimenting, thinking, talking, and writing become cognitive rehearsals (background knowledge) for reading.

Writing and reading clarify one's thoughts, generate coherent thinking, and cultivate *precision* in expressing one's inner thoughts *(→ LT/P memory consolidation)*

Discourse and writing become cognitive *rehearsals* for assessment

Source: Kenneth Wesson (2011). *Education for the Real World: six great ideas for parents and teachers.* Brain World, Issue 2, Volume 2.

Why Creative Play Is Vital for Advanced/Complex Thinking

Play helps young (and old) learners distinguish *the possible* from *impossible*; *fact* from *fiction*; *pretend* from *reality*

- play is practice for the "real thing"
- play is experimenting and exploring
- play occurs within one's own zone of proximal development
- play opens the mind to *see patterns* and *predictable reactions/results*
- play promotes creative thinking, imagination, innovation, inventions, "ah-hah" moments and "Eureka" moments
- play is confirmation - "I saw it with my own eyes!"
- play permits self-correction of errors
- play allows for participation in learning **without penalties**

The Cookie Thief

**A woman was waiting at an airport one night,
With several long hours before her flight.
She hunted for a book in the airport shop,
Bought a bag of cookies and found a place to drop.**

**She was engrossed in her book, but happened to see,
That the man beside her, as bold as could be,
Grabbed a cookie or two from the bag between,
Which she tried to ignore, to avoid a scene.**

**She read, munched cookies, and watched the clock,
As the gutsy "cookie thief" diminished her stock.
She was getting more irritated as the minutes ticked by,
Thinking, "If I wasn't so nice, I'd blacken his eye!"**

**With each cookie she took, he took one too.
When only one was left, she wondered what he'd do.
With a smile on his face and a nervous laugh,
He took the last cookie and broke it in half.**

**He offered her half, as he ate the other.
She snatched it from him and thought, "Oh brother,
This guy has some nerve, and he's also *rude*,
Why, he didn't even show any gratitude!"**

**She had never known when she had been so galled,
And sighed with relief when her flight was called.
She gathered her belongings and headed for the gate,
Refusing to look back at the "thieving ingrate."**

**She boarded the plane and sank in her seat,
Then sought her book, which was almost complete.
As she reached in her baggage, she gasped with surprise.
There was her bag of cookies in front of her eyes!**

**"If mine are here," she moaned with despair,
"Then the others were *his* and he tried to share!"
Too late to apologize, she realized with grief,
That *she* was the rude one, the ingrate, the thief !**

“We don't stop *playing* because we grow old; we grow old because we stop *playing*.”

-- George Bernard Shaw

…to be continued…

Started at 360

Now at: 360

Time allotted: 1 hr. 15 min.

Goal: 100

Ended with:

USED: 111