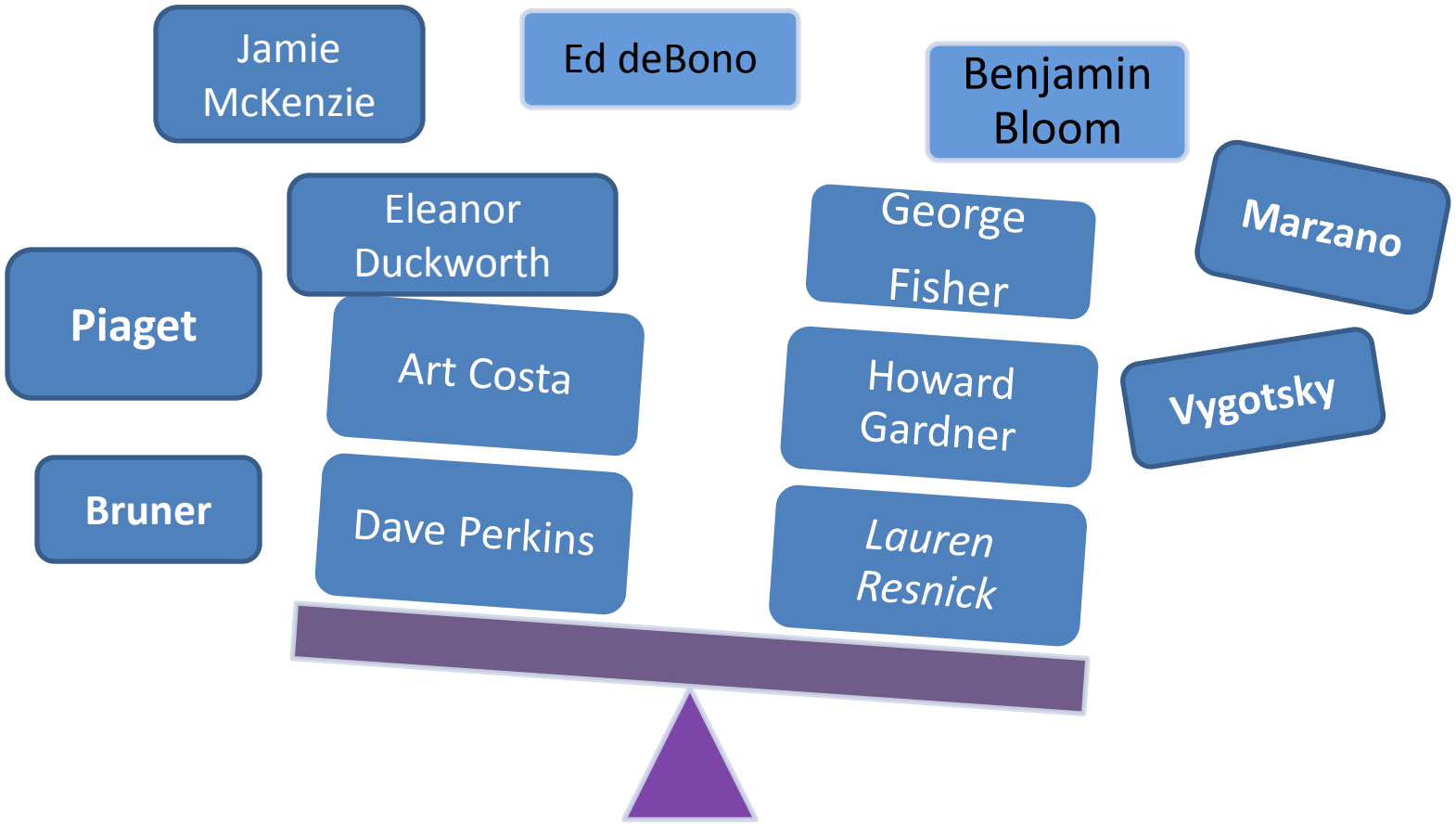

# Thinking Skills

Thinking Classroom

# Who help put this together?




**Lots of thoughts on this subject!**

# Research Questions for PreK to 5th grade teachers

Can we create short learning modules for teachers that model learning styles for students?

Can we get students to use thinking skills in their studies and home?

What must be done to have teachers collaborate at schools to create an engaging interdisciplinary learning environment that uses Thinking Skills?

# Objective

Develop short lesson plans for educators to provide thinking skill exercises for their students.

Get students to be comfortable in using thinking skills in all parts of their lessons.

Model for educators how thinking skills can be used as part of an Interdisciplinary learning environment.

# Who does not supports Thinking?

# Learning outcomes (what you want your students to know and be able to do as a result of the PD):

- 1) Define a variety of higher order thinking skills.
- 2) Determine what learning situations are best for using specific kinds of thinking skills.
- 3) Provide frequent opportunities for students to practice a variety of higher order thinking skills (teacher-designed exercises, lessons designed with thinking skills imbedded).
- 4) Evaluate published curriculum for the inclusion of appropriate thinking skills. Add components to enhance and broaden thinking skills.
- 5) Develop an increased awareness of the inclusion of a variety of higher order thinking skills across the curriculum.

# What is your objective to have students achieve higher order thinking skills?

List your assessment goals:

1.
2. Distinguishing important from unimportant
3. Integration and interpretation of information

# What is thinking?

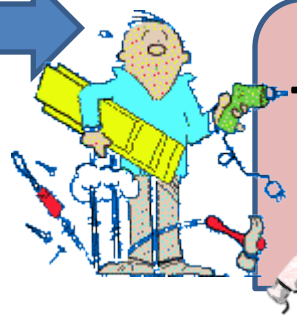
What the term refers to is the human capacity to think in conscious ways to achieve certain purposes.

| | |
|---|---|
| remembering | questioning |
| forming concepts | planning |
| reasoning | imagining |
| solving problems | making decisions |
| judgments | system thinking |

translating thoughts into actions.

**unfamiliar problems, uncertainties, questions, or dilemmas**

**The complexity of modern jobs requires people who can comprehend, judge and participate in generating new knowledge and processes.**



**Thinking skill Tools**

Feedback and assessment

**Success Next Step**

**Successful applications** of these skills result in **explanations, decisions, performances, and products** that are valid within the context of available knowledge and experience, and promote continued growth in higher order thinking, as well as other intellectual skills.

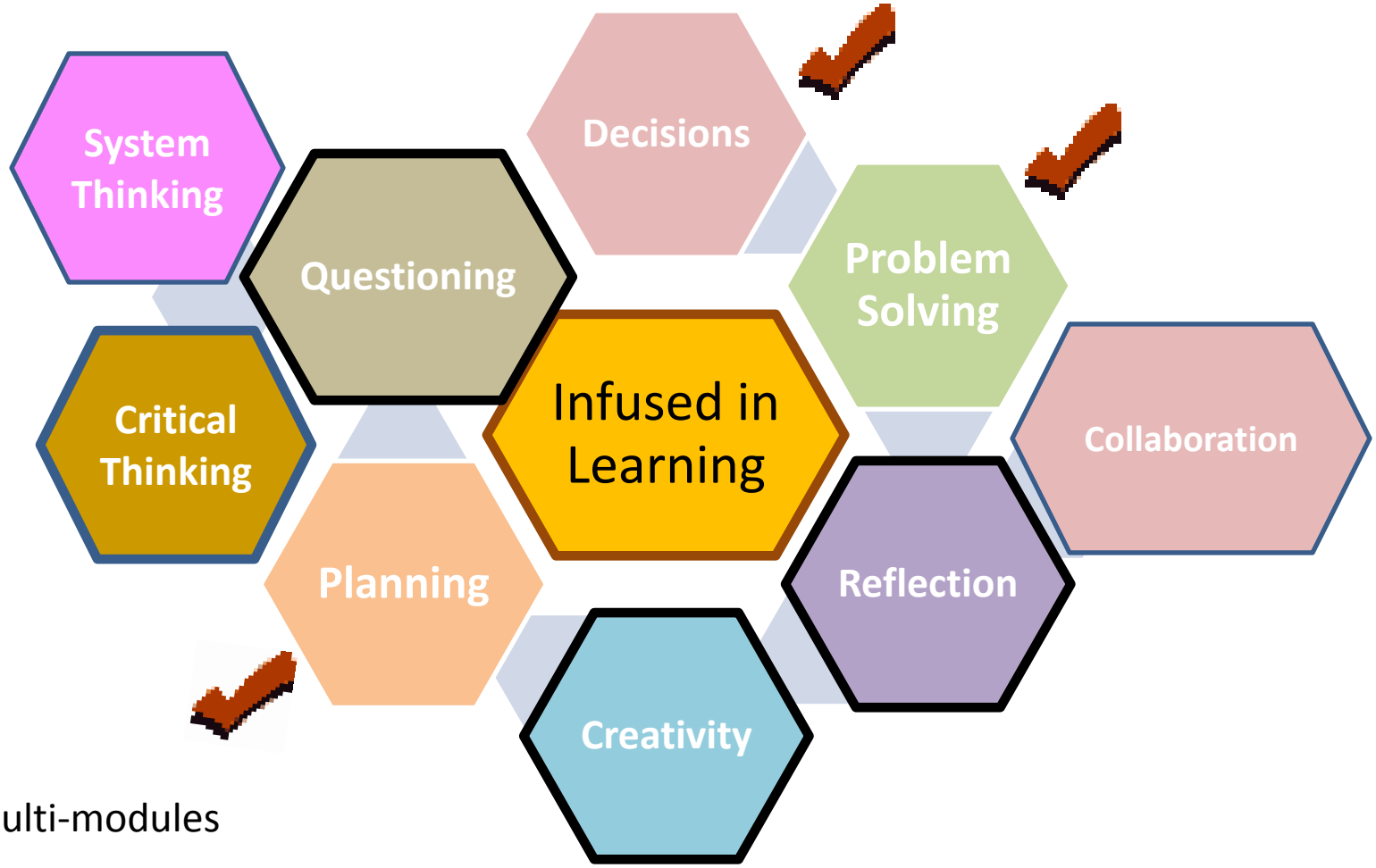
A thinking skill is a practical ability to think in ways that are judged to be more or less effective or skilled. They are the habits of intelligent behavior learned through practice and knowledge of the skill.

The students needs to be able to:

- Articulate the skill
- Be-able to use it in the right situation
- Be-able to use different skills together

An analogy would be the carpenter using the right tool for constructing a house and what tools are needed at different work times.

# What Modules can we learn to improve our Thinking Skills?



# Lower Order Thinking Skills

- cognitive strategies
- comprehension
- concept classification
- discriminations
- routine rule using
- simple analysis
- simple application

Higher Order Thinking Skills by FJ King, Ph.D. …etc.
www.cala.fsu.edu

# What should be included in the Module Design?

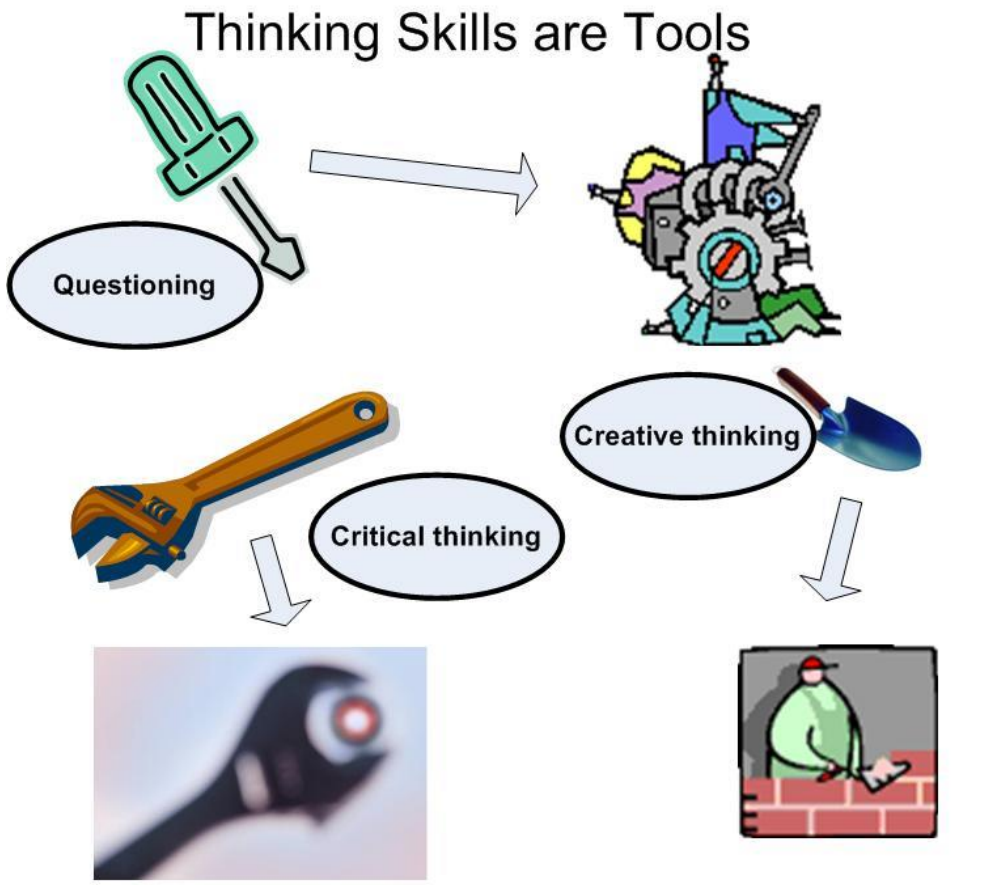
- Background/ History
- Theory/ Content
- Examples
- Worksheets
- Sample Lesson plans

Cognitive Approach

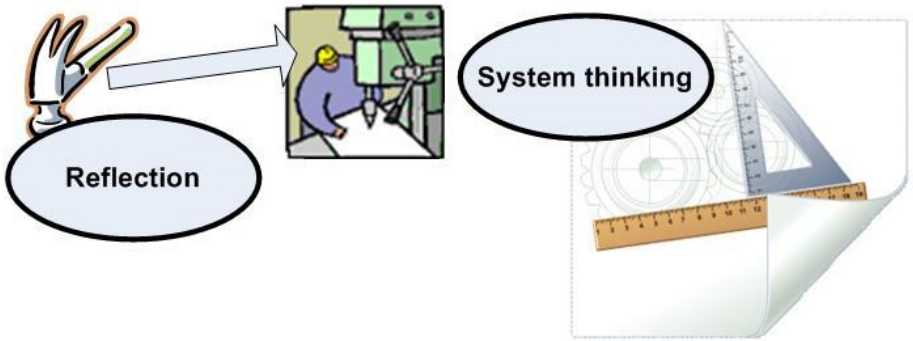
- Modeling
- Scaffolding
- Coaching
- Reflecting ( Meta-cognition )
- Fading

We need to start thinking that the thinking skills can be looked apron as tools for use in learning:

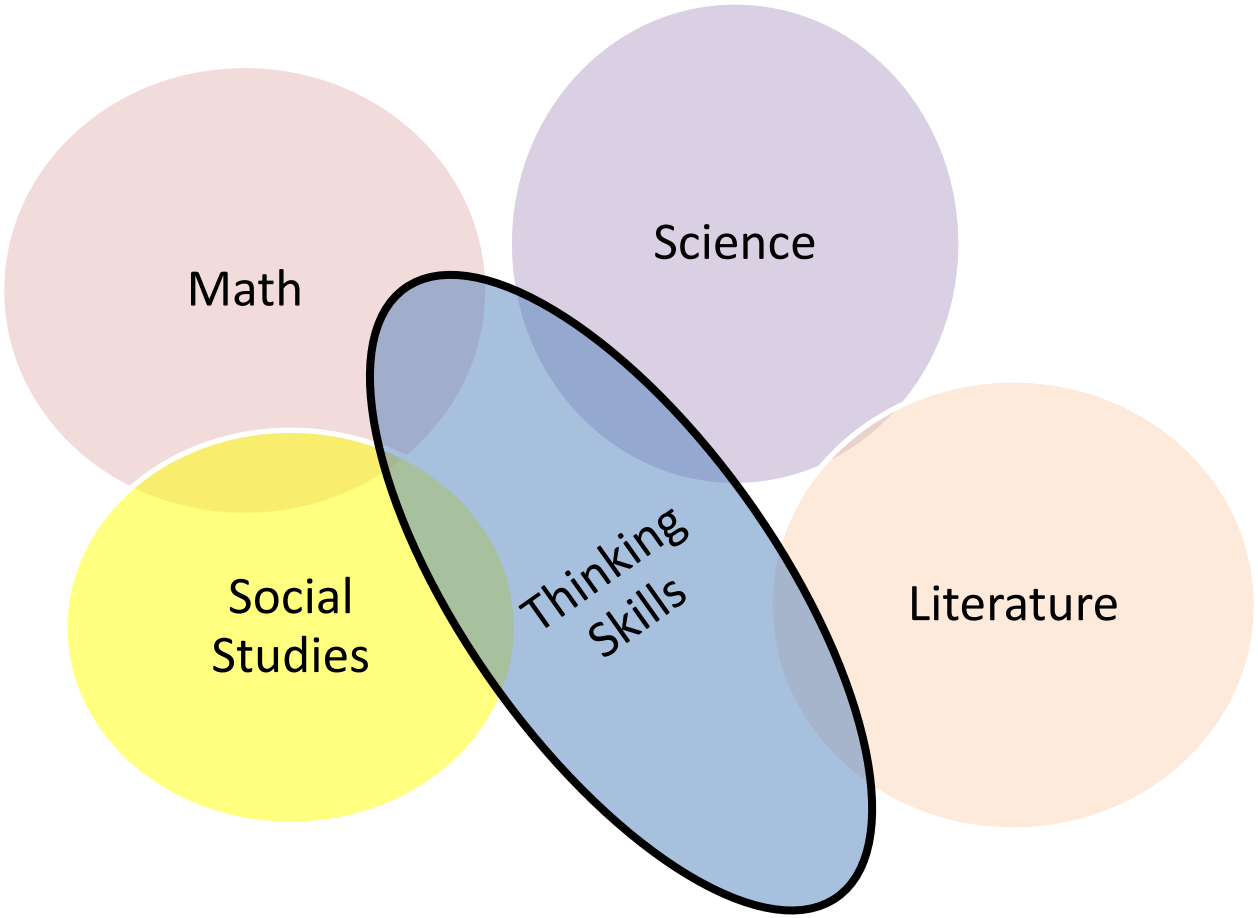
1. You need the right tool for the operation
2. Tools are used together to complete an operation




We need to give our students the tools to search and find knowledge to follow their interests.



# Infusing thinking skills into:

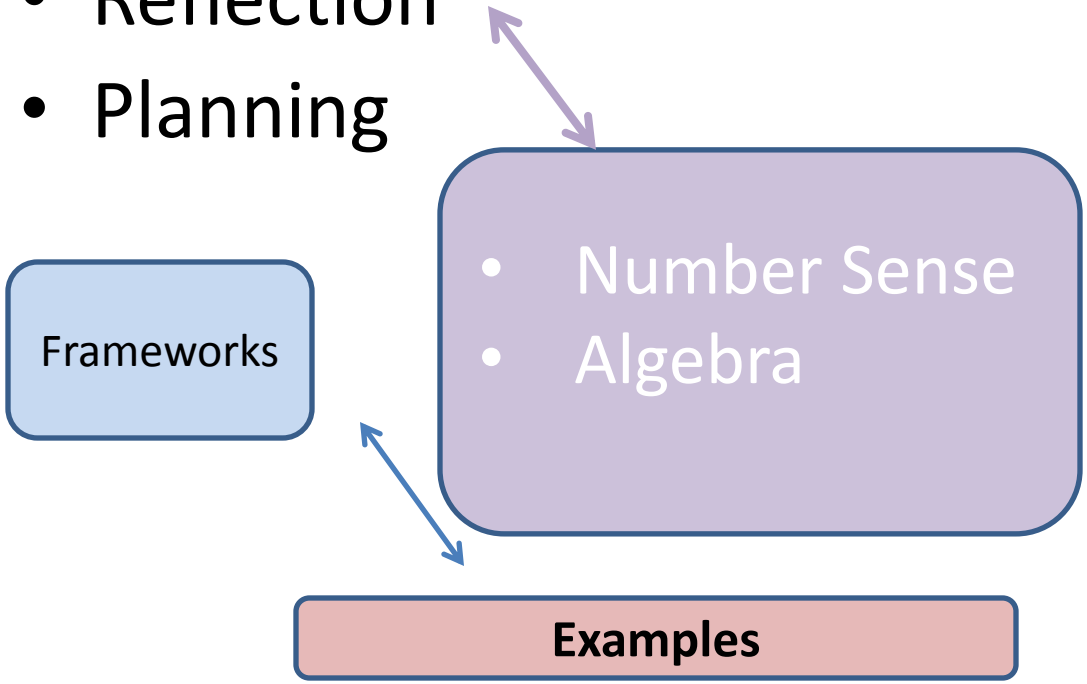


# See separate Module discussion

Examples

# Math

- Problem Solving Process
- System Thinking
- Reflection
- Planning




| **Understand the problem** |
| --- |
| List the key facts given and questions to be answered |
| Devise a plan or strategy such as:<br>•Look for a pattern<br>•Look at the basic foundation<br>•Draw a picture or diagram |
| Solve the problem |
| Check the results and examine the solution<br>**Do a mental test of the solution** |
| Communicate the complete solution with proper units and labels |
| Lock back to reflect on the process and other strategies that could have been used |
| Look ahead to think about how the problem could be extended |

**Mathematical Problem Solving Modified from George Polya's four step method in his book How to Solve it, by Pat Davidson**

# Math-2

**In math, students might also dig deeper and reveal their knowledge of problem solving by asking:**

- How does this problem relate to other I've solved already?
- Can I break this problem into parts?
- How can I represent this problem/
  these are excellent problem solving script questions that can be embed within our normal approach in all subjects.

# Science

**Suspend reaching a conclusion**

- Critical thinking
- Questioning
- Problem solving
- Creativity
- Reflection
- Planning
- Decision
- System Thinking

| |
|---|
| **Define the situation**<br>**Develop a Hypothesis** |
| The precise formulation of the Problem**. Create a model Design an Experiment** |
| **Perform the experiment**<br>Observation of the relevant facts |
| The use of previous knowledge |
| Formulation of the explanatory hypothesis |
| Deductions from the hypothesis<br>**Form a Conclusion** |
| Testing… **Argument** |
| Conclusion: **Write a report** |

Life Science
Earth and Space
Chemistry & Physics
Engineering

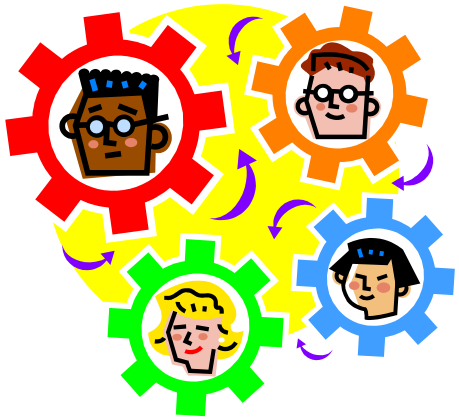
Frameworks

**Examples**

**Science Method The art of making sense … Ruby**

# Science page 2

Science exemplifies the attitude of a high degree of caution, exactness and thoroughness. … john Dewey



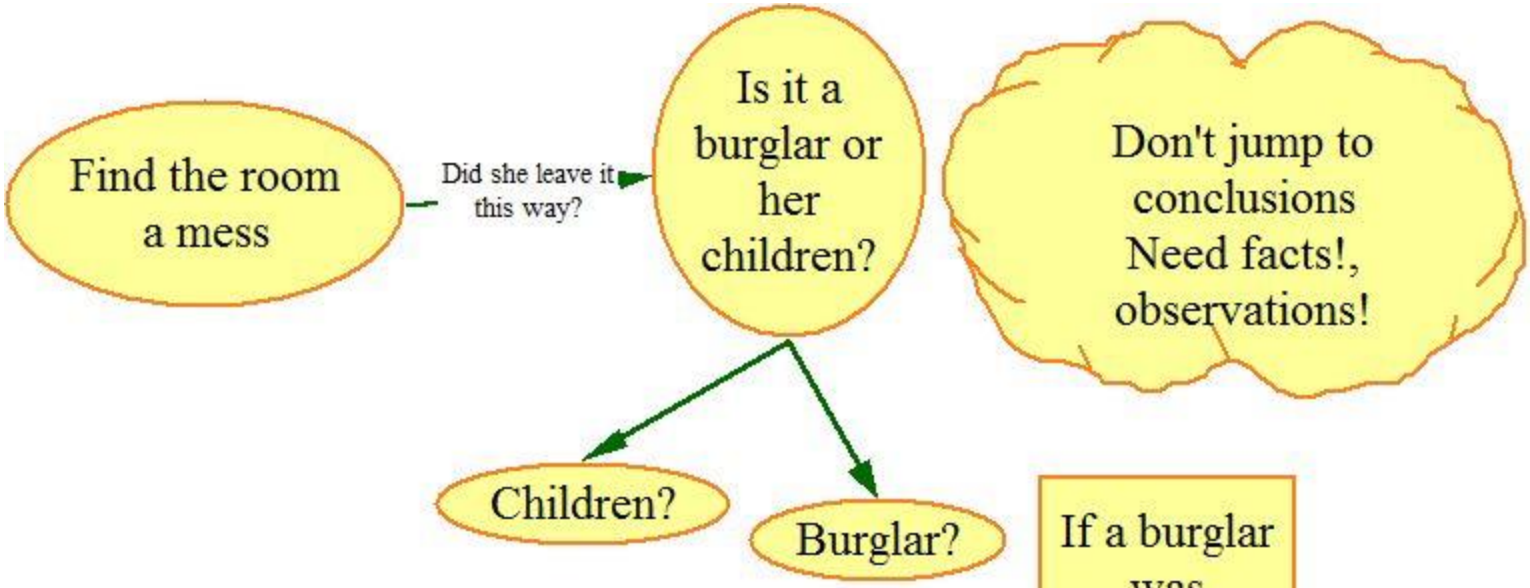
Iterative

**Deductive proof**

- Developing
- Applying
- Testing

**Exercise:**

A women who has left her rooms finds them upon return in a state of confusion, articles being scatted at random. What does her thought process go through?

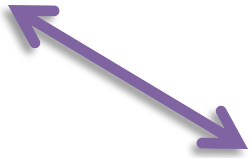



If a burglar was responsible, such and such things would be notices or observed

Make a List of things that would mean a Burglar; The children

# Literature

- Critical thinking
- Questioning
- Problem solving
- Creativity
- Reflection
- Planning
- Decision
- System thinking



| What's the author's purpose? |
| --- |
| What key questions or problems does the author raise? |
| What information, data and evidence does the author present |
| What key concepts guide the author's reasoning? |
| What key conclusion is the author coming to? Are they justified? |
| What is the primary assumption? |
| What is the author's viewpoint? |
| What are the implications of the author's reasoning? |

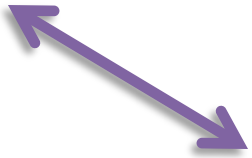
Reading
Writing
Communication

Frameworks

**Examples**

# Social Studies

- Critical thinking
- Questioning
- Problem solving
- Creativity
- Reflection
- Planning
- Decision
- System thinking



History
Current events
Environmental

Frameworks

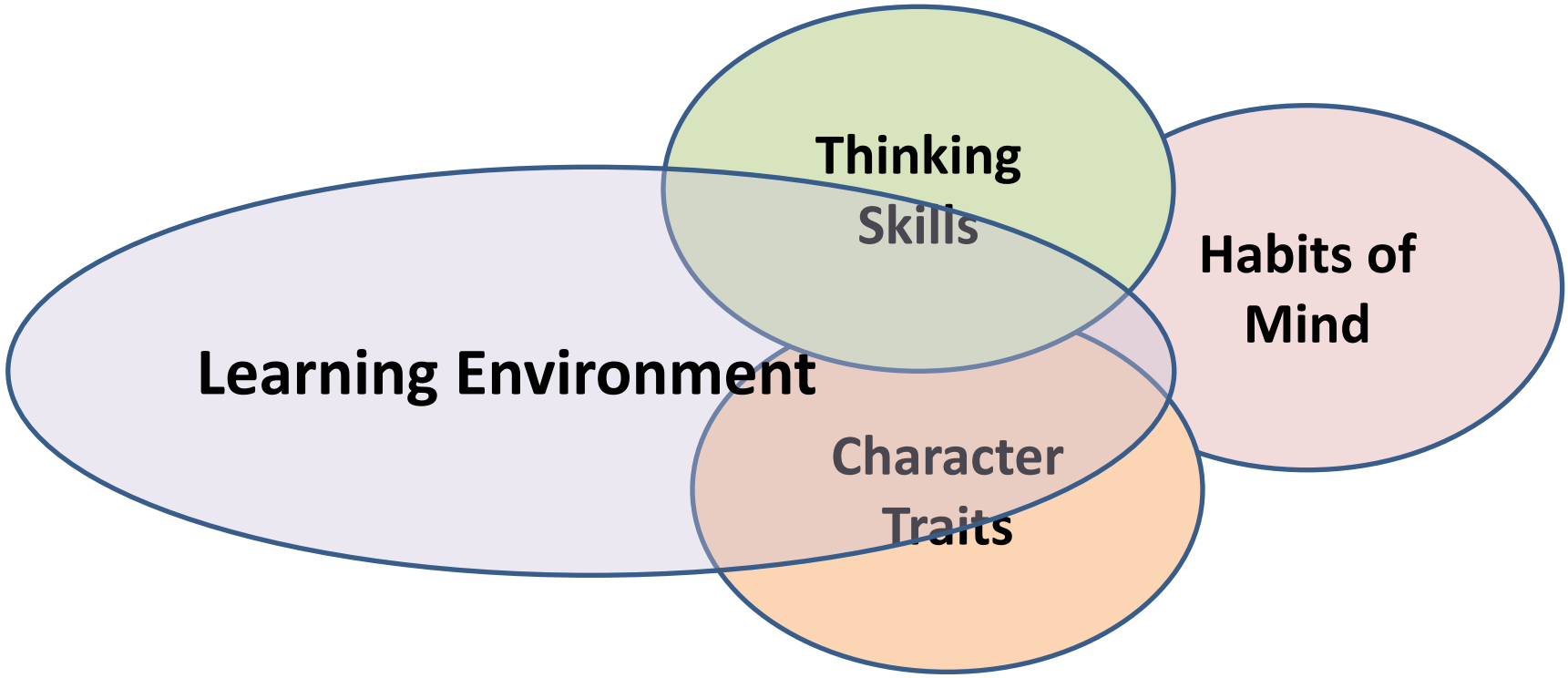
**Examples**

# Learning Environment .. Finish education system

- Must support the pupil's growth and learning.
- Must be physically, psychologically and socially safe and support the pupil's health.
- Objective is to increase pupil's curiosity and motivation to learn and to promote their activeness, self-direction, and creativity by offering interesting challenges and problems.
- Guide pupils in setting their own objectives and evaluating their own actions.
- Give the chance to participate in the creation and development of their own learning environment

# Learning Culture

Vygotsky's idea: "Children grow into the intellectual life around them"




Supportive attributes needed to achieve the learning of thinking skills

# The 16 Habits of Mind identified by Costa and Kallick include:

| | |
|---|---|
| **Persisting** | **Thinking and communicating with clarity and precision** |
| **Managing impulsivity** | **Gathering data through all senses** |
| **Listening with understanding and empathy** | **Creating, imagining, innovating** |
| **Thinking flexibly** | **Responding with wonderment and awe** |
| **Thinking about thinking (metacognition)** | **Taking responsible risks** |
| **Striving for accuracy** | **Finding humor** |
| **Questioning and posing problems** | **Thinking interdependently** |
| **Applying past knowledge to new situations** | **Remaining open to continuous learning** |

# 9 Principles of Learning

*Lauren Resnick*

- Academic Rigor in a Thinking Curriculum
- Accountable Talk
- Clear Expectations
- Fair and Credible Evaluations
- Learning as Apprenticeship
- Organizing for Effort
- Recognition of Accomplishment
- Socializing Intelligence
- Self-management of Learning

**Questions**

1. **How would you explain each principle?**
2. **What could you see doing in your class?**
3. **In what way would the students respond?**

# What does Industry want?

**From Joyce Plotkin .. www.masoftware.org , 2006**

- Critical thinking skills
- Good oral/written communications skills
- Global orientation
- Flexibility
- Ability to think outside the box
- Ability to lead/work in teams
- Ability to function at Internet speed
- Ability to take risks
- Ability to be lifelong learners
- Business, management, entrepreneurial studies

How do we fit?

# Example

How do we get students to talk about Science

http://ifl.lrdc.pitt.edu/ifl/index.php/resources/ask_the_educator/sam_spiegel

We want to engage students to have on going learning through dialogue and questions of each other.

# Learning outcomes

- awareness of themselves as thinkers and learners
- practice strategies for effective thinking
- develop the habits of intelligent behavior that are needed for lifelong learning

provides students opportunities to develop **character traits** such as **personal responsibility, self-respect, respect for others and trustworthiness**—all essential to overcoming social skills deficits.
… ***George Rogers***

# Teachers need to provide:

- *cognitive challenge* , challenging children's thinking from the earliest years
- *collaborative learning* , extending thinking through working with others
- *metacognitive discussion* , reviewing what they think and how they learn

# APA Summary of Basic Principles of Learning

| Nature of Learning | Learners freely and actively pursue personally meaningful goals and construct meaning through internal mediation, discovery, perceptions, thoughts, and beliefs. |
|---|---|
| **Goals of Learning** | Learners seek meaningful, coherent representations of knowledge. |
| **Construction of Knowledge** | Learners link new information and its meaning with past and future oriented knowledge. |
| **Higher Order Thinking** | Metacognition facilitates creative thinking, critical thinking, and development of expertise. |
| **Motivational Influences** | Motivation for learning results from individual beliefs about personal control, competence, and expectations for success or failure; ability; clarity and saliency of values, interests, and goals; and general feelings and mental states. |
| **Intrinsic Motivation** | Learners have natural enthusiasm, curiosity, and joy for learning that can be undermined by fear of failure, insecurity, self-consciousness, fear of punishment, or ridicule. |
| **Motivational Learning Tasks** | Relevant and authentic learning tasks of optimal difficulty and novelty for the individual student will stimulate curiosity, creativity, and higher order thinking. |
| **Constraints and Opportunities** | Genetic and environmental factors affect physical, intellectual, emotional, and social development. |
| **Social Acceptance and Self-Esteem** | Respectful, caring relationships that express belief in individual potential, appreciation of individual talents, and acceptance of individuality will lead to greater learning and self-esteem |
| **Individual Differences** | Learners have different capabilities and ways of learning due to environment and heredity; basic principles of learning, motivation, and effective instruction apply to all learners. |
| **Cognitive Filters** | Learners construct reality and interpret life experiences filtered through their personal beliefs, thoughts, and understandings. |

# Identifying thinking skills

Look for evidence that the children are engaged in information processing, reasoning, enquiry, creative thinking and evaluation ... ***Robert Fisher***

| | |
|---|---|
| **Information processing**<br>Finding relevant information, organizing information representing or communicating information | **Reasoning**<br>Giving reasons, making inferences or deductions, arguing or explaining a point of view |
| **Enquiry**<br>Asking questions, planning research or study, engaging in enquiry or process of finding out | **Creative thinking**<br>Generating ideas, imagining or hypothesizing, designing innovative solutions |
| **Evaluation**<br>Developing evaluation criteria, applying evaluation criteria, judging the value of information and ideas | |

# Key Skills needed to Judge

If thinking skills are the mental capacities we use to investigate the world, to solve problems and make judgments then to identify every such skill would be to enumerate all the capacities of the human mind and the list would be endless.

Many researchers have attempted to identify the key skills in human thinking, and the most famous of these is Bloom's Taxonomy

Bloom's taxonomy of thinking skills (what he called ‘the cognitive goals of education’) has been widely used by teachers in planning their teaching. He identifies a number of basic or ‘lower order’ cognitive skills - knowledge, comprehension and application, and a number of higher order skills – analysis, synthesis and evaluation. The following are the various categories identified by Bloom and processes involved in the various thinking levels.

# Bloom's Taxonomy
# Higher Order thinking

| Elements |
| --- |
| **Creating**<br>Generating new ideas, products, or ways of viewing things |
| **Evaluating**<br>Justifying a decision or course of action |
| **Analysing**<br>Breaking information into parts to explore understandings and relationships |
| **Applying**<br>Using information in another familiar situation |
| **Understanding**<br>Explaining ideas or concepts |
| **Remembering**<br>Recalling information |

# Bloom Questions

| Elements | Verbs | Major thinking skill |
|---|---|---|
| **Creating** Generating new ideas, products, or ways of viewing things | Designing, constructing, planning, producing, inventing. | Creative thinking<br>Questioning |
| **Evaluating**<br>Justifying a decision or course of action | Checking, hypothesising, critiquing, experimenting, judging | Critical thinking<br>Decision<br>Questioning |
| **Analysing**<br>Breaking information into parts to explore understandings and relationships | Comparing, organising, deconstructing, interrogating, finding | Critical thinking<br>System thinking |
| **Applying**<br>Using information in another familiar situation | Implementing, carrying out, using, executing | Planning<br>Collaboration |
| **Understanding**<br>Explaining ideas or concepts | Interpreting, summarising, paraphrasing, classifying, explaining | Reflecting<br>Collaboration |
| **Remembering**<br>Recalling information | Recognising, listing, describing, retrieving, naming, finding | System thinking<br>Planning |

# Intrinsic motivation … Judith Dodge

Teach students to work cooperatively with others.

Give students a voice in classroom decisions.

Provide opportunities for students personal growth

Teach to a variety of learning styles

Provide students with choices

Use a variety of instructional strategies

Offer fun activities that inspire creativity and reduce stress

# Lesson Planning

In lesson planning, the teacher may sometimes find it difficult to distinguish the highest level in the "lower order" category from the lowest level in the "higher order" category.

After all, thinking skills are not actually as separate as individual "building blocks," even though scholars and researchers often use such metaphors.

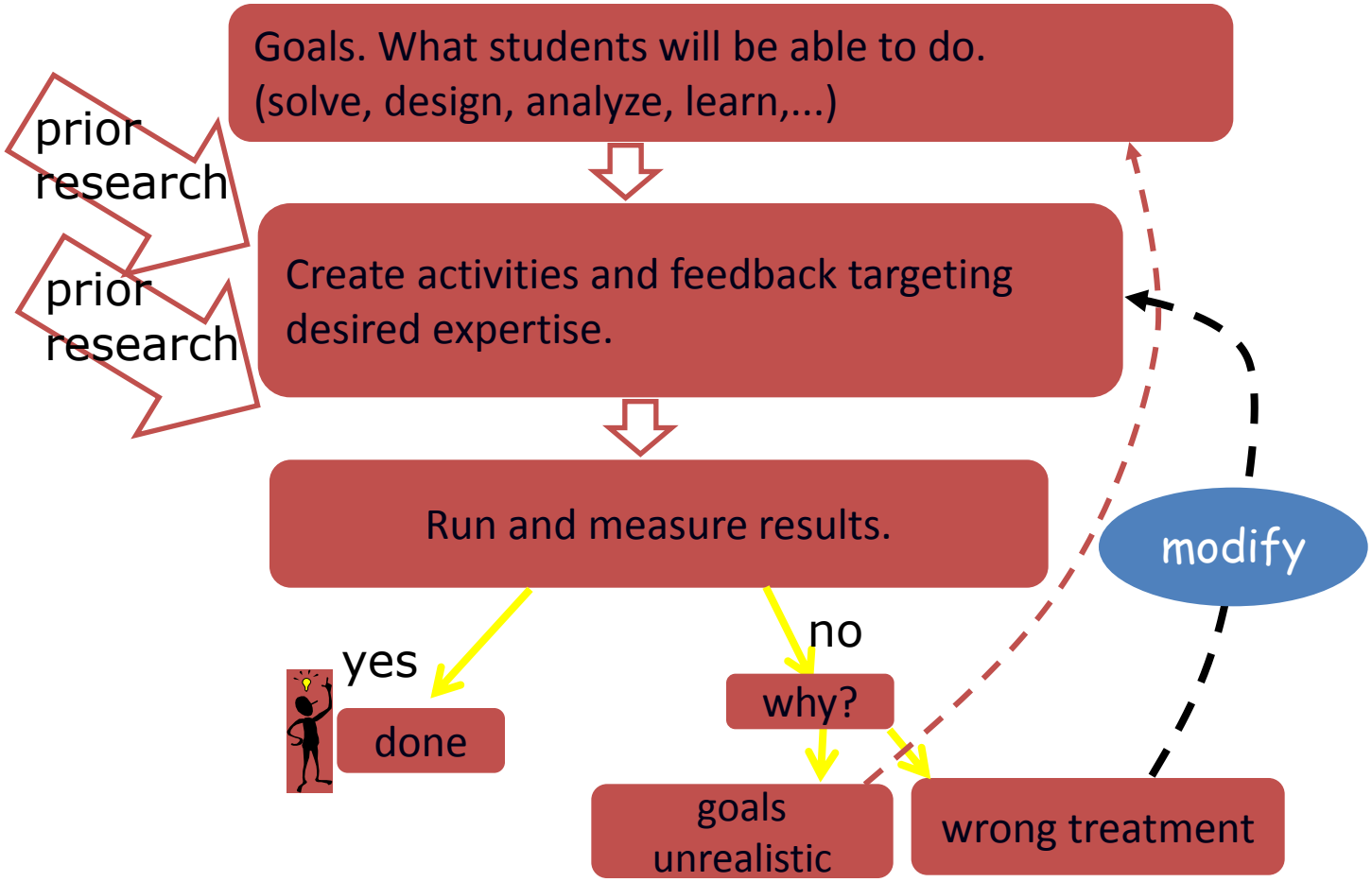
Nonetheless, mastery of content and lower order thinking are particularly important prerequisites to higher order thinking according to Gagné, Briggs, and Wager (1988):

# Learning

Putting the learning as an experiential element such as:

- Games … suing the tools of thinking skills teams have to overcome non-thinking goofs who look to destroy you. Gain points and rank as you battle the goofs
- Clickers

# Model 2 --scientific approach to science education




**⇒New insights on traditional science teaching, how to improve.**

# Features of effective activities for learning.

1. Reduce unnecessary demands on working memory

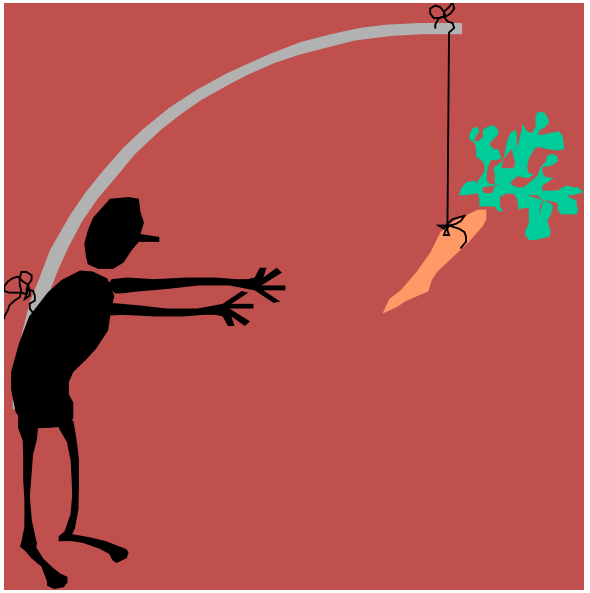
2. Explicit authentic modeling and practice of expert thinking. Extended & strenuous *(brain like muscle)*

**3. Motivation**

4. Connect with and build on prior thinking

# 3. Motivation-- essential

*(complex- depends on previous experiences, ...)*



a. Relevant/useful/interesting to learner (**meaningful context-- connect to what they know and value)**
*Problems where value of solution obvious.*

b. Sense that can master subject and how to master

c. Sense of personal control/choice

# Effective activities for learning.

1. Reduce unnecessary demands on working memory

2. Explicit authentic practice of expert thinking. Extended & strenuous *(brain like muscle)*

3. Motivation

4. Connect with and build on prior thinking

# Practicing expert-like thinking--

**Challenging but doable tasks/questions**

Explicit focus on expert-like thinking

- concepts and mental models
- recognizing relevant & irrelevant information
- self-checking, sense making, & reflection

Provide effective feedback (timely and specific)

"cognitive coach"

**How practicing expert thinking--**

Challenging but doable question (difficult concept)

Explicit focus on expert-like thinking

- actively developing concepts and mental models
- recognizing relevant & irrelevant information
- self-checking, sense making, & reflection

Getting timely and specific feedback
(peers, clicker histogram, instructor)

Highly engaged-- further questions/predictions with sim, testing understanding = "Expert learning"

good start, but not enough time in class!

further practice-- well designed homework
Require expert thinking & feedback,

$\Rightarrow$ long term retention

## Some Data:

| Model 1 (telling) traditional lecture method | Model 2 scientific teaching |
| --- | --- |
| • Retention of information from lecture<br>**10% after 15 minutes** | ⇒ >90 % after 2 days |
| • Fraction of concepts mastered in course<br>**15-25%** | ⇒ 50-70% with retention |
| • Beliefs about science-- what it is, how to learn,<br>**significantly less**<br>(5-10%) **like scientist** | ⇒ more like scientist |

## Summary:

Scientific model for science education

Much more effective. (and more fun)

## Good Refs.:

NAS Press "How people learn"
Redish, "Teaching Physics" (Phys. Ed. Res.)
Handelsman, et al. "Scientific Teaching"
Wieman, Change Magazine-Oct. 07
at *www.carnegiefoundation.org/change/*

CLASS belief survey: CLASS.colorado.edu
phet simulations: phet.colorado.edu
cwsei.ubc.ca-- resources, *Guide to effective use of clickers*

# clickers*--

Not automatically helpful--

give accountability, anonymity, fast response

Used/perceived as expensive attendance and testing device⇒ little benefit, student resentment.

Used/perceived to enhance engagement, communication, and learning ⇒ transformative

- challenging questions-- concepts
- student-student discussion ("peer instruction") & responses (learning and feedback)
- follow up instructor discussion- timely specific feedback
- minimal but nonzero grade impact

*An instructor's guide to the effective use of personal response systems ("clickers") in teaching-- www.cwsei.ubc.ca

Reflection

End
Thank you