Cognitive Theory
Applied in the Classroom

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The First Step:

How do your lessons and interactions reflect your expertise regarding the developmental level of the students you teach?
We can teach students if we are experts in:

- Students
- Differentiated Instruction
- Cognitive Science
- Content
Learning must be understood and meaningful.
Factors that Lead to Learning

- Frequency
- Intensity
- Cross Training
- Adaptivity
- Motivation and Attention

(Arendal and Mann, 2000, from Sprenger’s *How to Teach So Students Remember*, ASCD, 2005)
Sprenger’s Suggestions for Long Term Retention

- Reach
- Reflect
- Recode
- Reinforce
- Rehearse
- Review
- Retrieve

(from Sprenger’s *How to Teach So Students Remember*, ASCD, 2005)
New information entering the brain must be manipulated in some way or it will be lost fairly quickly.

(adapted from Sprenger and Sousa)

“Identifying similarities and differences is the number one way to raise student achievement, according to the results of a meta-analysis.”

(Sprenger and Marzano)

Organize information by category, patterns, and connections for long-term retention.
Successful Thinkers...

- Concede ignorance when they are ignorant.
- Find out what’s going on.
- Respect intellectuals and don’t deride them.
- Speak out after doing their homework.
- Examine superstitions.
- Play thinking games and amuse themselves by trying to answer puzzle questions.
- Become more informed about history than they are.
Successful Thinkers…

- Aren’t afraid to change their minds.
- Are aware that their opinions, assumptions, and beliefs are often affected by peer-group pressure.
- Are realistically skeptical – even of leaders.
- Recognize that they have personal prejudices.
- Do not fall in love with their first answers.

Remember Who’s Doing the Learning:

- Whoever responds to students/classmates is doing the learning. Make sure the majority of the time it’s the students responding, not the teacher.

- Teachers ask 80 questions each hour on average, while students ask only two during that same hour. (Hollas) Students learn more when they ask the questions. Find ways to make question-asking so compelling and habitual they can’t escape it.
“All thinking begins with wonder.”
 -- Socrates

Our job is not to make up anybody’s mind, but to open minds and to make the agony of decision-making so intense you can escape only by thinking.”

-- Fred Friendly, broadcaster
Two Factors Affecting the Pre-Adolescent and Adolescent Brain:

- Moral and Abstract Reasoning
- Immediate Working Memory
- Awareness of Consequences
- Planning
- Impulsivity control

Input by-passes cognition centers; goes directly to emotional response centers.

Pre-Frontal Cortex
Hippocampus and the Amygdala
Activate the…

…AMYGDA L A!

- Amygdala encodes emotion onto information as it’s processed in the hippocampus.
- Learning with strong emotion retained longer.
- Don’t go too far – emotion can dominate cognition.
- Purposefully plan for the emotional atmosphere.
Oxygen/Nutrient-Filled Bloodflow When the Body is in Survival Mode

Vital Organs

Areas associated with growth

Areas associated with social activity

Cognition
The Brain’s Dilemma: What Input to Keep, and What Input to Discard?

- Survival
- Familiarity/Context
- Priming
- Intensity
- Emotional Content
- Movement
- Novelty

The brain never stops paying attention. It's always paying attention.

-- Summarized from Pat Wolfe’s *Brain Matters*, 2001
Prime the brain prior to asking students to do any learning experience.

**Priming** means we show students:

1) What they will get out of the experience (the objectives)

2) What they will encounter as they go through the experience (itinerary, structure)
With hocked gems financing him,
Our hero bravely defied all scornful laughter
That tried to prevent his scheme.
Your eyes deceive, he had said;
An egg, not a table
Correctly typifies this unexplored planet.
Now three sturdy sisters sought proof,
Forging along sometimes through calm vastness
Yet more often over turbulent peaks and valleys.
Days became weeks,
As many doubters spread
Fearful rumors about the edge.
At last from nowhere
Welcome winged creatures appeared
Signifying momentous success.

-- Dooling and Lachman (1971)
pp. 216-222
The Primacy-Recency Effect

The way the brain learns

How many teachers sequence their lessons for learning

Learning Potential

Beginning Middle End

Lesson Sequence

The Primacy-Recency Effect
Avoid Confabulation

The brain seeks wholeness. It will fill in the holes in partial learning with made-up learning and experiences, and it will convince itself that this was the original learning all along. To prevent this:

**Deal with Misconceptions!**

Students should summarize material they already understand, not material they are coming to know.
Perception

- What do you see?
- What number do you see?
- What letter do you see?

Perception is when we bring meaning to the information we receive, and it depends on prior knowledge and what we expect to see. (Wolfe, 2001)

Are we teaching so that students perceive, or just to present curriculum and leave it up to the student to perceive it?
## Recall Success with Individual, Unrelated Items

<table>
<thead>
<tr>
<th>Age of Student</th>
<th># of Unconnected, Individual Items Successfully Recalled (plus or minus 2, Wolfe, 2001)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>15+</td>
<td>7</td>
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</table>
Visuals and Graphics are Powerful!

Examples:
When students are learning vocabulary terms, significantly more are learned when students portray the words graphically (ex: Shape spellings) instead of defining terms and using them in a sentence.

Students can portray Aristotle’s Rhetorical Triangle (ethos, pathos, logos) by juggling.
We file by **similarities**, and we retrieve by **differences**.

What does this mean for instruction?
Sleep

- Melatonin production in young adolescents shifts by 3 to 5 hours, but runs for the same length of time.
- Sleep deprivation often invokes the starvation response in the body.
- Sleep helps us encode memories for long-term memory; lack of sleep lowers the brain’s capacity to learn new things (Dye, 2000, as cited in Sprenger)
5 Things to Remember as We Plan and Teach:

- It takes 4 exposures to new information to fully integrate it into our existing thinking. (Marzano, 2007)
- Lectures chunked (10-15 minutes followed by 2-5 minute processing, then repeat...) are far more effective than long lectures followed by summarizing
- Skip the note-taking during content delivery – It dilutes their later usefulness as well as the learning experience. ‘Single words and symbols okay, however -- ‘enough to mark something to fully explain later.
- Use a lot more non-linguistic representations
- Use a lot more narrative, even with seemingly non-narrative friendly topics
Metaphors

“Getting the picture does not mean writing the formula or crunching the numbers, it means grasping the metaphor.”

-- James Bullock, 1994, p. 737

In math, models are the metaphors.
Let’s frame today’s conversation...
I’m a bit rusty on this...
Let’s peel away the layers and see what lies in the center.
It was anarchy in the cafeteria!
There was an upturn in the economy.
Breaking news...
Are you on the fence about it?
Attack the arguments, not the person.
If $x = 2$ and $y = 4$, what does $3x + 6y$ equal?
Toss the idea around.
The sinking of the Lusitania was the catalyst for...
You need to have parallel structure in this sentence
Wouldn’t it be great to harness the power of the sun?
What’s our benchmark for this standard?
How many main body paragraphs do you have?
We’re not on the same wavelength.
Can I grab two minutes of your time today?
This is a lot to absorb.
I was floored by his behavior.
Google it.
Endoplasmic Reticulum is like the circulatory system of the cell.
What’s the root of the word?
Do you get the point of this?
Students must have a frame of reference to understand the metaphor:

“He flozzled his Website.”

-- Is this a good or a bad thing? We don’t know.

“He flozzled his Website, and the fallout was considerable.”

This is probably something bad because we understand that “fallout” usually refers to bad things, such as the radioactive aftermath of a nuclear detonation. We can gather meaning for the unknown phrase, “flozzled,” because we understand the fallout metaphor.
Ask students to reinforce their metaphors occasionally with associated attributes and verbs. Examples:

- If students state that debate opponents squared off about a controversial issue, they can continue the metaphor by describing who was in each corner of the controversy.
- If they describe a particular year in Congress as a three-ring circus, they can identify a particular policy or political party as the ringmaster.
- Students can observe a herd of classmates stampeding down the hallway.

It helps to make the implicit explicit:

- What does it mean to triangulate something?
- If our thinking is parallel to someone else’s thinking, what do we mean?
- The character said that life was like a carnival Tilt-a-Whirl. What did she mean by that?
- Kira just said she going to be toast tonight with these grades. Is this good or bad for her?
Metaphors (Gallagher)

- Iceberg
- Square Peg, Round Hole
- Brake Pedal, Gas Pedal
- Pencil/Eraser
- Billiards Table
- Snow Globe

_______ is like a _________ because _________.

______.

______.
Metaphors – Analysis Chart

- Symbol to Represent
- Explanation of Symbol
- How this Symbol Connects to Character/Event
- Passages Cited to Support this Connection

-- “Seen” and “Unseen” Elements/Characteristics

Great Books on Using Metaphors to Teach:

Deeper Reading (Gallagher) and Metaphors We Live By (Lakoff and Johnson)
Use and Teach Analogies

- Antonyms
- Synonyms
- Part : Whole
- Whole : Part
- Tool : Its Action
- Tool user : Tool
- Tool: Object It’s Used With
- Category : Example
- Effect : Cause
- Cause : Effect

- Increasing Intensity
- Decreasing Intensity
- Action : Thing Acted Upon
- Action: Subject Performing the Action
- Object or Place: Its User
- Noun : Closely Related Adjective
# Components of Blood Content Matrix

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<thead>
<tr>
<th></th>
<th>Red Cells</th>
<th>White Cells</th>
<th>Plasma</th>
<th>Platelets</th>
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</thead>
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<tr>
<td><strong>Purpose</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Amount</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size &amp; Shape</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Nucleus ?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Where formed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## T-List or T-Chart: Wilson’s 14 Points

<table>
<thead>
<tr>
<th>Main Ideas</th>
<th>Details/Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reasons President Wilson Designed the Plan for Peace</td>
<td>1.</td>
</tr>
<tr>
<td>Three Immediate Effects on U.S. Allies</td>
<td>2.</td>
</tr>
<tr>
<td></td>
<td>3.</td>
</tr>
<tr>
<td>Three Structures/Protocols created by the Plans</td>
<td>1.</td>
</tr>
<tr>
<td></td>
<td>2.</td>
</tr>
<tr>
<td></td>
<td>3.</td>
</tr>
</tbody>
</table>
**Cornell Note-Taking Format**

<table>
<thead>
<tr>
<th>Reduce</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Summarize in short phrases or essential questions next to each block of notes.]</td>
<td>[Write your notes on this side.]</td>
</tr>
</tbody>
</table>

**Review** -- Summarize (paragraph-style) your points or responses to the questions. Reflect and comment on what you learned.
Somebody Wanted But So

[ Fiction ]

Somebody *(characters)* …

wanted *(plot-motivation)* … ,

but *(conflict)* … ,

so *(resolution)* … .
Something Happened And Then

[Non-fiction]

Something *(independent variable)*…

happened *(change in that independent variable)*…,

and *(effect on the dependent variable)*…,

then *(conclusion)*….
Chronological Order

Definition and Key words: This involves putting facts, events, concepts into sequence using time references to order them. Signal words include on (date), now, before, since, when, not long after, and gradually.

“Astronomy came a long way in the 1500s and 1600s. In 1531, Halley’s Comet appeared and caused great panic. Just twelve years later, however, Copernicus realized that the sun was the center of the solar system, not the Earth, and astronomy became a way to understand the natural world, not something to fear. In the early part of the next century, Galileo made the first observations with a new instrument – the telescope. A generation later, Sir Issac Newton invented the reflecting telescope, a close cousin to what we use today. Halley’s Comet returned in 1682 and it was treated as a scientific wonder, studied by Edmund Halley.”
Compare and Contrast

Definition and Key words: Explains similarities and differences. Signal words include however, as well as, not only, but, while, unless, yet, on the other hand, either/or, although, similarly, and unlike.

“Middle school gives students more autonomy than elementary school. While students are asked to be responsible for their learning in both levels, middle school students have more pressure to follow through on assignments on their own, rather than rely on adults. In addition, narrative forms are used to teach most literacy skills in elementary school. On the other hand, expository writing is the way most information is given in middle school.”
Cause and Effect

Definition and Key words: Shows how something happens through the impact of something else. Signal words include because, therefore, as a result, so that, accordingly, thus, consequently, this led to, and nevertheless.

“Drug abusers often start in upper elementary school. They experiment with a parent’s beer and hard liquor and they enjoy the buzz they receive. They keep doing this and it starts taking more and more of the alcohol to get the same level of buzz. As a result, the child turns to other forms of stimulation including marijuana. Since these are the initial steps that usually lead to more hardcore drugs such as Angel Dust (PCP), heroin, and crack cocaine, marijuana and alcohol are known as “gateway drugs.” Because of their addictive nature, these gateway drugs lead many youngsters who use them to the world of hardcore drugs.”
Problem and Solution

**Definition and Key words:** Explains how a difficult situation, puzzle, or conflict develops, then what was done to solve it. Signal words are the same as Cause and Effect above.

“The carrying capacity of a habitat refers to the amount of plant and animal life its resources can hold. For example, if there are only 80 pounds of food available and there are animals that together need more than 80 pounds of food to survive, one or more animals will die – the habitat can’t “carry” them. Humans have reduced many habitats’ carrying capacity by imposing limiting factors that reduce its carrying capacity such as housing developments, road construction, dams, pollution, fires, and acid rain. So that they can maintain full carrying capacity in forest habitats, Congress has enacted legislation that protects endangered habitats from human development or impact. As a result, these areas have high carrying capacities and an abundance of plant and animal life.”
Proposition and Support

**Definition and Key words:** The author makes a general statement followed by two or more supporting details. Key words include: In addition, also, as well as, first, second, finally, in sum, in support of, therefore, in conclusion.

“There are several reasons that teachers should create prior knowledge in students before teaching important concepts. First, very little goes into long-term memory unless it’s attached to something already in storage. Second, new learning doesn’t have the meaning necessary for long-term retention unless the student can see the context in which it fits. Finally, the brain likes familiarity. It finds concepts with which it is familiar compelling. In sum, students learn better when the teacher helps students to create personal backgrounds with new topics prior to learning about them.
Enumeration

Definition and Key words: Focuses on listing facts, characteristics, or features. Signal words include to begin with, secondly, then, most important, in fact, for example, several, numerous, first, next finally, also, for instance, and in addition.

“The moon is our closest neighbor. It’s 250,000 miles away. Its gravity is only 1/6 that of Earth. This means a boy weighing 120 pounds in Virginia would weigh only 20 pounds on the moon. In addition, there is no atmosphere on the moon. The footprints left by astronauts back in 1969 are still there, as crisply formed as they were on the day they were made. The lack of atmosphere also means there is no water on the moon, an important problem when traveling there.”
To Increase (or Decrease) a Task’s Complexity, Add (or Remove) these Attributes:

- Manipulate information, not just echo it
- Extend the concept to other areas
- Integrate more than one subject or skill
- Increase the number of variables that must be considered; incorporate more facets
- Demonstrate higher level thinking, i.e. Bloom’s Taxonomy, William’s Taxonomy
- Use or apply content/skills in situations not yet experienced
- Make choices among several substantive ones
- Work with advanced resources
- Add an unexpected element to the process or product
- Work independently
- Reframe a topic under a new theme
- Share the backstory to a concept – how it was developed
- Identify misconceptions within something
To Increase (or Decrease) a Task’s Complexity, Add (or Remove) these Attributes:

- Identify the bias or prejudice in something
- Negotiate the evaluative criteria
- Deal with ambiguity and multiple meanings or steps
- Use more authentic applications to the real world
- Analyze the action or object
- Argue against something taken for granted or commonly accepted
- Synthesize (bring together) two or more unrelated concepts or objects to create something new
- Critique something against a set of standards
- Work with the ethical side of the subject
- Work in with more abstract concepts and models
- Respond to more open-ended situations
- Increase their automacity with the topic
- Identify big picture patterns or connections
- Defend their work
Manipulate information, not just echo it:
- “Once you’ve understood the motivations and viewpoints of the two historical figures, identify how each one would respond to the three ethical issues provided.”

Extend the concept to other areas:
- “How does this idea apply to the expansion of the railroads in 1800’s?” or, “How is this portrayed in the Kingdom Protista?”

Work with advanced resources:
- “Using the latest schematics of the Space Shuttle flight deck and real interviews with professionals at Jet Propulsion Laboratories in California, prepare a report that…”

Add an unexpected element to the process or product:
- “What could prevent meiosis from creating four haploid nuclei (gametes) from a single haploid cell?”
Reframe a topic under a new theme:

- “Re-write the scene from the point of view of the antagonist,” “Re-envision the country’s involvement in war in terms of insect behavior,” or, “Re-tell Goldilocks and the Three Bears so that it becomes a cautionary tale about McCarthyism.”

Synthesize (bring together) two or more unrelated concepts or objects to create something new:

- “How are grammar conventions like music?”

Work with the ethical side of the subject:

- “At what point is the Federal government justified in subordinating an individual’s rights in the pursuit of safe-guarding its citizens?”
William’s Taxonomy

Fluency
Flexibility
Originality
Elaboration
Risk Taking
Complexity
Curiosity
Imagination
Frank Williams’ Taxonomy of Creative Thinking

**Fluency** – We generate as many ideas and responses as we can

Example Task: Choose one of the simple machines we’ve studied (wheel and axle, screw, wedge, lever, pulley, and inclined plane), and list everything in your home that uses it to operate, then list as many items in your home as you can that use more than one simple machine in order to operate.

**Flexibility** – We categorize ideas, objects, and learning by thinking divergently about them

Example Task: Design a classification system for the items on your list.
Frank Williams’ Taxonomy of Creative Thinking

Originality – We create clever and often unique responses to a prompt

Example Task: Define life and non-life.

Elaboration – We expand upon or stretch an idea or thing, building on previous thinking

Example: What inferences about future algae growth can you make, given the three graphs of data from our experiment?
Frank Williams’ Taxonomy of Creative Thinking

Risk Taking – We take chances in our thinking, attempting tasks for which the outcome is unknown

Example: Write a position statement on whether or not genetic engineering of humans should be funded by the United States government.

----------------------------------------------------------------

Complexity – We create order from chaos, we explore the logic of a situation, we integrate additional variables or aspects of a situation, contemplate connections

Example: Analyze how two different students changed their lab methodology to prevent data contamination.
Frank Williams’ Taxonomy of Creative Thinking

Curiosity – We pursue guesses, we wonder about varied elements, we question.

Example: What would you like to ask someone who has lived aboard the International Space Station for three months about living in zero-gravity?

Imagination – We visualize ideas and objects, we go beyond just what we have in front of us

Example: Imagine building an undersea colony for 500 citizens, most of whom are scientists, a kilometer below the ocean’s surface. What factors would you have to consider when building and maintaining the colony and the happiness of its citizens?
Synectics
(William J. Gordon)

“The joining together of different and apparently irrelevant elements,” or put more simply, “Making the familiar strange.”

1. Teach a topic to students.
2. Ask students to describe the topic, focusing on descriptive words and critical attributes.
3. Teacher identifies an unrelated category to compare to the descriptions in #2. *(Think of a sport that reminds you of these words. Explain why you chose that sport.)* Students can choose the category, too.
4. Students write or express the analogy between the two: *The endocrine system is like playing zones in basketball. Each player or gland is responsible for his area of the game.*
4-Square Synectics

1. Brainstorm four objects from a particular category (examples: kitchen appliances, household items, the circus, forests, shopping malls).
2. In small groups, brainstorm what part of today’s learning is similar in some way to the objects listed.
3. Create four analogies, one for each object.

Example: How is the human digestive system like each household item: sink, old carpet, microwave, broom

Example: How is the Pythagorean Theorem like each musical instrument: piano, drum set, electric guitar, trumpet?
Memorization Techniques

Practice reciting facts while looking at your eyes in a mirror, while standing in front of your family or friends, while waiting.

Memorize the lines from the end to the front.
Memorize in phrases, and use “bridges” (last word of one phrase, first word of the next phrase)
Use different voices to recite the facts/lines.
Have someone call the cues for you.
Use memory devices (mnemonics).
Have a crazy conversation with someone, in which each time one of you speaks, you use one of the words or concepts.
Let time pass between memorizing sessions.
Draw and color a picture of the concepts/lines.
Use props.
Practice in the same place you’ll be asked to remember them.
Make an outline of the lines or concepts, and memorize that.
Inquiry Method

1. Something arouses students’ curiosity.

2. Students identify questions regarding topic. There is usually one main question with several sub-questions that help answer the main question. These questions are submitted to classmates for review.

3. Students determine the process of investigation into topic. Their proposal for how to conduct the investigation is submitted to classmates for review and revision as necessary.

4. Students conduct the investigation.

5. Students share their findings.
Socratic Seminar

Pre-Seminar:
A. Shared experiences, chosen for richness of ideas, issues, ambiguity, “discussability”
B. Students reflect on material
   Group dynamics, ground rules, and courtesy are understood and accepted.

Seminar:
A. Teacher asks a provocative question. Opening, Core, and Closure Questions
B. Students respond to the provocative question and each other.
C. Teacher offers core questions that help students interpret and to re-direct, also evaluates and tries to keep mouth shut.
C. Closing - connect to the real world of the student

Post-Seminar
   Writings, Summations, Artwork, Reflection, Critique, Analysis
Debate Format

1. **Statement of the General Debate Topic and Why it’s Important** - 1 min.
2. **Affirmative Position Opening Remarks** - 3 min.
3. **Negative Position Opening Remarks** - 3 min.
4. **Affirmative Position Arguments** - 5 min.
5. **Negative Position Arguments** - 5 min.
6. **Caucus** - Students on both teams consider their arguments and rebuttals in light of what has been presented. - 3 min.
7. **Affirmative Rebuttal and Questioning of the Negative’s Case** - 3 min.
8. **Negative Rebuttal and Questioning of the Affirmative’s Case** - 3 min.
9. **Closing Arguments Affirmative Position** - 2 min.
10. **Closing Arguments Negative Position** - 2 min.
Human Continuum

Use a human continuum. Place a long strip of masking tape across the middle of the floor, with an "Agree" or “Yes” taped at one end, and "Disagree" or “No” at the other end. Put a notch in the middle for those unwilling to commit to either side. Read statements about the day’s concepts aloud while students literally stand where they believe along the continuum. Be pushy – ask students to defend their positions.
Line-up

- Groups of students line up according to criteria. Each student holds an index card identifying what he or she is portraying.
- Students discuss everyone’s position with one another -- posing questions, disagreeing, and explaining rationales.
Line-up

Students can line-up according to:

chronology, sequences in math problems, components of an essay, equations, sentences, verb tense, scientific process/cycle, patterns: alternating, category/example, increasing/decreasing degree, chromatic scale, sequence of events, cause/effect, components of a larger topic, opposites, synonyms
Meeting of Minds
at Rachel Carson Middle School

Portrayals of Dr. Sally Ride, Albert Einstein, Josef Stalin, Bob Dylan, Boss Tweed, Dr. Robert Oppenheimer, Senator Joseph McCarthy, the Unsinkable Molly Brown, Rosa Parks. In the background: Advisors for each historical figure.
Meeting of Minds

- Students portray historical figures who’ve been called together to discuss modern world issues and complex ideas. This debate is moderated by the teacher.
- Each team of students researches the figure and shares a summary of what they discover with the class prior to the debate.
- Prior to the debate, each team identifies how their figure would probably respond to several of the identified modern issues, and what “holes” they can poke in other figures’ responses.
- Each team has 5 - 6 members: 1 performing as the historical figure, 1 – 3 who design a personalized backdrop for the figure during the debate, 1- 3 who design and prepare an accurate costume and props for the figure.
- All team members research and discuss responses, citing evidence for how the group determined the figure’s responses to the issues.
Meeting of Minds

Potential Topics for Discussion:

- Should Earth have one language or many? What are the roles of men and women in society?
- Should students be required to wear uniforms in school?
- What are the qualities of a good leader?
- Should rap music lyrics be censored?
- Should our country have gone to war?
Simulations

www.teachinteract.com
Dale Seymour Publications
“Education Simulations” on the Net
Examples:
Toothpick bridges, WWI Boot camp,
Mock Trials, Walking through the heart as blood cells, Ionic/Covalent bond dance
“Word Link”

1. Each student gets a word.
2. In partners, students share the link(s) between their individual words.
3. Partner team joins another partner team, forming a “word cluster.”
4. All four students identify the links among their words and share those links with the class.

SDA - Subtle Difference Analysis

Identify words/concepts that are close in meaning, but not an exact match. Identify how they are similar and what makes them “just off” the match. Example pairs:

- Outstanding/Exemplary
- Confined/Restricted
- Elaborate/Complex
- Intelligent/Smart
- Child/Offspring
- House/Home
- Mature/Wise
- Late/Tardy
- Soil/Dirt
One-Word Summaries

“The new government regulations for the meat-packing industry in the 1920’s could be seen as an opportunity...,”

“Picasso’s work is actually an argument for.....,”

“NASA’s battle with Rockwell industries over the warnings about frozen temperatures and the O-rings on the space shuttle were trench warfare....”

Basic Idea: Argue for or against the word as a good description for the topic.
Exclusion Brainstorming

The student identifies the word/concept that does not belong with the others, then either orally or in writing explains his reasoning:

- **Mixtures** – plural, separable, dissolves, no formula
- **Compounds** – chemically combined, new properties, has formula, no composition
- **Solutions** – heterogeneous mixture, dissolved particles, saturated and unsaturated, heat increases
- **Suspensions** – clear, no dissolving, settles upon standing, larger than molecules
Categorizing Games

Any game in which students categorize items according to identified criteria. No one category can have less than three items. Individuals or teams can compete to be accurate and first.

Examples:

- Categorize the Greek gods and goddesses three different ways (domains/powers, relationships, chronological appearance, frailties, uses...)
- “Word Sorts”
- Sort these student essays (products) into “Proficient,” “Good, but in need of improvement,” and “Struggling”
“Physicalizing” the abstract and symbolic:

- Gets oxygen and nutrients to cognitive centers of the brain via the bloodstream
- Relieves bone growth plate stress
- Relaxes students and improves their perspective/attitude – creates mild euphoria
- Supports cognitive theory regarding how students best learn
- Makes abstract content vivid and thereby illuminates it
- It’s fun and intrinsically motivating
Premise:

There is not any curriculum so symbolic or abstract that we cannot “physicalize” it for better student learning.
Physicalizing Process:

- Identify essential components, pieces, or definition of whatever we’re teaching.
- Physicalize those pieces and present them to the class.
- Class critiques the physicalization in terms of accuracy, comprehensiveness, appropriateness, and clarity. ‘Makes suggestions for improvement.

*All three steps are learning experiences that help students internalize the knowledge.*
“I was put on earth by God in order to accomplish a certain number of things… right now I am so far behind… I will never die!”

-Calvin and Hobbes