Everything's Connected: Teaching Problem-Solving with Real-World Issues and Models

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Real-World Problem Solving

Content Areas

Climate Change

Pandemic

Pollution

Social Injustice

Advanced Technologies

Water Supply

Space Exploration

Use of Models

- Develop expertise in a content domain by embedding subject specific process models.
- Applied as a tool to differentiate for gifted (complexity)
- Used to guide students to demonstrate their expertise in creative and meaningful ways.
- Vetted by experts in the field

Developing Expertise

- Addressing Preconceptions & Concepts
  - Connecting to world
  - Overarching concepts as a way to “frame” outside world
  - Appropriate content & understanding
- What does it mean to “do .....” – DISCIPLINE SPECIFIC
  - Inquiry and Investigation
  - Thinking Like a ......
  - Using the models and vocabulary of...
  - Constructing meaning
- Metacognition
  - Reflecting on what was learned
  - Discussion
  - Feedback
  - Questions

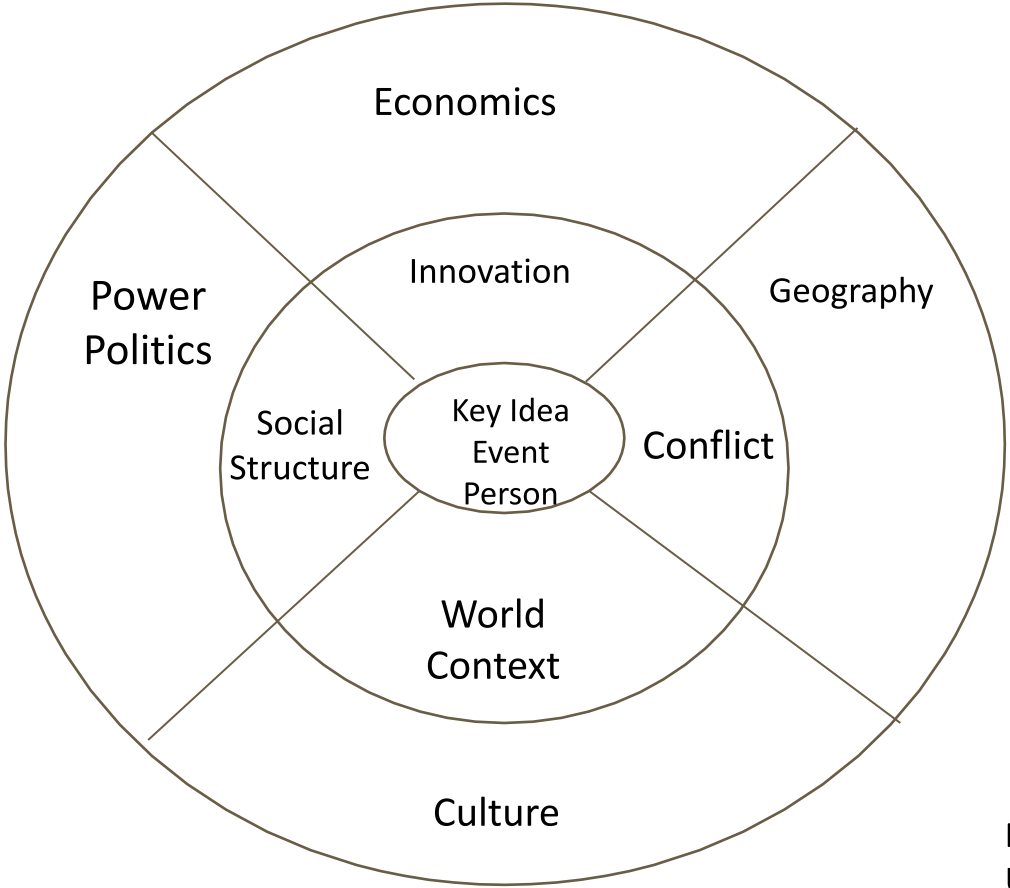
National Research Council 2005

Novices vs. Experts

- When experts solve problems, they spend considerably more time defining the problem than novices do and have stronger metacognitive skills.
- Develop a mental framework for organizing knowledge
- Retrieve integrated collective facts (rather than piecemeal facts)
- Perceive structure of situations in order to know next steps and examine patterns
- Understand when to revise ideas

(Adams, Wieman, & Schwartz, 2008, para 2).

Social Studies Wheel



Mofield & Stambaugh (2016)
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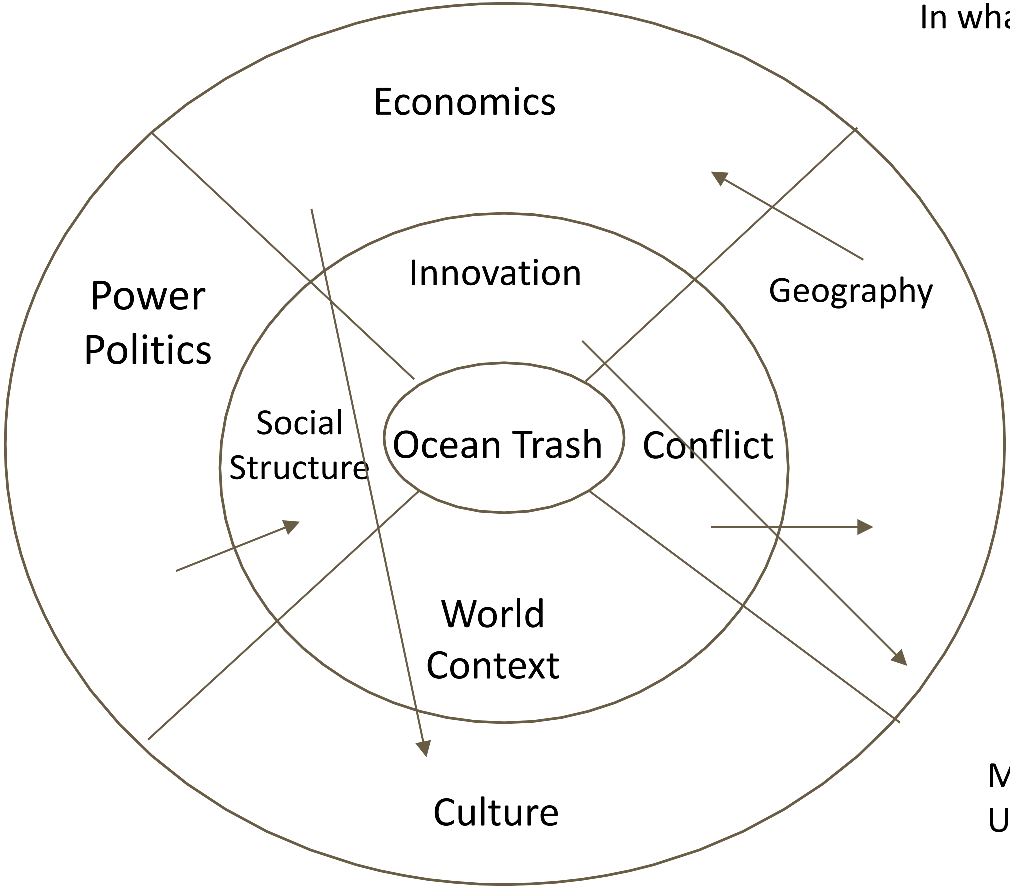
Is the problem of ocean trash reversible?

What are the short-term and long-term implications?

In what ways might we decrease __?

Experts:
Understand complexity of causes

Forecast second-order effects of solution ideas.



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Single factors related to issue

Geography- What areas of the world are contributing the most to the trash issue?

Economics- Plastics are cheap and easy to make. Businesses make more money from making large quantities of cheap goods.

Innovation- The innovation of plastic makes life easier (introduced after WWII as light, durable material).

Culture- Disposing items after one use is the norm

Social Structure- Citizens are not aware of the long-term consequences of one- use disposable plastics.

Politics/Power- The laws in various states are different (e.g., banning plastic bags); lack of consistency across the globe.

Making connections across factors

Politics/Government + Innovation: How can laws be used to incentivize new innovation?

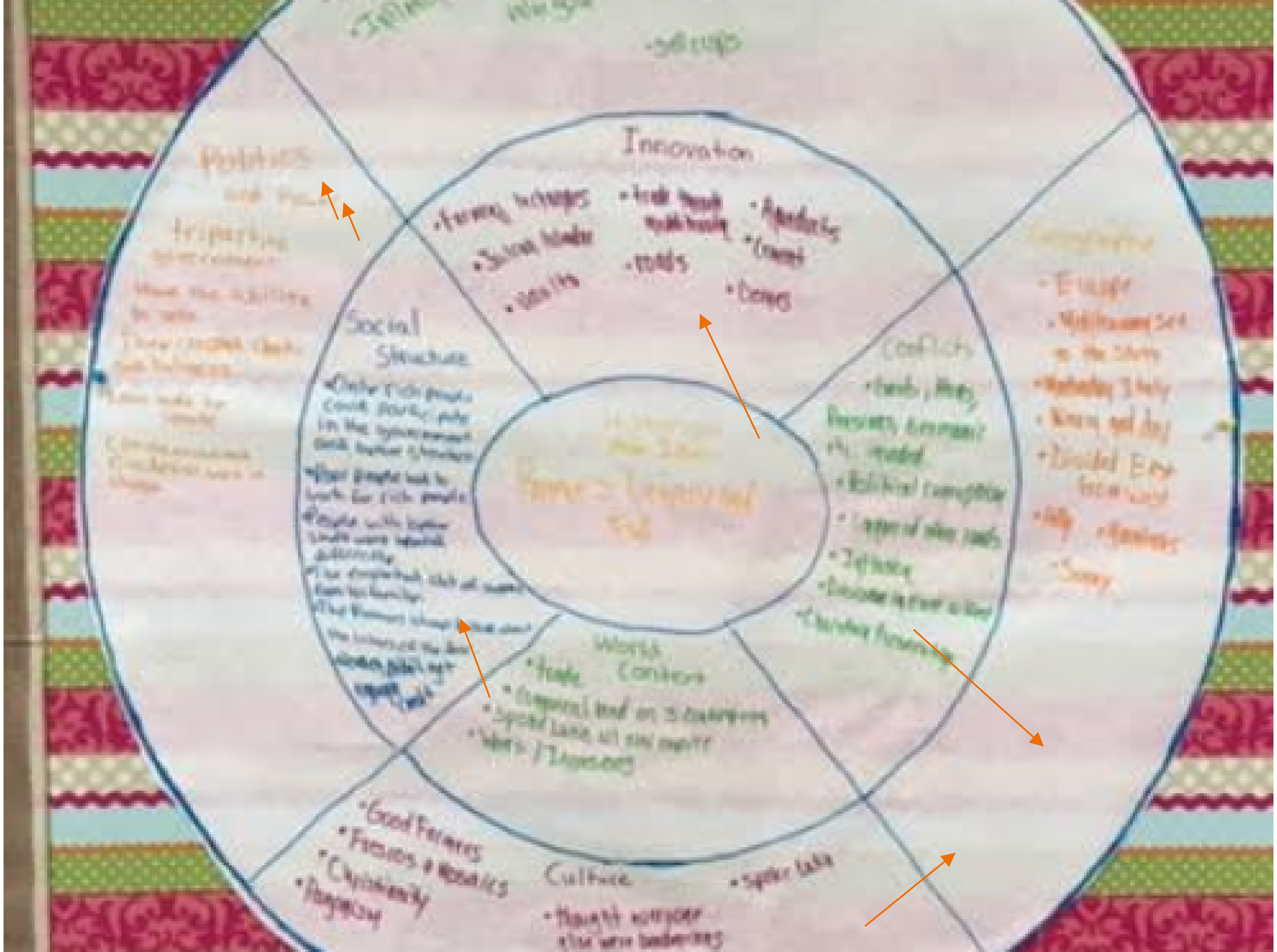
Economics + Politics/Power: How might we create policies to discourage manufacturers from making plastics?

Students can use the Social Studies Wheel to:

- Analyze 8-10 interactions that cause the problem.
- Analyze 8-10 interactions that are effects of the problem.
- Analyze the “root” cause or underlying problem by examining interactions
- Hypothesize how a proposed solution will interact with multiple factors

Example: 9-11 Speech

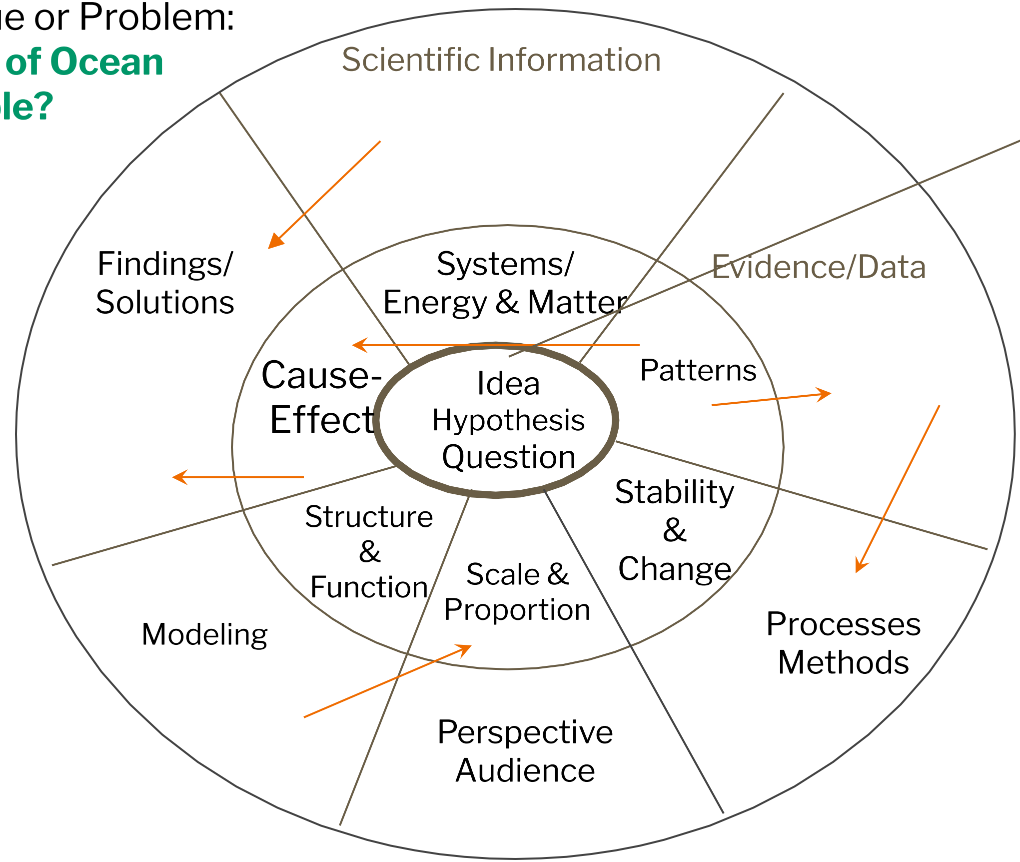
Level 1	Level 2	Level 3
Economics: What impact did the 9-11 attacks have on trade and economy? **Geography**: What was the significance of the geography on the 9-11 attacks? **Culture**: What role did culture play in the 9-11 attacks? **Politics**: How does the government structure impact the US's response to the 9-11 attacks?	**Geography + Culture:** How did geography and culture influence the decisions of the War on Terror? Which two factors on the wheel were most influential in creating the conflict that ensued after the 9-11 attacks?	**Geography + Conflict:** How might the outcomes have been different if the attacks were done overseas? How would this have impacted the conflicts that ensued after the attacks?


Innovation
Social Structure
Conflict
Culture
• Good Farmers
• Frescos & Mosaics
• Christianity
• Paganism

Real World Issue or Problem:

Is the Problem of Ocean Trash Reversible?

Question: **Where is the trash coming from? How will we solve the problem?**



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Real World Problem: - Is the problem of ocean trash reversible?

- **Scientific Information -** What scientific information is related to this idea exists? Did it work? What effects did it have in the short term? Long term? (ecosystems, food chains, physical science- structure of matter)
- **Evidence/Data-** What data do I need to collect to find out if this will work? Where does the trash come from? How does it travel?
- **Processes/Methods-** What methods have already been used to study this problem? {use of drone technology and algorithms to analyze plastic items; use of software to determine how the trash travels)
- **Modeling-** What might happen if plastic use decreased by 20%? What would a model of trash spread look like with 20% increase in plastics? What conditions do I need to consider as part of my model?
- **Perspectives/Audience-** What other perspectives need to be considered? How might different scientists look at this differently? What about the general public? (marine biologists, residents)
- **Findings/Solutions-** What other solutions have worked to stop the spread of the trash?

Simple Questions- NGSS Cross-Cutting Concepts

- **Systems/Energy & Matter:** What are the system's inputs, boundaries, outputs, and interactions? How does energy flow in and out of the system? What systems are affected?

- **Patterns-** What patterns do I notice? How can this be classified? (Scientists can uncover cause of problem by examining where trash comes from and what type)

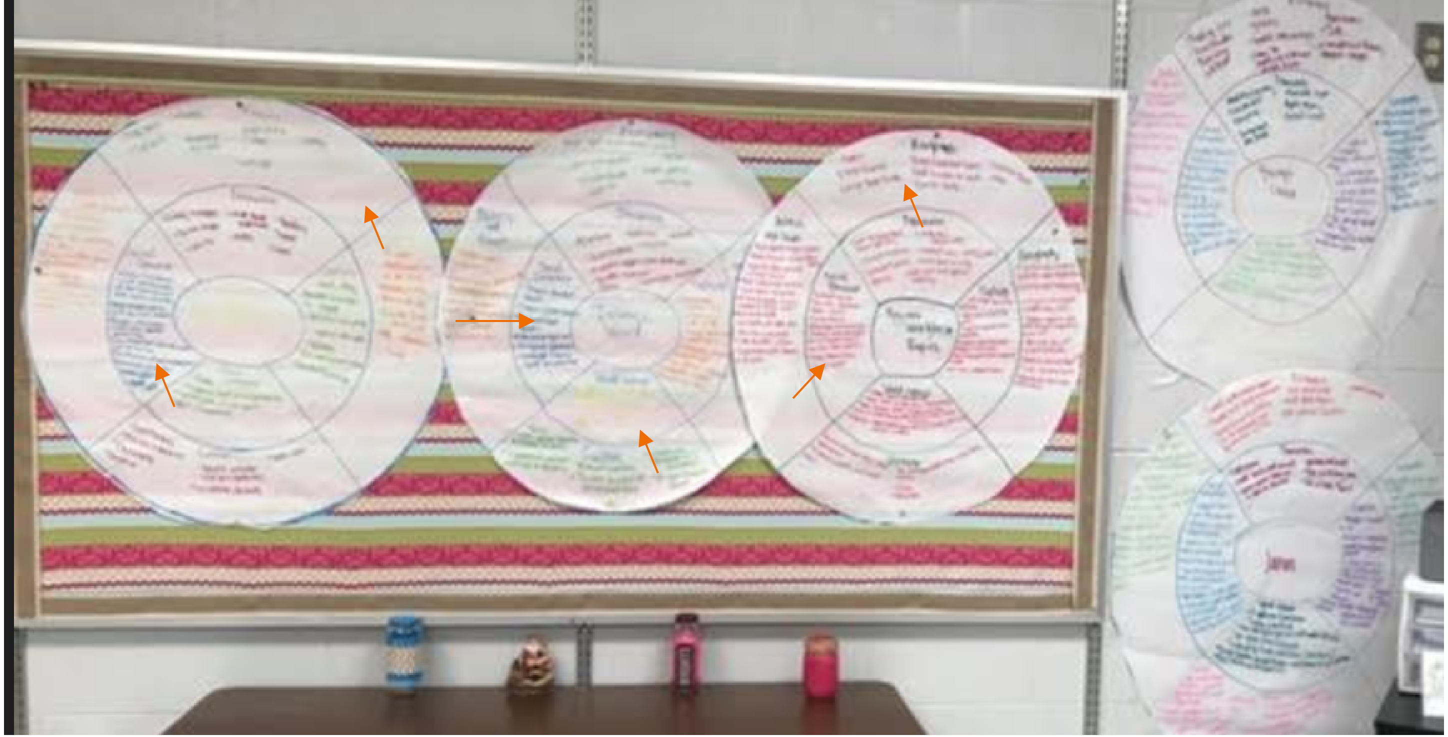
- **Scale & Proportion-** How can I measure or quantify____? How does proportion affect/predict____? (We can only see 1% of the trash; we must understand the scale of rubbish per person)

- **Stability & Change**- What changes occur as a result of ___? What causes or prohibits stability? What does not change?

- **Structure & Function-** What are the parts? What are the functions? How are the parts related?
- **Cause-effect-** What are the causes of___? What effect does__ have on ___?

Example: Cloud seeding

Level 1	Level 2	Level 3
Scientific Information: What scientific evidence do we have to support cloud seeding? **Cause and effect**: What effects does cloud seeding have on the environment? **Structure and Function:** Why are cumulus clouds targeted for cloud seeding? What is it about their structure that enables cloud seeding to happen?	**Scale and Proportion + Scientific Information:** How often can cloud seeding be done without causing harm? What information or evidence suggests this or do we need to collect?	**Scale and Proportion + Cause and Effect + Modeling:** What if we increased the amount of salt within the salt:water ratio. Would this necessarily produce more rain? Create a model.



Make Learning and Models Visible - Connect Multiple Disciplines Through Arrows, String, or Other Ways to Show Interactions and Connections

How can teach problem solving skills across different content domains?

- City Development/Population Growth & Ecosystems
- Genetically Modified Foods
- Clean Water
- Model United Nations

Application of Models

Students will learn to think as an expert in the field when teachers

- Use models over time in a variety of ways
- Embed complex questions within instruction
- Compare patterns of interactions across lessons
- Intentionally incorporate complexity within student products, tasks, and assessments
- Allow opportunities for student-driven exploration of issues and texts
- Student-led connections (Socratic Seminars)

Use models to

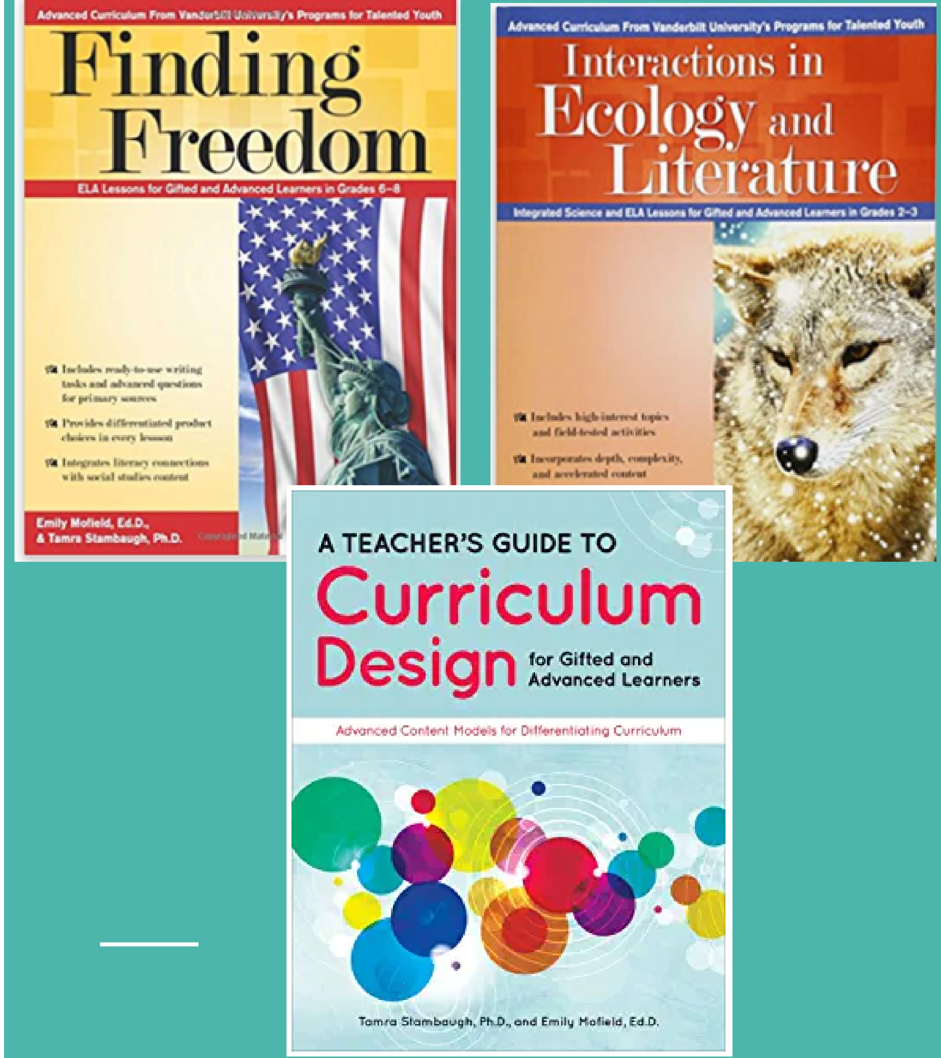
- Internalization of thinking like an expert
- Student planning and pre-planning for projects, problem-based learning, writing, competitions, and independent study
- Teacher planning and differentiation
- Other ideas?

Reflection

- How do you envision using these models in your own content?
- How do these models impact student learning and how you teach problem solving in various content area?

For More Information and Examples

Vanderbilt PTY Curriculum Series
Taylor Francis-Routledge (Prufrock Press)



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