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Please enjoy this complimentary excerpt from *Tools for Teaching Conceptual Understanding, Elementary*, by Julie Stern, Nathalie Lauriault, and Krista Ferraro. Use this lesson framework to guide your students through the process of generating and testing hypotheses to discover connections between concepts.

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Lesson Framework #2: Generating and Testing Hypotheses

Once students have been introduced to the concepts that anchor your unit of study, they are ready to generate and test hypotheses about the relationships among those concepts. In his book *The Art and Science of Teaching* (2007), Robert Marzano notes that providing opportunities for students to generate hypotheses and test them—through experimental inquiry, problem solving, decision making, or investigation tasks—has been proven to produce substantial learning gains. This is likely because the process of generating and testing hypotheses engages students’ preconceptions about the concepts (their initial hypotheses will reveal their preconceptions about how the concepts relate to each other) and asks them to become aware of the ways in which new knowledge challenges or confirms their prior understanding.

Generating and testing hypotheses about conceptual relationships generally happens through these steps:

1. Students write initial response to conceptual questions (their preconceptions).
2. Students learn a little about a specific context, enough to generate a hypothesis (topic/context/facts).
3. Students develop a hypothesis about the conceptual relationship in light of the topic.
4. Students learn more about the topic in order to test their hypotheses.
5. Students abstract to an improved statement of conceptual relationship supported by evidence from the context. (Steps 4 and 5 can be repeated several times.)
6. Students transfer this understanding to a new situation.
7. Students reflect on growth in thinking and understanding.

To prepare to take their students through these steps, teachers can follow the framework shown in Figure 4.2.

As an example, let’s look at a fourth-grade lesson on poetry. The conceptual relationship might be something like, *Poets use rhyme and repeated line to establish the mood of a poem.*

1. **Conceptual question:** Students record initial responses to the question: Why do poets use rhymes and repeated lines?
2. **Background:** Next they learn a little about the poet Cristina Rossi and that they are going to read a poem called “Who Has Seen the Wind?”

FIGURE 4.2 GENERATING AND TESTING HYPOTHESES LESSON FRAMEWORK

Lesson Principle	Questions to Ask Yourself	Might Look Like
<p>1. Start with conceptual questions that target the statement of conceptual relationships of the unit.</p>	<ul style="list-style-type: none"> • What conceptual relationships are at the heart of this unit? • How can I create conceptual questions that engage students and allow for deep thought right away? • What questions will allow me to gauge students' preinstructional understanding of the concepts? 	<ul style="list-style-type: none"> • Students recording initial thoughts about conceptual relationships in journal. • Groups draw nonlinguistic representations of the concept on chart paper and gallery walk to see breadth of class's thinking. • Small groups discuss conceptual questions and teacher observes. • Teacher provides variety of sample relationship statements, and students explain which one aligns with their thinking and why.
<p>2. Provide enough background on topic of inquiry to make a hypothesis (e.g., background on author or text, preview of historical example).</p>	<ul style="list-style-type: none"> • In what context will students investigate the concepts? • What background information would allow students to generate useful hypotheses about the concept in this context? • How could I preview the topic in a way that intrigues students and sets the stage for inquiry? How can I set up a "mystery" for students to solve? 	<ul style="list-style-type: none"> • Stations or gallery walk of intriguing images that introduce basics of topic. • Short lecture or student presentation explaining basic background. • Dramatic read-aloud of key passage of text or quote about the historical event/figure. • Students read "fact sheet" with four or five key details. • Students brainstorm background knowledge in KWL (know, want to know, learned) chart.
<p>3. Students generate hypotheses about the topic/text based on current understanding of conceptual relationships.</p>	<ul style="list-style-type: none"> • How can students use their current understanding of the concepts to generate hypotheses about the topic/text? 	<ul style="list-style-type: none"> • Students brainstorm hypotheses about the topic/text on sticky notes and categorize them as a group. • Students list as many hypotheses as possible in journal, and then circle the best one. • Pairs discuss and come to consensus on a hypothesis they will test together.

Lesson Principle	Questions to Ask Yourself	Might Look Like
<p>4. Provide texts/ experiences that allow students to test their hypotheses about the topic through a specific context.</p>	<ul style="list-style-type: none"> • What experiences would allow students to test their hypotheses and gain a more nuanced or sophisticated understanding of the relationship between concepts? • Which inquiry strategies will best help students test their hypotheses about this topic? 	<ul style="list-style-type: none"> • Individual reading, marking text for evidence for/against hypothesis, group discussion of text and evidence found. • Whole class watches video or lecture and records evidence for/against hypothesis; pairs discuss viability of hypothesis and revise if necessary. • Students research information online and collect evidence for/against hypothesis. • Students rotate through stations and gather evidence to test hypothesis.
<p>5. Ask students to generalize about the concepts in light of what they learned about the topic.</p>	<ul style="list-style-type: none"> • How could students use their learning about the topic to create a transferable understanding about the concepts in general? 	<ul style="list-style-type: none"> • Students write statements to express relationship between concepts. • Additionally, _____. • Students draw nonlinguistic representations of the conceptual relationship and explain their thinking to a partner. • Synectics—students consider a variety of images and choose which one best represents the conceptual relationship.
<p>6. Have students refine and test their statements of conceptual relationship (and peers' statements).</p>	<ul style="list-style-type: none"> • How can students increase the clarity, accuracy, precision, depth, breadth, relevance, significance, and fairness of their statements? • How can students use facts to support their statements? 	<ul style="list-style-type: none"> • Students ask "Why?" "How?" and "So what?" to improve precision and significance of statements. • Students list facts and examples <i>outside the context studied</i> that support their generalizations. • Students read others' statements and refine or support them with evidence. • Students create Structure of Knowledge diagrams to show how they built their statement. • Students perform research to further test and refine their statements.

(Continued)

FIGURE 4.2 (Continued)

Lesson Principle	Questions to Ask Yourself	Might Look Like
<p>7. Ask students to reflect on learning and explain transferability of their statements of conceptual relationships.</p>	<ul style="list-style-type: none"> • How can students gain awareness of their learning and the usefulness of their new understanding of the concepts? • How can I help students track their own growth in thinking and understanding? 	<ul style="list-style-type: none"> • Students return to original thoughts about concept and compare to their new thoughts. • Students complete exit slip describing how their understanding has changed. • Students track growth on novice to expert scale/rubric (see Chapter 5) and explain what happened in their brains to make this progress. • Students name the points of the lesson when they were doing “complex” or “deep” thinking and explain what this felt like. • Pairs brainstorm situations when they could use their new idea (transferability). • Students explain how partner helped them push their thinking or led them to a breakthrough.

3. **Generate hypothesis:** Based on what they know about the poet and the name of the poem, students hypothesize about how and why the poet will use rhyme and repeated lines.
4. **Test the hypothesis:** The students read the poem and discuss what surprised them followed by the effects that rhyme and repeated lines had on the poem. Through guided discussion, the teacher could ask students about how they feel when reading the poem to elicit ideas about emotion and mood.
5. **Generalize:** Students return to the initial question with refined thinking about why poets use rhyme and repeated lines. They use evidence from the poem to defend their responses.
6. **Transfer:** Students transfer their understanding to a new poem such as “At the Zoo” by William Makepeace Thackeray. This poem is a complete change in mood and uses rhyme and repeated lines in a different way. Students discuss and then return to their refined thinking for further reflection using evidence from this new poem.
7. **Reflect:** Students reflect on the ways in which their thinking became more precise through the lesson.