Conceptual Flow: Bridging the Gap Between Standards, Instructional Materials, and Student Learning

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Session Outcomes

• Be aware of how to develop a conceptual flow

• Understand the value of a conceptual flow as a guide for: planning instruction, assessment points, and evaluating instructional materials

• Connect to the Common Core Standards and the Next Generation Science Standards
How People Learn

• Prior Knowledge
• Conceptual Frameworks
• Metacognition

(Bransford et al., 2000)
Guiding Questions

• What do we want students to learn?
• How we will know if they have learned it?
• What will we do if they haven’t learned it?
• What will we do if they already know it?
• Do we believe they can learn it?

Dufour et al., 2006
Conceptual Flow Basics

- Details the important concepts
- Identifies an instructional sequence
- Identifies important concepts for assessment of student understanding
- Serves as a tool for evaluation of instructional materials

(DiRanna, Osmundson, Topps, Gerhardt, Barakos, Cerwin, Carnahan, Strang, 2008)
Conceptual Flow: Building Schema

BIGGEST IDEA/CONCEPT

Supporting Ideas

Smaller Ideas
Goldilocks and the Three Bears

Recall the story….

Fact or Big Idea

3 bears
Ate porridge
Differential heating
Baby bear bed was just right
Goldilocks was a girl
Breaking and entering
Fact or Concept?

*Use clip art to stamp your answer.*

<table>
<thead>
<tr>
<th></th>
<th>Fact</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>The sun’s energy drives the water cycle.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insects have 6 legs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are 3 states of matter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uneven heating of the earth’s surfaces creates convection currents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living things demonstrate a structure function relationship.</td>
<td></td>
<td></td>
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</tbody>
</table>
Facts or definitions are pieces of information. The focus is on verifiable and discrete details.

In teaching, facts are often presented without making connections to the big ideas in science.

Concepts are over-arching ideas that clearly show the relationships between facts. They are frequently abstract.

In teaching, concepts are often presented with connections to the real world and to the big ideas of science.
Quick Writing Prompt

What should an exiting ______ grader know about ______?

What should an exiting 8th grader know about the properties of matter?

>Type your responses in the chat.]
Collaborative Post-It Conceptual Flow
Density is a characteristic property of matter. The configuration of atoms in a substance determines the properties of the substance.

There are groups of elements that have similar properties, including highly reactive metals, less-reactive metals, highly reactive non-metals, and some almost completely non-reactive gases.

When a new material is made by combining two or more substances, it has properties that are different from the original materials.

Density of matter varies with temperature.

When elements are listed in order by the masses of their atoms, the same sequence of properties appears over and over again in the list.

Density is a relationship between a substance’s mass and volume.

A substance will float in a liquid, when the density of the substance is less than the density of the liquid.

A substance will sink in a liquid, when the density of the substance is greater than the density of the liquid.

Density can be used to predict the behavior of matter in terms of sinking and floating.

The relative densities of substances determine whether they will sink or float in a density column.

Density of solids and liquids can be calculated, i.e., \( d = \frac{m}{v} \).

At constant pressure and temperature the density of a substance does not change.

Heating and cooling cause changes in the properties of matter.

Matter has characteristic properties and the properties of matter can change.
Formative Assessment

• Think about where you would need an assessment in this conceptual flow.

• Draw a flag at critical points that will inform instruction.

[When returned to previous slide, put clip art where you think formative assessment belongs.]
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Steps to Create a Conceptual Flow; CF in IM and Assessments

1. Individual pre-think to “what should a student know?” prompt; transfer ideas to post-its.
2. Collaborative pre-think: share with your team and determine one “post-it flow.”
3. Read the instructional materials and note the concepts for the IM conceptual flow.
4. Match collaborative pre-think to concepts addressed in the instructional materials.
5. Align concepts from the collaborative pre-think and instructional materials to content standards.
6. Review progression of concepts and place them in an instructional sequence with the strongest possible links for student understanding.
7. Flag assessments.
Examples of Conceptual Flow Resources
Let’s pause for questions from the audience.
New Opportunities for All Learners

- Common Core Standards (ELA and Mathematics)
- Next Generation Science Standards
- 21st Century Skills
Next Generation Science Standards

Science and engineering

Core ideas in the discipline

Concepts across disciplines
Observation

Take independent notes as you observe samples 1 and 2. Use all senses except taste.

#1 is clear; has no smell; stays on finger when touched; doesn’t cling to side of cup
#2 is clear; has smell; cools finger and seems to evaporate; clings to side of cup
Observation: Ice in Each Cup

What do you observe in cup #1? In cup #2?

[Type your responses in the chat.]
Whiteboard Entry

- Draw a model on the whiteboard that indicates how closely packed the molecules would be in both liquids and the ice.
- Explain in writing how you know which materials have the same, greater, or less density.

[Raise your hand to volunteer.]

1) 

2) 

3) 
### Scientific and Engineering Practices

*Put clip art next to the “best” practice embedded in the ice experiment.*

<table>
<thead>
<tr>
<th>Practice</th>
<th>Place clip art below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking questions and defining problems</td>
<td></td>
</tr>
<tr>
<td>Developing and using models</td>
<td></td>
</tr>
<tr>
<td>Planning and carrying out investigations</td>
<td></td>
</tr>
<tr>
<td>Analyzing and interpreting data</td>
<td></td>
</tr>
<tr>
<td>Using mathematics and information and computer technology</td>
<td></td>
</tr>
<tr>
<td>Developing explanations and designing solutions</td>
<td></td>
</tr>
<tr>
<td>Engaging in argument</td>
<td></td>
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<tr>
<td>Obtaining, evaluating, and communicating information</td>
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</tbody>
</table>
# Crosscutting Concepts

[Put clip art next to the “best” crosscutting concept embedded in the ice experiment.]

<table>
<thead>
<tr>
<th>Concept</th>
<th>Place clip art below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns</td>
<td></td>
</tr>
<tr>
<td>Cause and effect: mechanism and explanation</td>
<td></td>
</tr>
<tr>
<td>Scale, proportion and quantity</td>
<td></td>
</tr>
<tr>
<td>Systems and system models</td>
<td></td>
</tr>
<tr>
<td>Energy and matter: flows, cycles and conservation</td>
<td></td>
</tr>
<tr>
<td>Structure and function</td>
<td></td>
</tr>
<tr>
<td>Stability and change</td>
<td></td>
</tr>
</tbody>
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Let’s pause for questions from the audience.
Common Core State Standards for English Language Arts Literacy in History Social Science, Science and Other Technical Subjects
Oral and Written Language

• Recall the types of thinking and products you engaged in during the activity.

• How did these support oral and written language?
Oral Language in CaCCSS: Speaking and Listening Standards

• Present claims and findings (e.g., argument, narrative, response to literature presentations), emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
Written Language in CaCCSS

Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.

c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially).

d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

e. Provide a concluding statement or section related to the information or explanation presented.

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Rigor/Relevance Framework

- **A**: Routine Memorization
- **B**: Practical Hands On
- **C**: Complex Analytical
- **D**: Challenging Real World

- **High** Rigor
- **Low** Rigor
- **Low** Relevance
- **High** Relevance
Quadrant D Moments

How does science get you to “Quadrant D Moments?”

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NGSS ← Conceptual flow → CCSS

Activity

Practices and Cross Cutting Concepts

Communication

Quadrant “D” Moments

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Taking it Home

- How might you use the conceptual flow in your context?
- How might the conceptual flow help with incorporation of the common core standards? Next Generation Science Standards?
Let’s pause for questions from the audience.
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