SYNTHESIZING KNOWLEDGE WITH CONCEPT MAPS

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Evidence-based teaching group
WHAT IS A CONCEPT MAP?

Concept maps are graphical representations for organizing and representing knowledge.

- **Characteristics:**
  - Focus question
  - Concepts
  - Propositions
  - Knowledge domains
  - Cross-links
  - Heirarchical

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CONCEPT MAPPING PROMOTES MEANINGFUL LEARNING

- Provides a scaffold upon which to organize knowledge
- Uses prior knowledge to assimilate and construct new knowledge
- Recognizes individual differences in prior knowledge
- Promotes the formation of new connections between knowledge domains
- Utilizes motor, visual, and communication skills
- Requires emotional investment
- Promotes peer teaching and collaboration in group settings
- Engages the creative process
- Mirrors scientific thinking
- Uncovers misconceptions

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Knowledge integration

- Sorting molecular entities into appropriate categories (concepts)
- Connecting biological ideas
- Integrating ideas to build a network of biological ideas (knowledge integration)

Nature of connections

- Associative, functional, and causal connections (propositions/links)
- Mechanistic reasoning (scientific reasoning)
- (Communication)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Fragmented (&lt;24 pts overall)</th>
<th>Transitional (24-31 pts overall)</th>
<th>Connected (32-35 pts overall)</th>
<th>Nuanced (36-40 pts overall)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorting molecular entities (concepts)</td>
<td>Grouping of entities are often scientifically non-normative and/or Mechanism-inappropriate.</td>
<td>Shows beginnings of boundary definition between mental categories. The grouping of most entities are scientifically normative and mechanism-appropriate.</td>
<td>Grouping of almost all entities is scientifically normative and mechanism-appropriate.</td>
<td>Groupings of all entities are scientifically normative and mechanism-appropriate. Boundaries between groupings are appropriate yet flexible.</td>
</tr>
<tr>
<td>Nature of connections (proposition/links)</td>
<td>Relies on associative terms or vague action terms or locations to build a mechanistic explanation. Entities or groups of entities are not connected or are linked but not described.</td>
<td>While vague and associative connections are still present, includes some causal or functional connections between molecular events. Very few missing or blank connections.</td>
<td>Molecular entities are temporally and spatially within mechanistic chains of molecular events. Use of vague, structural or categorizing connections is moderate. Associative connections are infrequent.</td>
<td>Connects entities with functional, mechanistic, causal, or action terms/phrases. Use of vague connections is infrequent and the use of, structural or categorizing connections used sparingly.</td>
</tr>
<tr>
<td>Connecting biological ideas (scientific reasoning)</td>
<td>Connection of ideas is frequently scientifically non-normative. Alternative connections are not plausible.</td>
<td>Heuristic reasoning is used to connect ideas. These ideas, though productive in some situations, serve to reinforce non-normative connections.</td>
<td>Scientifically normative connections are made between most ideas. Heuristic reasoning is less frequent.</td>
<td>All entities are connected by scientifically normative ideas.</td>
</tr>
<tr>
<td>Knowledge integration</td>
<td>Mechanisms are conflated, with little to no evidence of scientifically normative interrelatedness of groups.</td>
<td>Relationships between mechanisms are tenuous and may or may not be supported by scientifically normative arguments.</td>
<td>Describes a productively continuous chain of molecular events in which entities have corresponding temporal and spatial activities. Relationships between mechanistic groupings are supported by scientifically normative arguments.</td>
<td>Shows relationships between mechanistic groupings. Adds functional or causal connections to relevant biological phenomena and integrates several ideas to describe a nuanced overarching biological principle.</td>
</tr>
<tr>
<td>Communication</td>
<td>Information is not clear, very difficult to understand.</td>
<td>Information is presented and some understanding can be gained.</td>
<td>Information is presented clearly and allows for a good level of understanding.</td>
<td>Information is presented clearly and allows for a high level of understanding.</td>
</tr>
</tbody>
</table>
Focus question: “What are the mechanisms by which apolipoprotein B-48 and apolipoprotein B-100 contribute to lipid metabolism?”
CREATE A CONCEPT MAP

Using Cmap software, create a concept map that addresses the focal question:

“What is the central dogma of biology?”

Use the highlighted concepts in the list below. As time permits, try integrating additional concepts to your map.

<table>
<thead>
<tr>
<th>Cell</th>
<th>Phenotype</th>
<th>Protein</th>
<th>Gene Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inheritance</td>
<td>RNA polymerase</td>
<td>Membrane</td>
<td>DNA polymerase</td>
</tr>
<tr>
<td>DNA</td>
<td>Transcription</td>
<td>Ribosome</td>
<td>Replication Fork</td>
</tr>
<tr>
<td>Mutations</td>
<td>Gene</td>
<td>Genetic Disease</td>
<td>Amino Acids</td>
</tr>
<tr>
<td>Neuron</td>
<td>Translation</td>
<td>RNA</td>
<td>Skin Cell</td>
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</tbody>
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