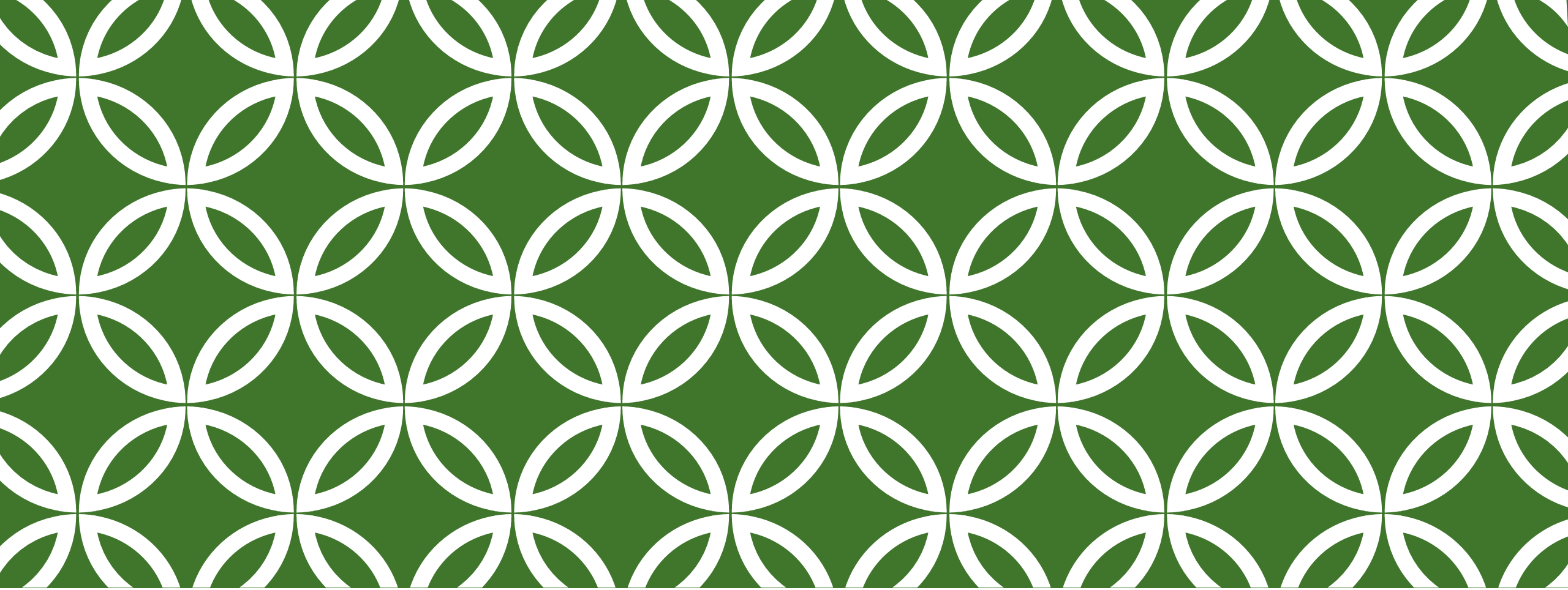


SYNTHESIZING KNOWLEDGE WITH CONCEPT MAPS

John Shabb

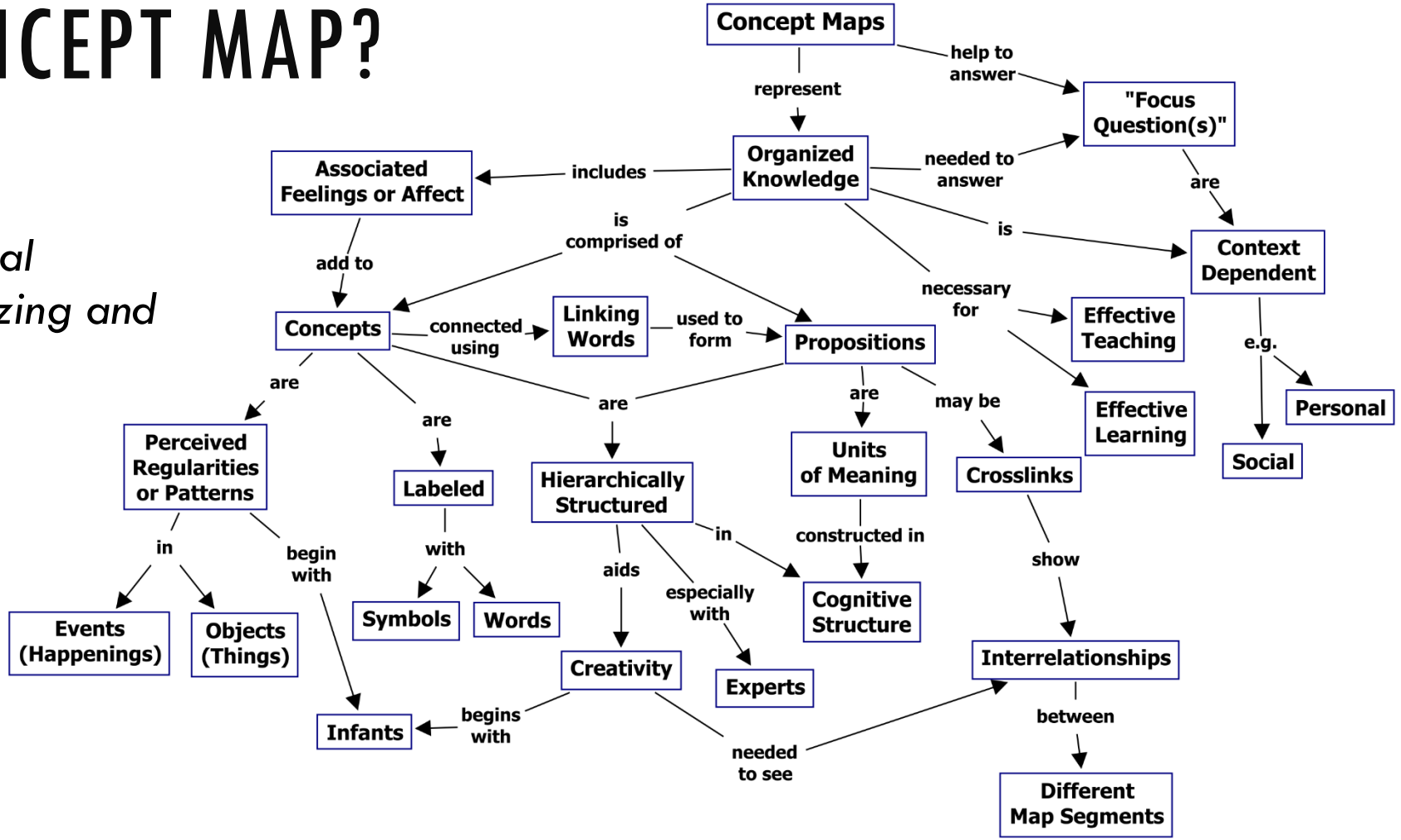
November 6, 2018

Evidence-based teaching group

WHAT IS A CONCEPT MAP?

Concept maps are graphical representations for organizing and representing knowledge.

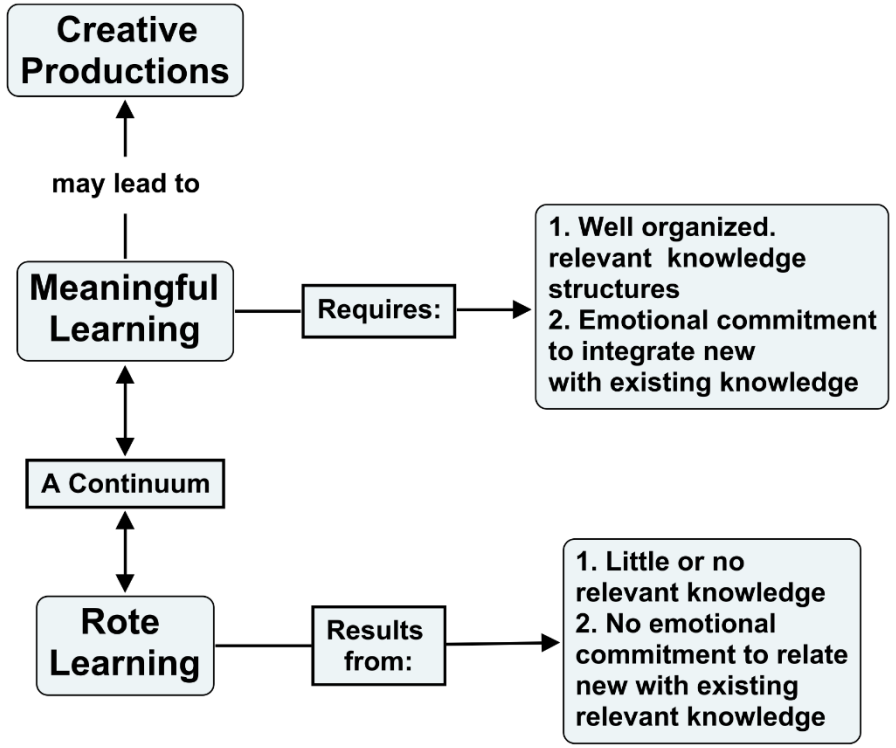
- Characteristics:
  - Focus question
  - Concepts
  - Propositions
  - Knowledge domains
  - Cross-links
  - Heirarchical



Novak JD and Cañas AJ (2006) Institute for Human and Machine Cognition (IHMC)

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**

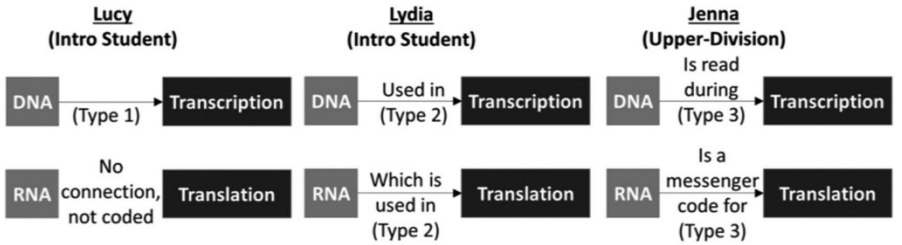


Novak JD and Cañas AJ (2006) Institute for Human and Machine Cognition (IHMC)

KNOWLEDGE INTEGRATION THEORETICAL MODEL FOR MOLECULAR AND CELLULAR BIOLOGY

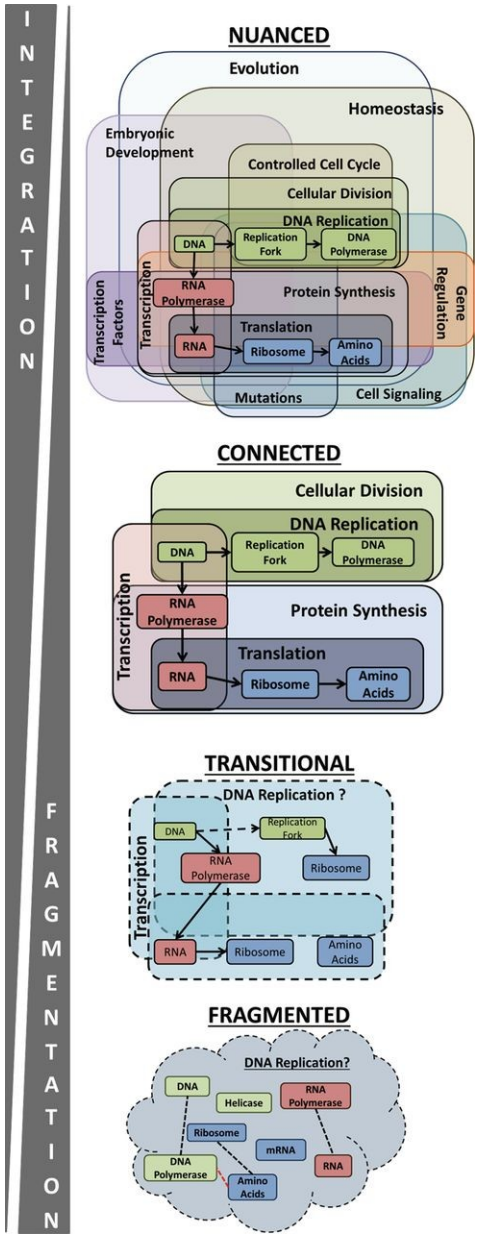
Knowledge integration

- 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)*



Southard K, Wince T, Meddleton S, and Bolger MS (2016) Features of knowledge building in biology: Understanding undergraduate students' ideas about molecular mechanisms. *CBE Life Sci Educ* **15**:1-16

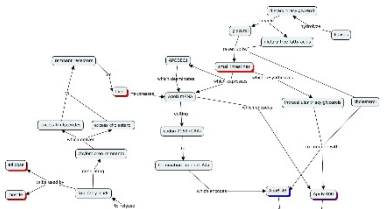
RUBRIC FOR ASSESSING CONCEPT MAPS

Criteria	Fragmented (<24 pts overall) 0-3 pts	Transitional (24-31 pts overall) 4-5 pts	Connected (32-35 pts overall) 6-7 pts	Nuanced (36-40 pts overall) 8 pts
Sorting molecular entities (concepts)	Grouping of entities are often scientifically non-normative and/or Mechanism-inappropriate.	Shows beginnings of boundary definition between mental categories. The grouping of most entities are scientifically normative and mechanism-appropriate.	Grouping of almost all entities is scientifically normative and mechanism-appropriate.	Groupings of all entities are scientifically normative and mechanism-appropriate. Boundaries between groupings are appropriate yet flexible.
Nature of connections (proposition/links)	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.	While vague and associative connections are still present, includes some causal or functional connections between molecular events. Very few missing or blank connections.	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.	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.
Connecting biological ideas (scientific reasoning)	Connection of ideas is frequently scientifically non-normative. Alternative connections are not plausible.	Heuristic reasoning is used to connect ideas. These ideas, though productive in some situations, serve to reinforce non-normative connections.	Scientifically normative connections are made between most ideas. Heuristic reasoning is less frequent.	All entities are connected by scientifically normative ideas.
Knowledge integration	Mechanisms are conflated, with little to no evidence of scientifically normative interrelatedness of groups.	Relationships between mechanisms are tenuous and may or may not be supported by scientifically normative arguments.	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.	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.
Communication	Information is not clear, very difficult to understand.	Information is presented and some understanding can be gained.	Information is presented clearly and allows for a good level of understanding.	Information is presented clearly and allows for a high level of understanding.

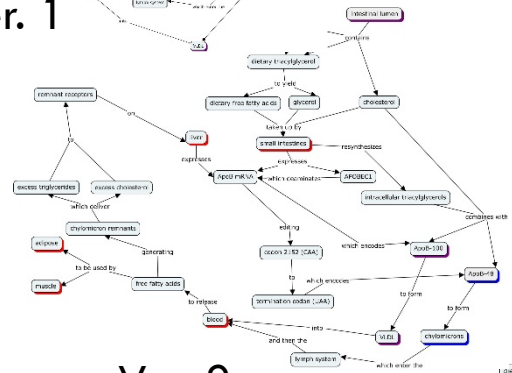
A CONCEPT MAP IS NEVER DONE

Focus question: *"What are the mechanisms by which apolipoprotein B-48 and apolipoprotein B-100 contribute to lipid metabolism?"*

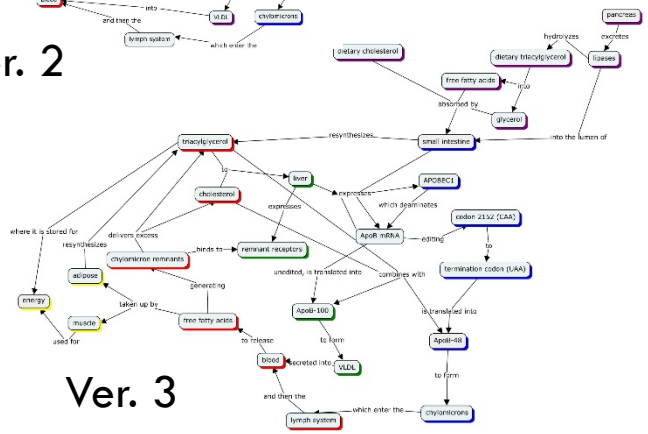
Ver. 1



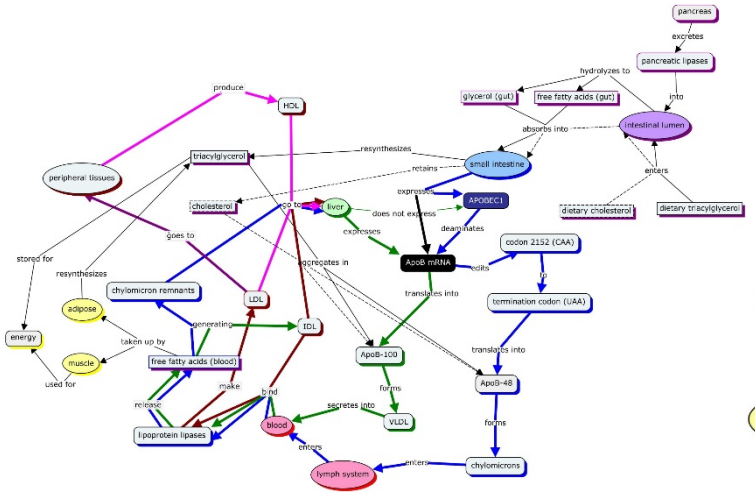
Ver. 2



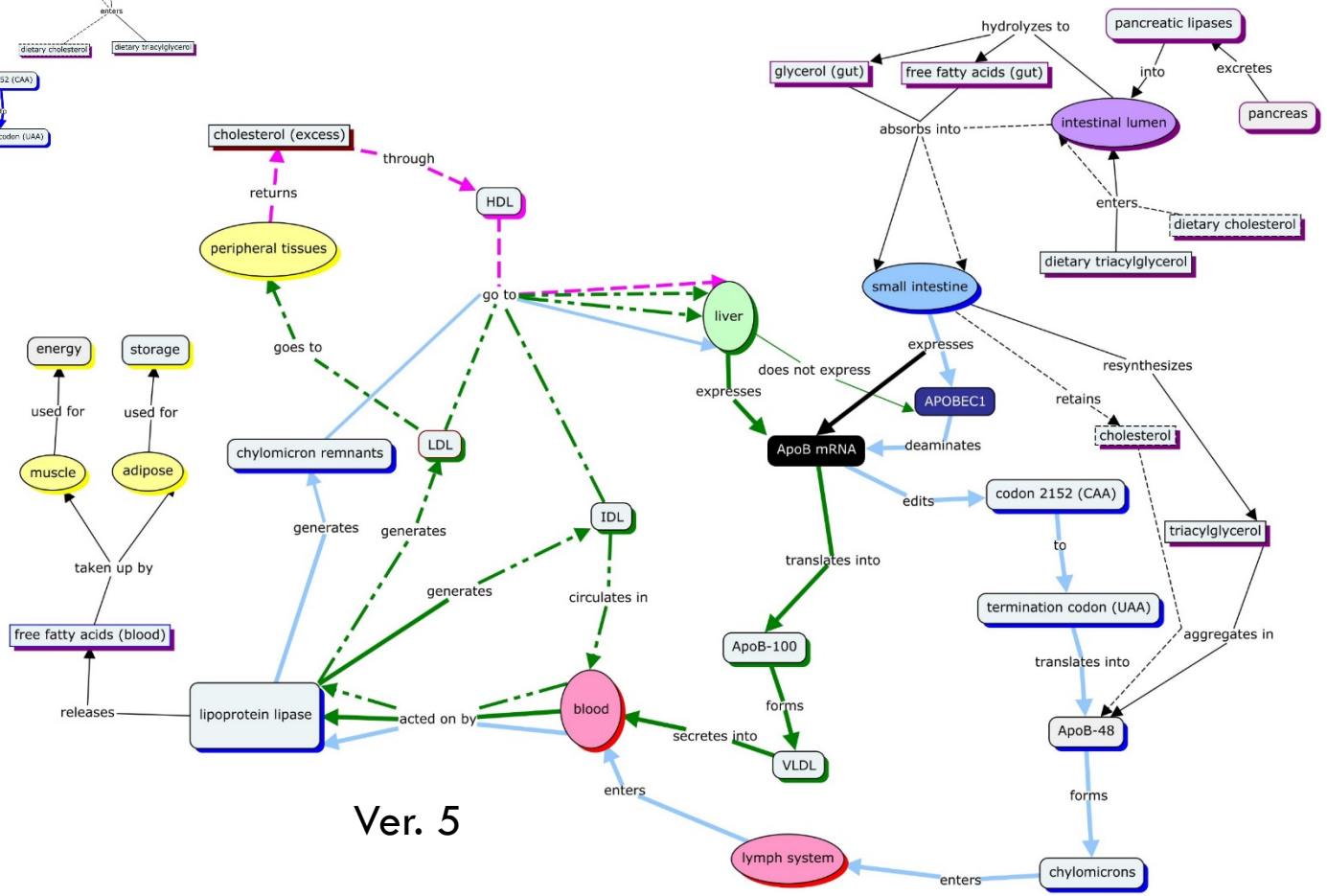
Ver. 3



Ver. 4



Ver. 5



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.

Cell	Phenotype	Protein	Gene Regulation
Inheritance	RNA polymerase	Membrane	DNA polymerase
DNA	Transcription	Ribosome	Replication Fork
Mutations	Gene	Genetic Disease	Amino Acids
Neuron	Translation	RNA	Skin Cell

DEBRIEF