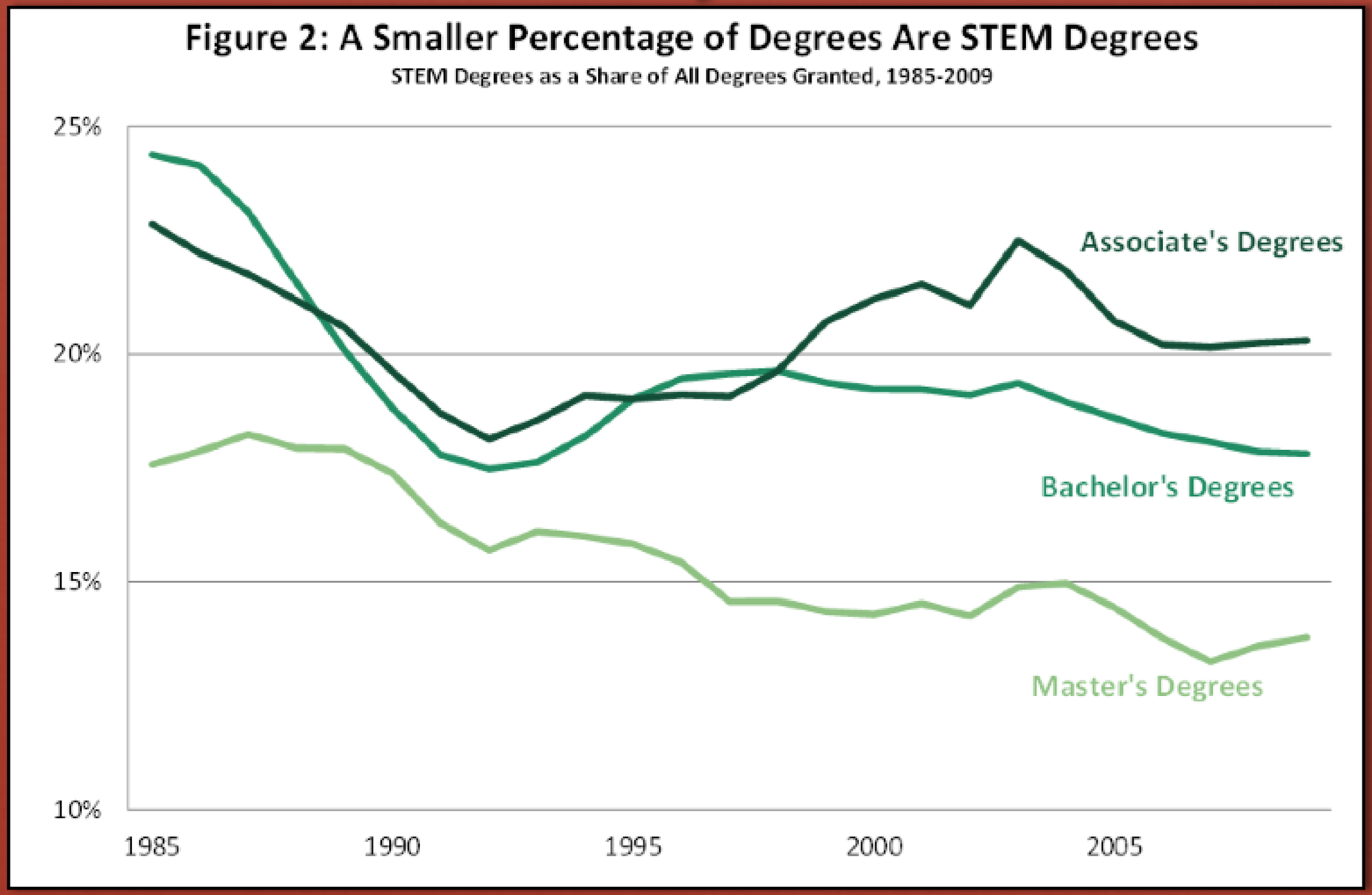
Use of Multimedia to Increase Comprehension in an Introductory STEM Course

Lack of STEM Majors & Graduates



Source: Chairman's staff of the Joint Economic Committee based on data from the Department of Education's National Center for Education Statistics: Integrated Postsecondary Education Data. STEM Degrees include degrees in: Engineering, Physical Sciences, Geosciences, Math & Computer Sciences, and Life Sciences

Need to Change Instructional Approach?

Traditional Approach Emphasizes:	To Aid Underrepresented Students Emphasize:
Inductive Reasoning	Organization
Hierarchical & Linear Relationships	Visualization & Images
Empirical Research	Less Competitive Atmosphere
Abstract Conceptualization	Concrete Conceptualization

Multimedia represents a useful tool for accomplishing this

Multimedia Excels in Certain Learning Environments

When intrinsic load is high	the use of well-designed multimedia decreases extrinsic load	while managing germane load.
processes cannot be experienced in every day life,	by using dual coding,	to direct schema construction
vocabulary is complex,	to support working memory,	by connecting vocabulary with structures,
and spatial relationships are important	while reducing cognitive load	and showing processes in motion

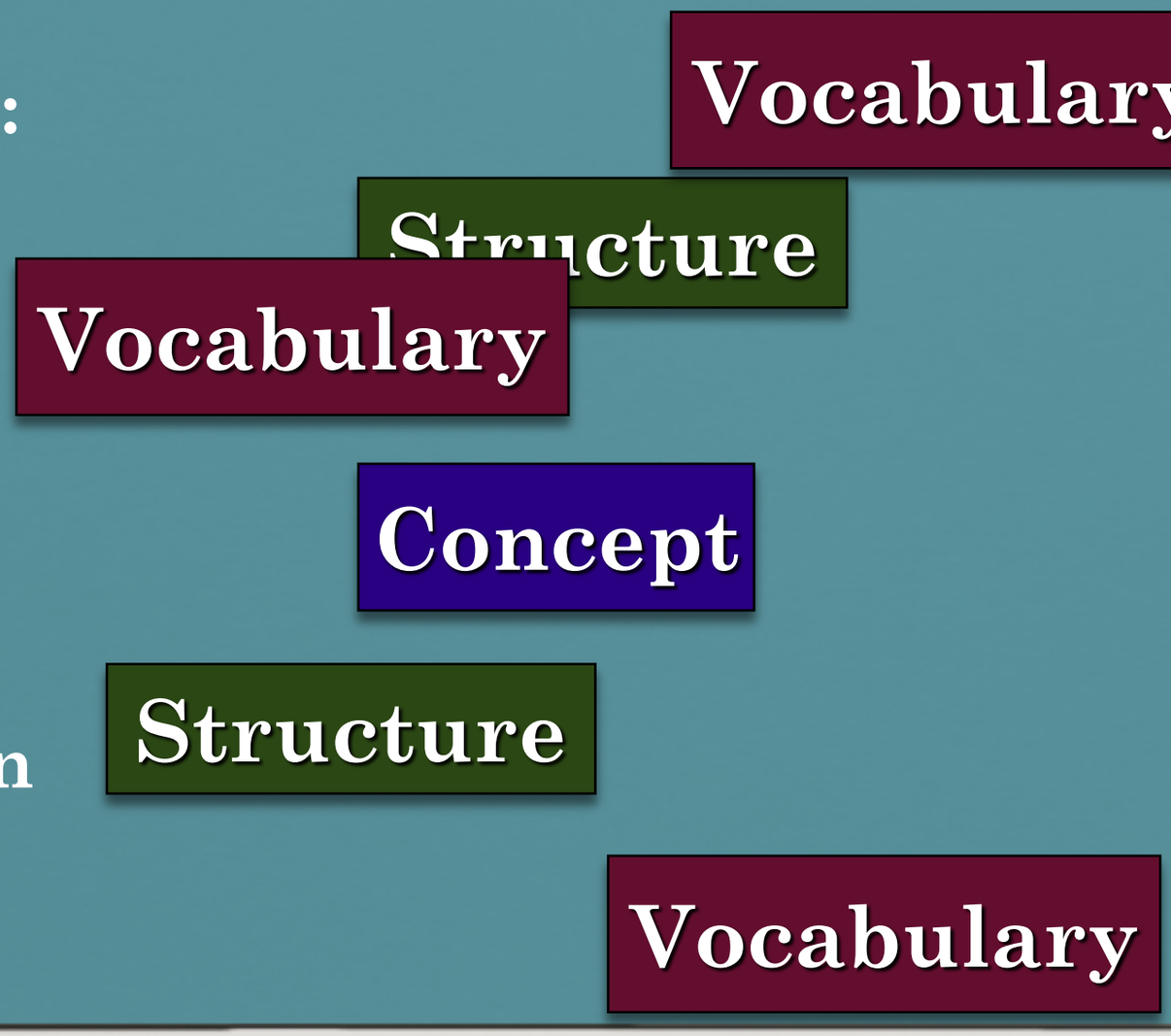
Multimedia and Schema Construction

Schemas represent small chunks of information constructed while learning

Effective instructional techniques create, add to, connect, rearrange schemas to enrich mental model of a concept

Multimedia helps process:

- **Words succinctly connected to structures, structures to concepts**
- **Processes seen in motion**
- **User defines pace**



Experimental Design

Selected four of eight introductory biology course sections

Tested effects of learning photosynthesis with multimedia compared to text document with static pictures

<u>Quantitative:</u>

Pretest - Administer Media - Posttest/Quiz/Exam

<u>Qualitative:</u>

Focus groups, social validity questions

Results

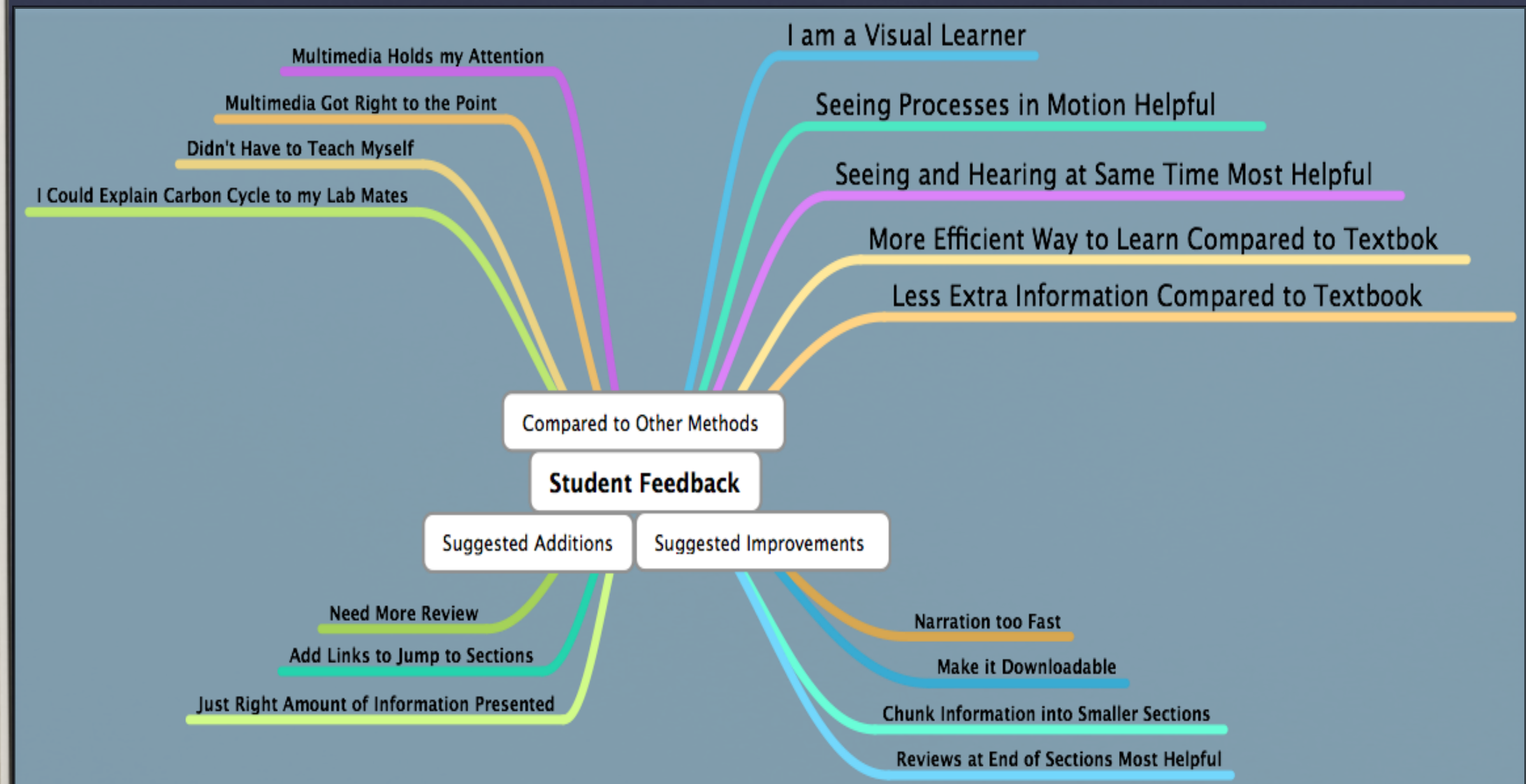
Use of multimedia increases comprehension

	Pre-test/Post-test Results	Daily Quiz Results	Unit Exam Results
Spring 2012	$p < 0.016$	$p < 0.004$	$p < 0.024$
Fall 2012	$p < 0.045$	$p < 0.048$	no data

Students with lower-prior knowledge benefited more

	Pre-test/Post-test Results
Spring 2012	$p < 0.042$
Fall 2012	$p < 0.019$

Results


Multimedia Holds my Attention
Multimedia Got Right to the Point
Didn't Have to Teach Myself
I Could Explain Carbon Cycle to my Lab Mates
I am a Visual Learner
Seeing Processes in Motion Helpful
Seeing and Hearing at Same Time Most Helpful
More Efficient Way to Learn Compared to Textbok
Less Extra Information Compared to Textbook
Compared to Other Methods
Student Feedback
Suggested Additions
Suggested Improvements
Need More Review
Add Links to Jump to Sections
Just Right Amount of Information Presented
Narration too Fast
Make it Downloadable
Chunk Information into Smaller Sections
Reviews at End of Sections Most Helpful

Conclusions

Multimedia can be an effective tool for increasing comprehension within introductory STEM courses

- **Multimedia decreases extrinsic load while focusing germane load; this enhances schema construction**

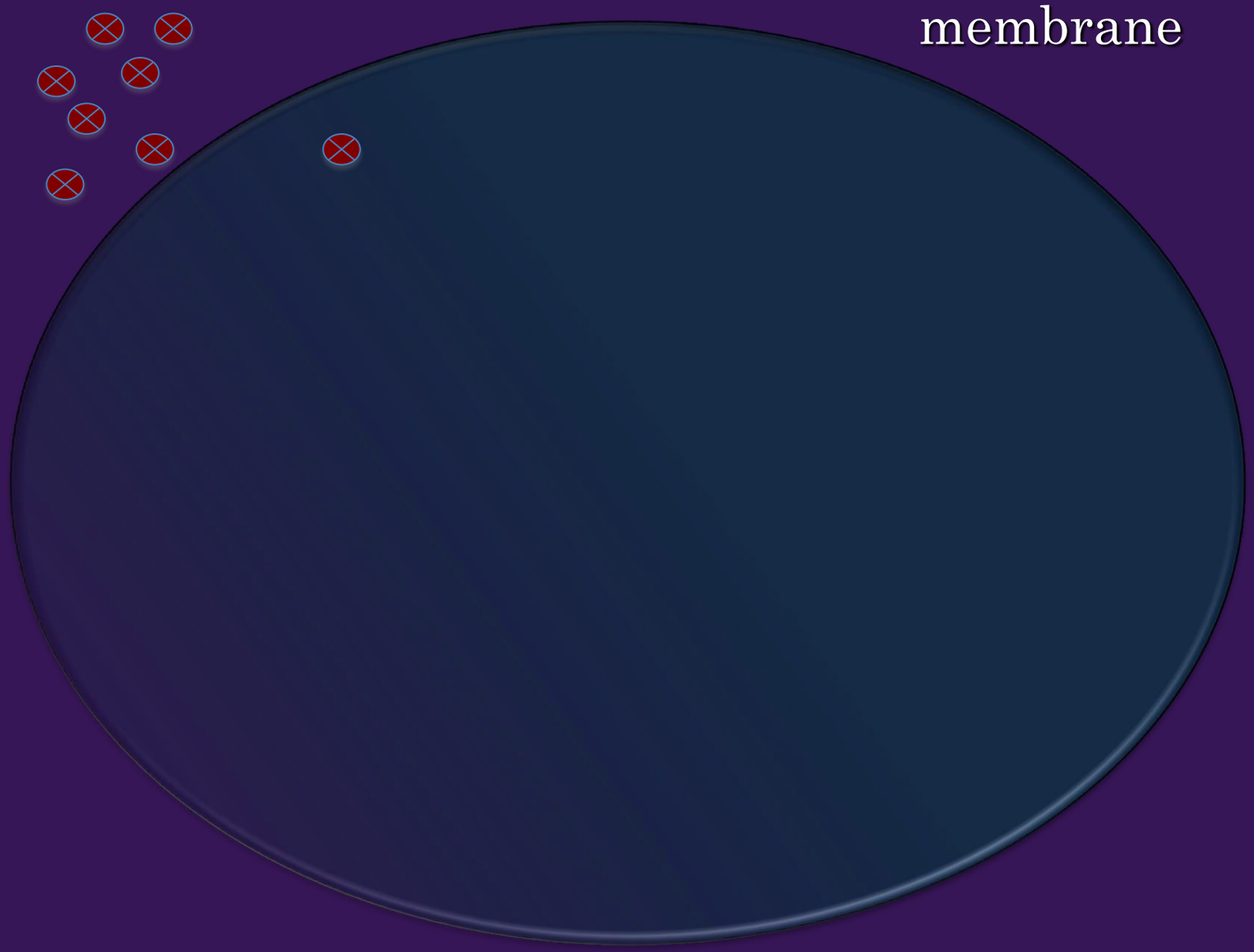
- **Benefit greater for those with a lower-prior knowledge level**

Diffusion and Concentration Gradients

Simple Diffusion

1. Concentration Gradient

2. Ability to cross the membrane



Examples of In-Class Applications

Doesn't have to be fancy or professionally done; in fact, it's not recommended

Students prefer familiar voices using familiar terminology

Overlap between multimedia and in-class activities, lecture helpful