

Combating Cognitive Load with Multimedia Design Principles

Matthew McHargue, M.Ed
Online Educator Development Course
Northwest-Shoals Community College

Objectives

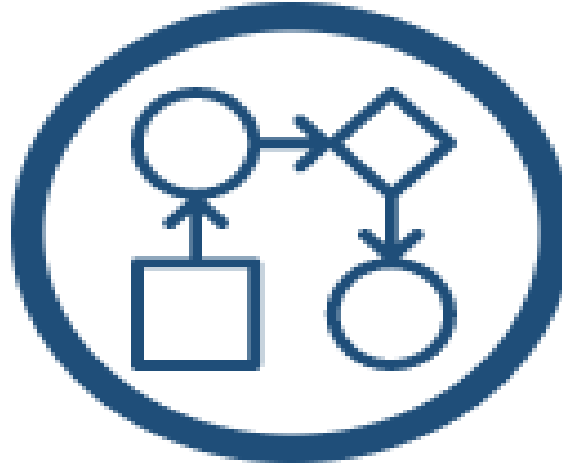
1. Define Cognitive Load Theory.
2. Describe the learning process.
3. Describe Clark and Mayer's (2016) principles of multi-media design.

Roadmap

Define CLT



Learning
Process



Principles



Defining Cognitive Load Theory



Cognitive Load Theory

Revolves around

recei

man

information.

Cognitive Architecture



Cognitive Load Theory

Teaching while taking the human **cognitive architecture** into consideration.

Dr. Majeda Awawdeh



The Theorists

Cognitive Load Theory



Dr. John Sweller

Cognitive Theory of Multimedia Learning



Dr. Richard Mayer



Types of Cognitive Load

Intrinsic Load



Extraneous Load



Germane Load

Cognitive Load



Types of Cognitive Load

Intrinsic Load



Element Interactivity

“the **natural complexity of information** that must be understood and material that must be learned, unencumbered by instructional issues such as how the information should be presented or in what activities learners should engage to maximise learning.”

Sweller (1994)



Element Interactivity

Types of Cognitive Load

Extraneous Load

“Nonoptimal instructional procedures are referred to as imposing extraneous load. Cognitive load theory is primarily concerned with techniques designed to **reduce extraneous load.**”

Sweller (1994)



Types of Cognitive Load

Germane Load

Germane cognitive load is concerned only with learner characteristics. It refers to the **working memory** resources that the learner devotes to dealing with the intrinsic cognitive load associated with the information...**germane cognitive load is independent of the information presented.**

Sweller (1994)



Types of Cognitive Load

Germane Load



Extraneous Load

Intrinsic Load



The Learning Process



Working Memory

“The characteristics of **working memory** are central to cognitive load theory and to instructional design.”

Sweller (2016)

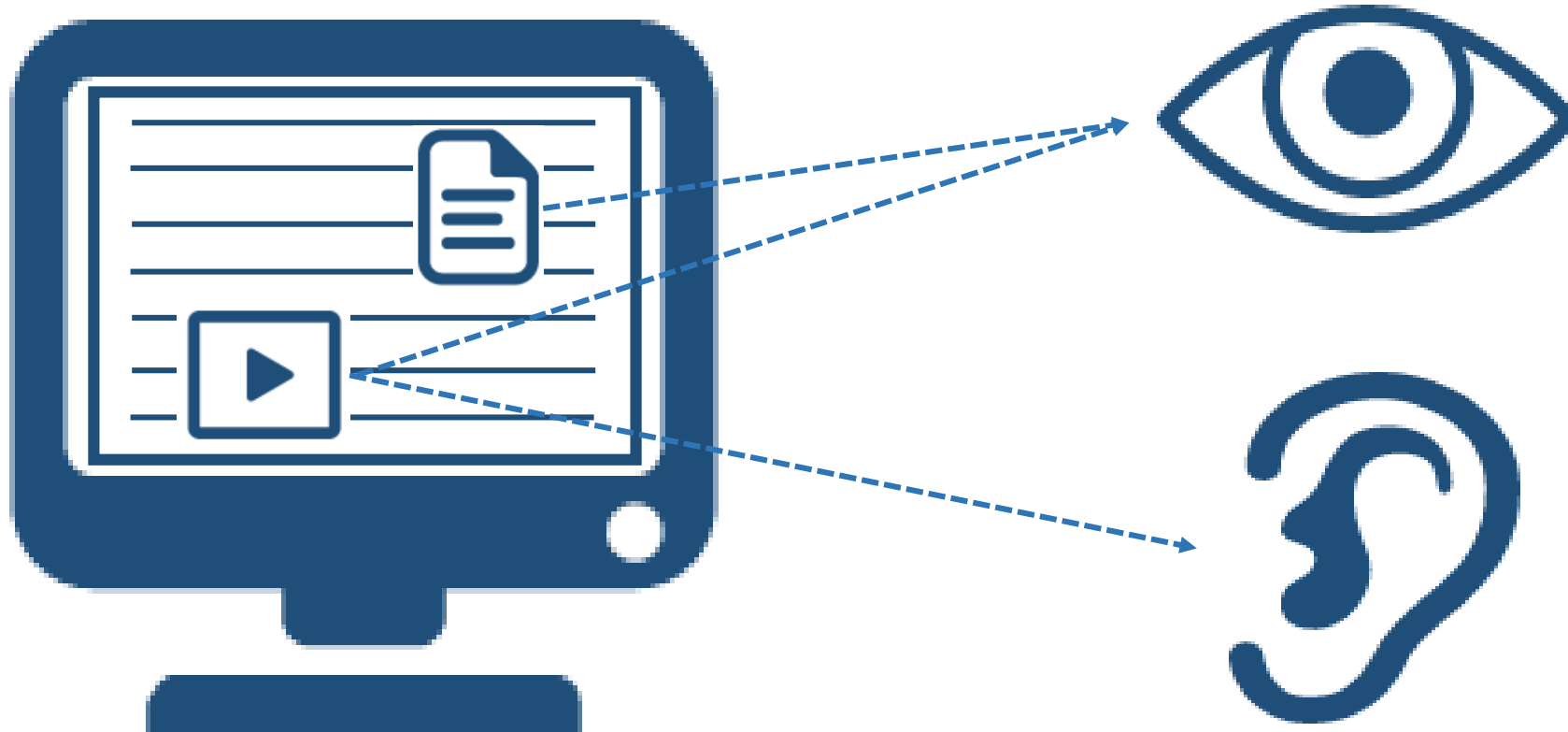


Working Memory

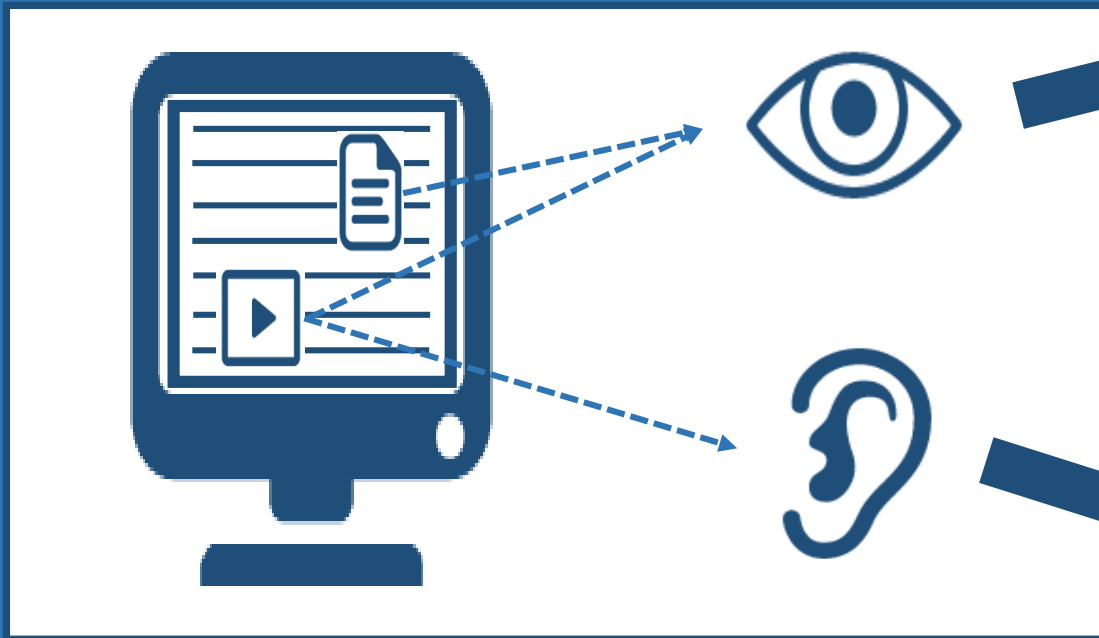
Working memory is the collection of **cognitive mechanisms** utilized to **receive, process, and organize** incoming **information**



Working Memory



Working Memory



Visuo-Spatial Sketchpad

Processes **visual** and **spatial information**

(e.g. an object's shape, color, and relative location to other objects)

Phonological Loop

Processes **verbal** and **auditory** information



Working Memory



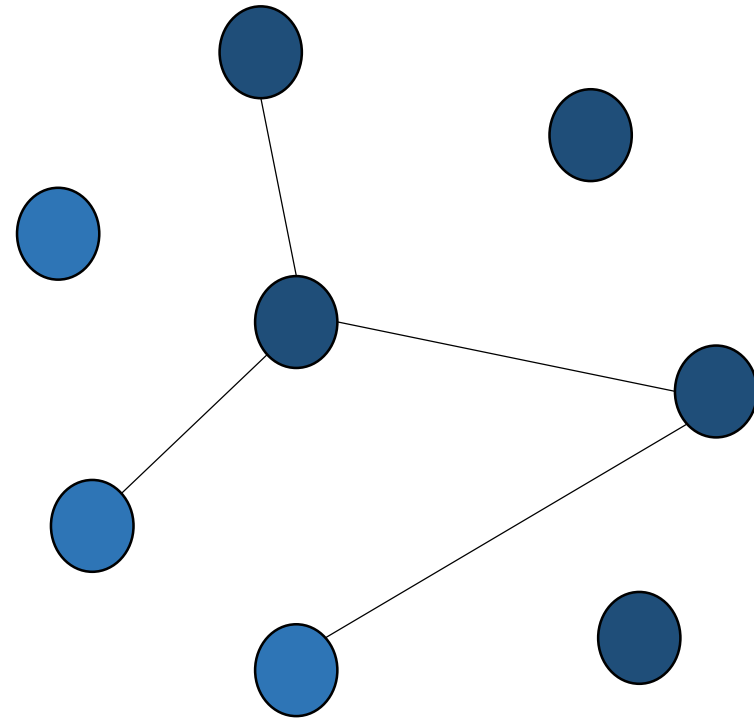
- ❑ **Limited** capacity in storage and duration
- ❑ **3-5 chunks** at a time
- ❑ **Schema** construction begins



Schema Construction

Schema

An **organized network** of information



Long-term Memory

Long-term memory is the **hard drive of the brain**. We never lose information stored here, only the ability to retrieve it.

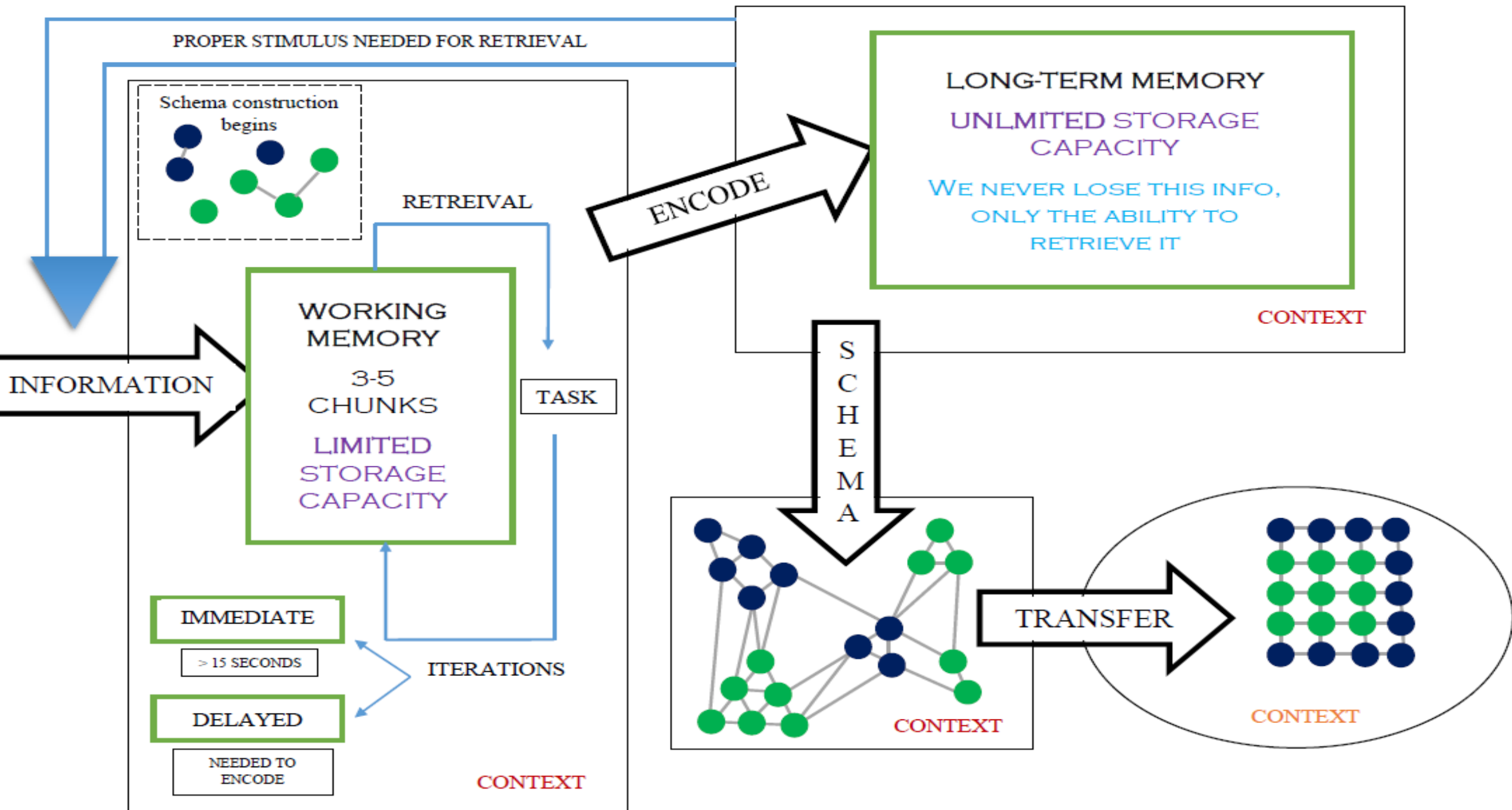


Long-term Memory



- ❑ **Unlimited** capacity in storage and duration
- ❑ Appropriate prompt/**stimulus necessary** to retrieve information
- ❑ More **complex schemas** constructed





Quick Write

$$x^2 + 8x + 16$$

Take two minutes and write down **everything you know** about or can do to the expression above. Include any **words** or **phrases** that pop into your head.



Quick Write

The Curse of Expertise

"Research shows that **it is not simply general abilities**, such as memory or intelligence, nor the use of general strategies **that differentiate experts from novices**. Instead, experts have acquired extensive knowledge that affects **what they notice** and **how they organize, represent**, and **interpret information** in their environment."

(Bransford, Brown, Cocking, 2000)

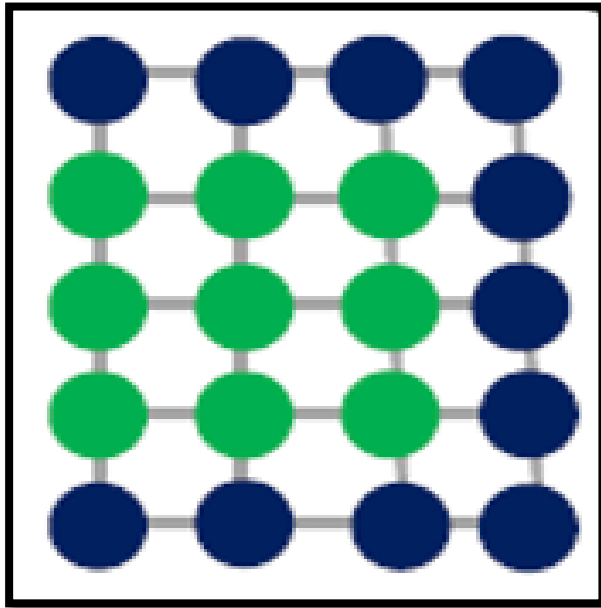


The Curse of Expertise

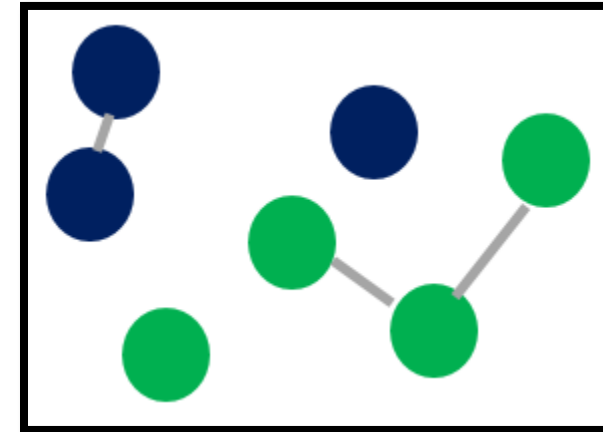
- ❑ Recognition of **meaningful patterns and relationships**
- ❑ In-depth knowledge of **core concepts** and “**big picture**” ideas
- ❑ Complex arrays of **interconnected schemas**
- ❑ **Automation** of tasks



The Curse of Expertise



VS

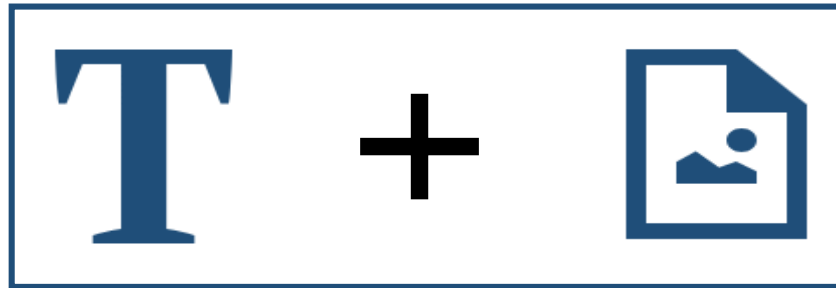


Principles of Multimedia Design



Multimedia Principle

Use **text** and **graphics** rather than just text alone



Multimedia Principle

Decorative	Added for aesthetic appeal
Representational	Illustrate the appearance of an object
Organizational	Demonstrate qualitative relationships
Relational	Summarize quantitative relationships
Transformational	Illustrate changes in time or over space
Interpretive	Make intangible phenomena visible and concrete



Coherence Principle

Limit the amount of **material** in
your instruction



Coherence Principle

When things have to be made more interesting, it is because **the thing itself is wanting**. Moreover, the phrase is a misnomer. The thing, the object, is **no more interesting than it was before**.

John Dewey



Coherence Principle

T

Avoid extra **text** for...

T

added interest

elaboration

technical depth



Coherence Principle



Avoid extra **graphics**
that...



distract

disrupt

seduce



Coherence Principle



Avoid extra **audio**
when...



material is unfamiliar

material is presented
quickly

learner is unable to
control pace



Modality Principle

Present **words as audio narration**
rather than on-screen text



Redundancy Principle

Explain visuals with words in
audio or text but not both



Redundancy Principle

Exceptions to the rule...

There are no graphics

The learner has control of the pace of the lesson

Technical subject or foreign language

The learner is likely to have difficulty processing spoken words

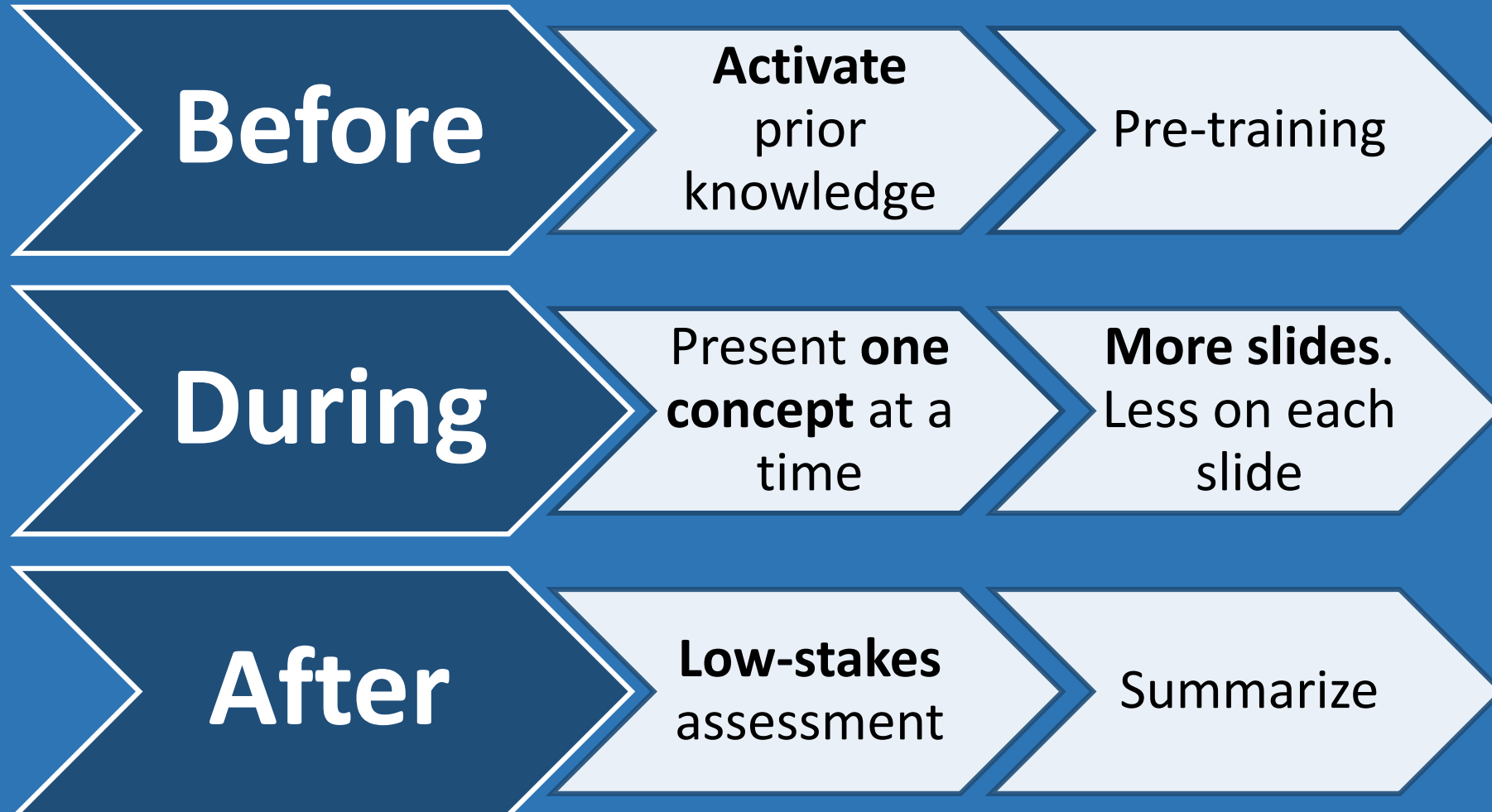


Segmenting Principle

Break your presentation into **bite size pieces**



Segmenting Principle



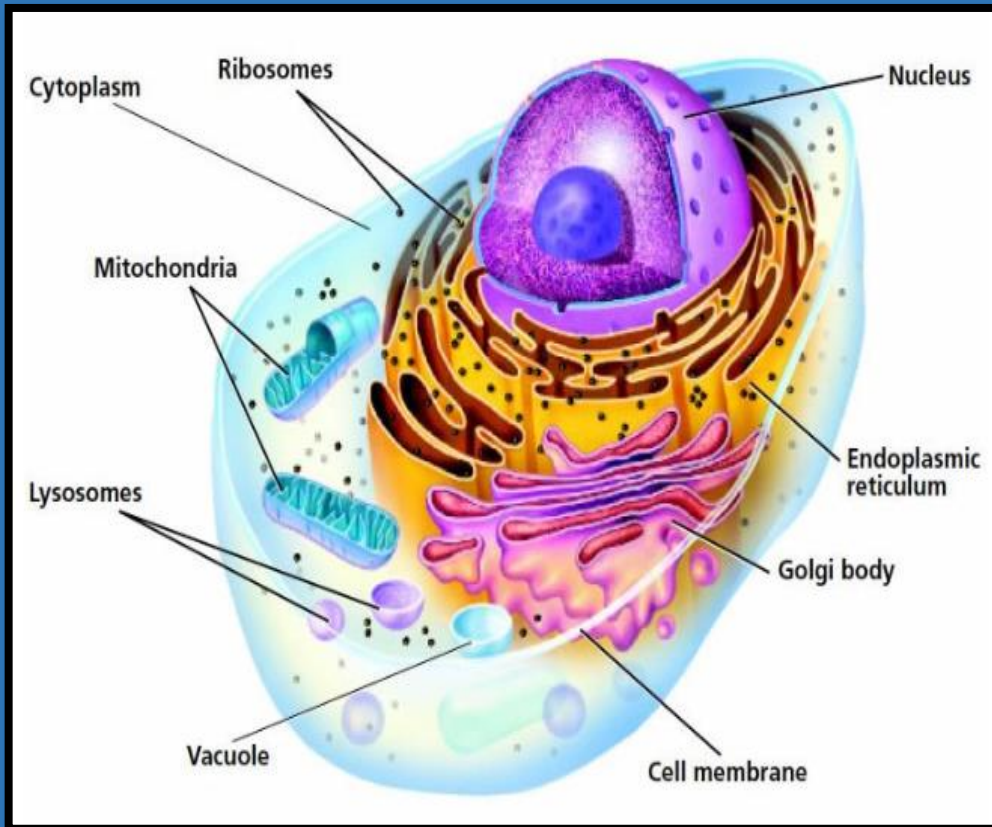
Contiguity Principle

Align words to corresponding graphics

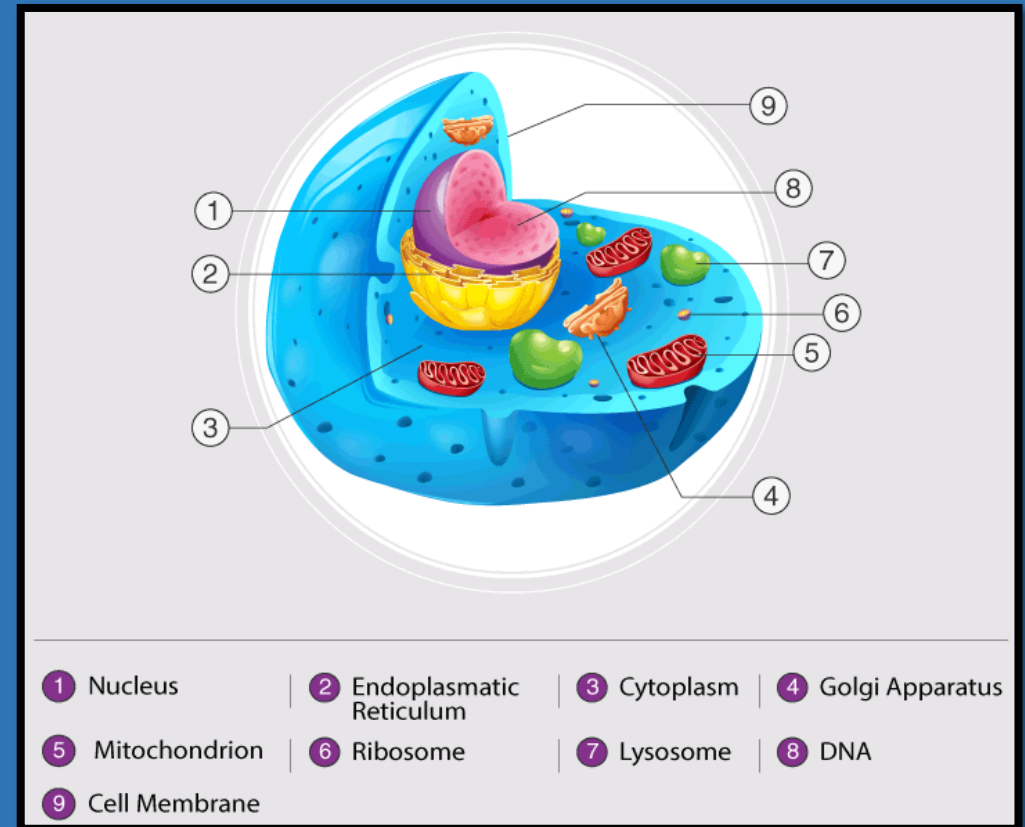


Contiguity Principle

This



Not this



Worked Example Principle

I do, **we** do, **you** do
&

Provide **exemplars** of correctly completed
assignments



References

Baddeley, A.D. (1999). *Essentials of Human Memory*. Hove: Psychology Press.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington: National Academy of sciences.

Clark, R., Mayer, R. (2016). *eInstruction and the science of instruction: Proven guidelines for consumers and designers of multimedia learning (4th ed)*. Wiley, Hoboken, NJ.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction*, 4, 295-312.

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review*, (22) 123-138.

Sweller, J. (2016). Working memory, long-term memory, and instructional design. *Journal of Applied Research in Memory and Cognition*, (5) 360-367.