ET60012 FOUNDATIONS OF EDUCATIONAL TECHNOLOGY

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Cognitive Load Theory

John Sweller

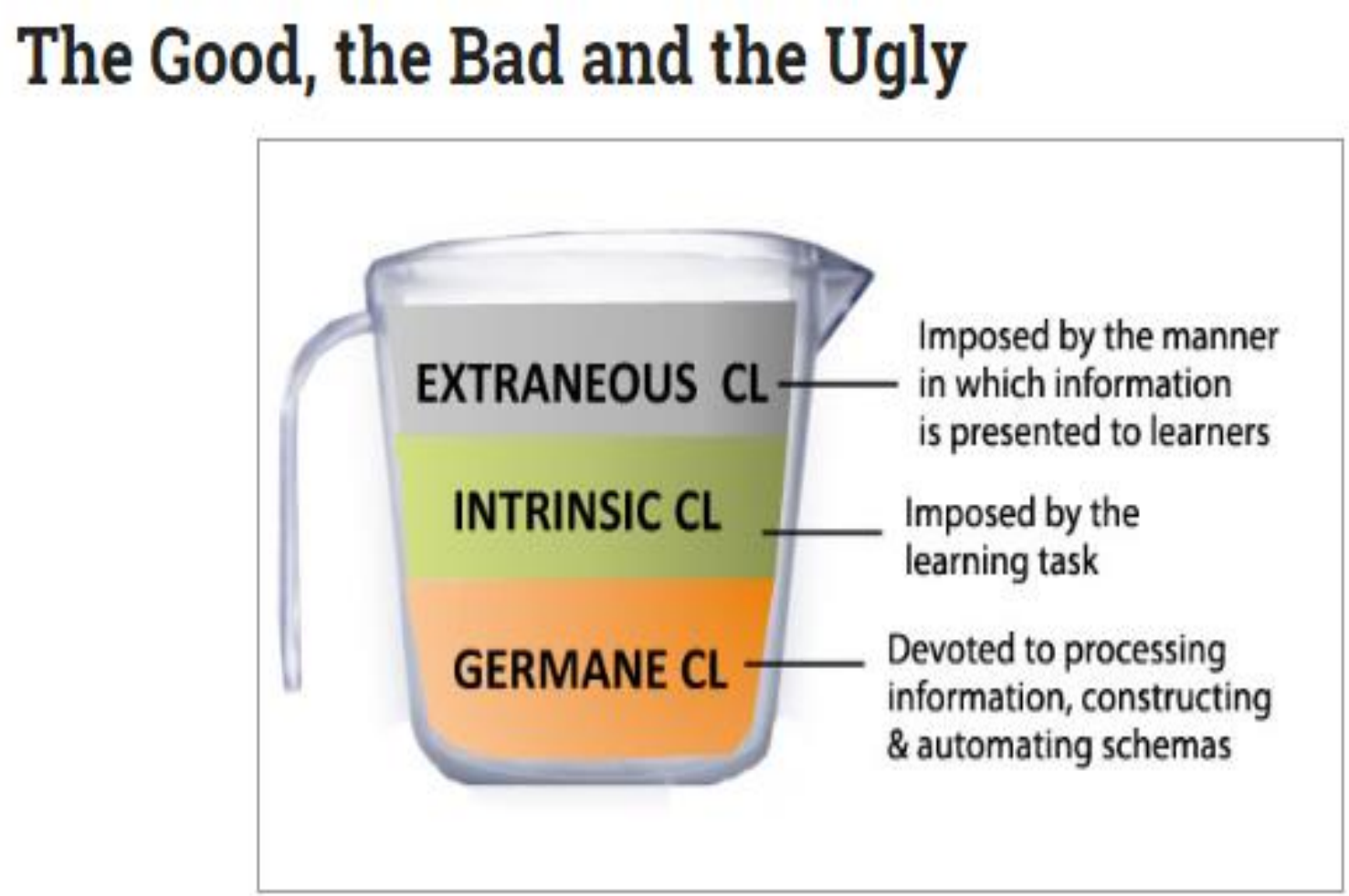
Basic components

- Working memory:A cognitive system with a limited capacity that is responsible for temporarily holding information available for processing.
- Long-term memory: Place where informative knowledge is held indefinitely
- Cognitive load: the effort being used in the working memory to process the information

Types of cognitive load

- Intrinsic Cognitive Load (non-altered): those elements that must be processed simultaneously.
- Extraneous Cognitive Load (non-desirable): those elements that require additional mental processing but do not add to the learning experience.
- Germane Cognitive Load (desirable): those elements that help the learner transfer information from short-term memory into long-term memory and vice versa.

Types of cognitive load



Recommendations

- Change problem solving methods to avoid means-ends approaches that impose a heavy working memory load, by using goal-free problems or worked examples.
- Eliminate the working memory load associated with having to mentally integrate several sources of information by physically integrating those sources of information.

Recommendations

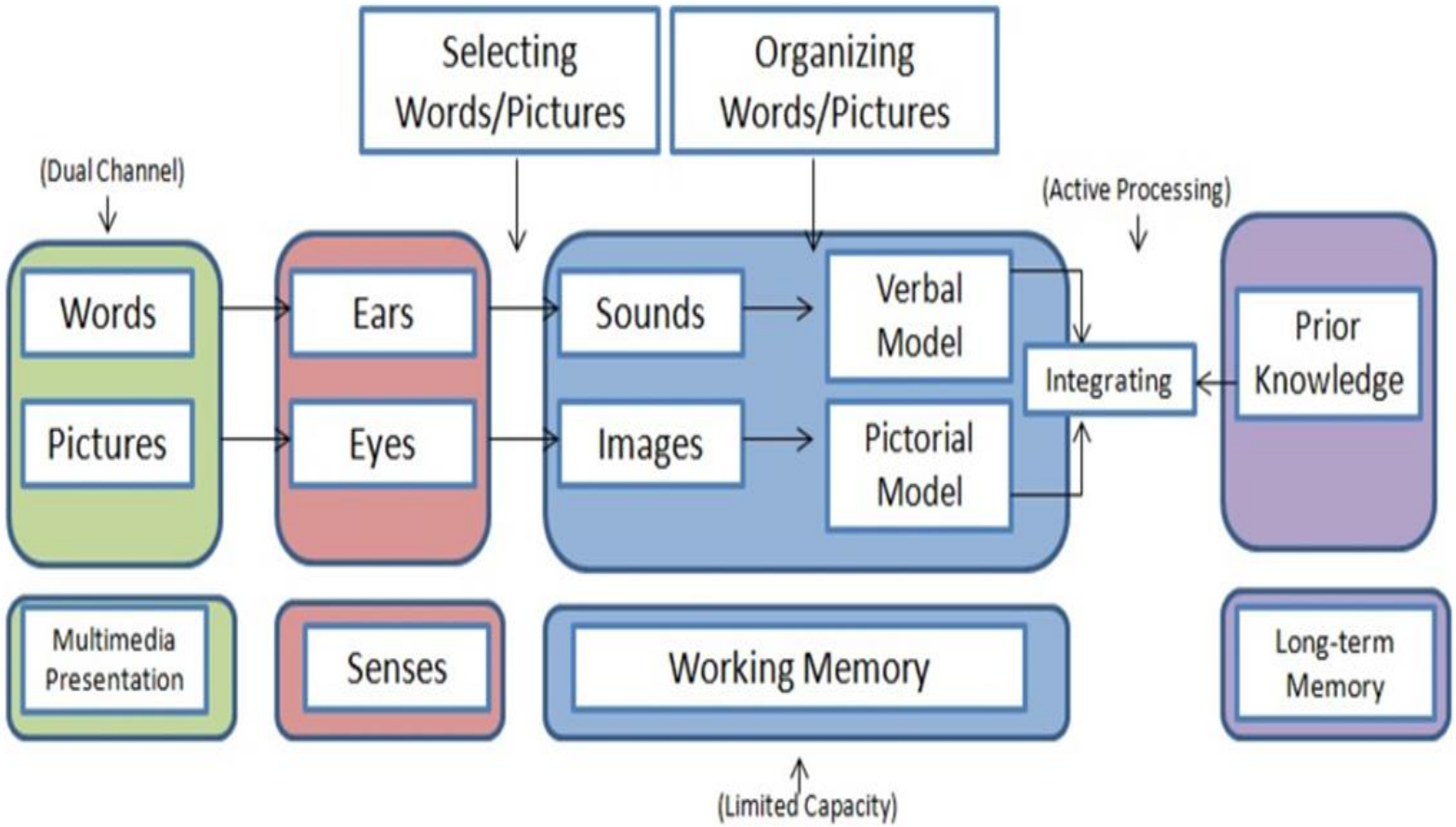
- Eliminate the working memory load associated with unnecessarily processing repetitive information by reducing redundancy.
- Increase working memory capacity by using auditory as well as visual information under conditions where both sources of information are essential (i.e. non-redundant) to understanding.

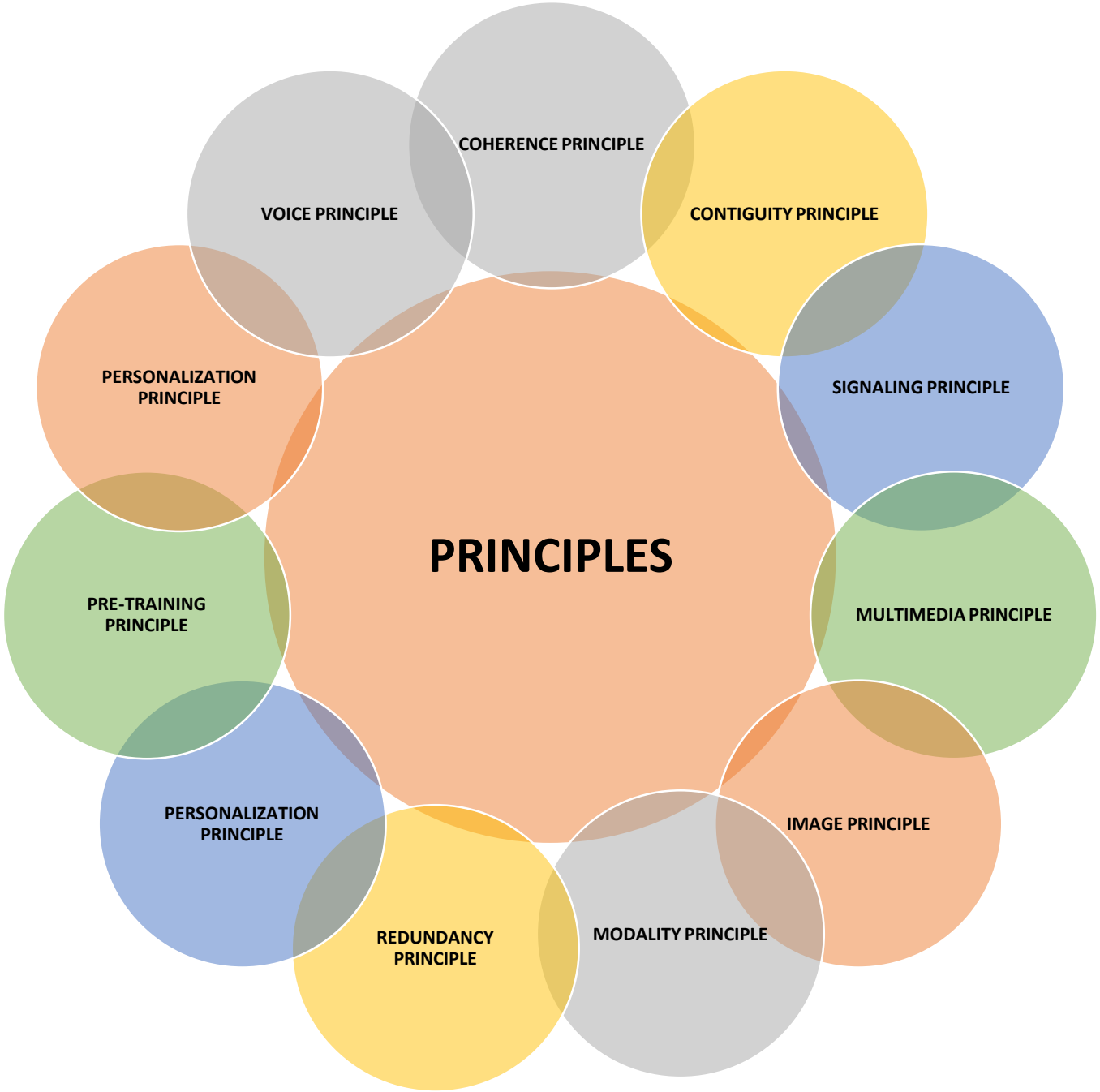
Cognitive Theory of Multimedia Learning (CTML)

Richard Mayer

Assumption	Description	Related work
Dual channels	Humans process separate channels for processing visual and auditory information	Paivio (1986)
Limited capacity	Humans are limited in the amount of information that can be processed in each channel at one time	Chandler & Sweller (1991)
Active processing	Humans engage in active learning by attending to relevant incoming information, organizing selected information into coherent mental representations , and integrating mental representations with other knowledge	Mayer (2001)

Cognitive Theory of Multimedia Learning Model

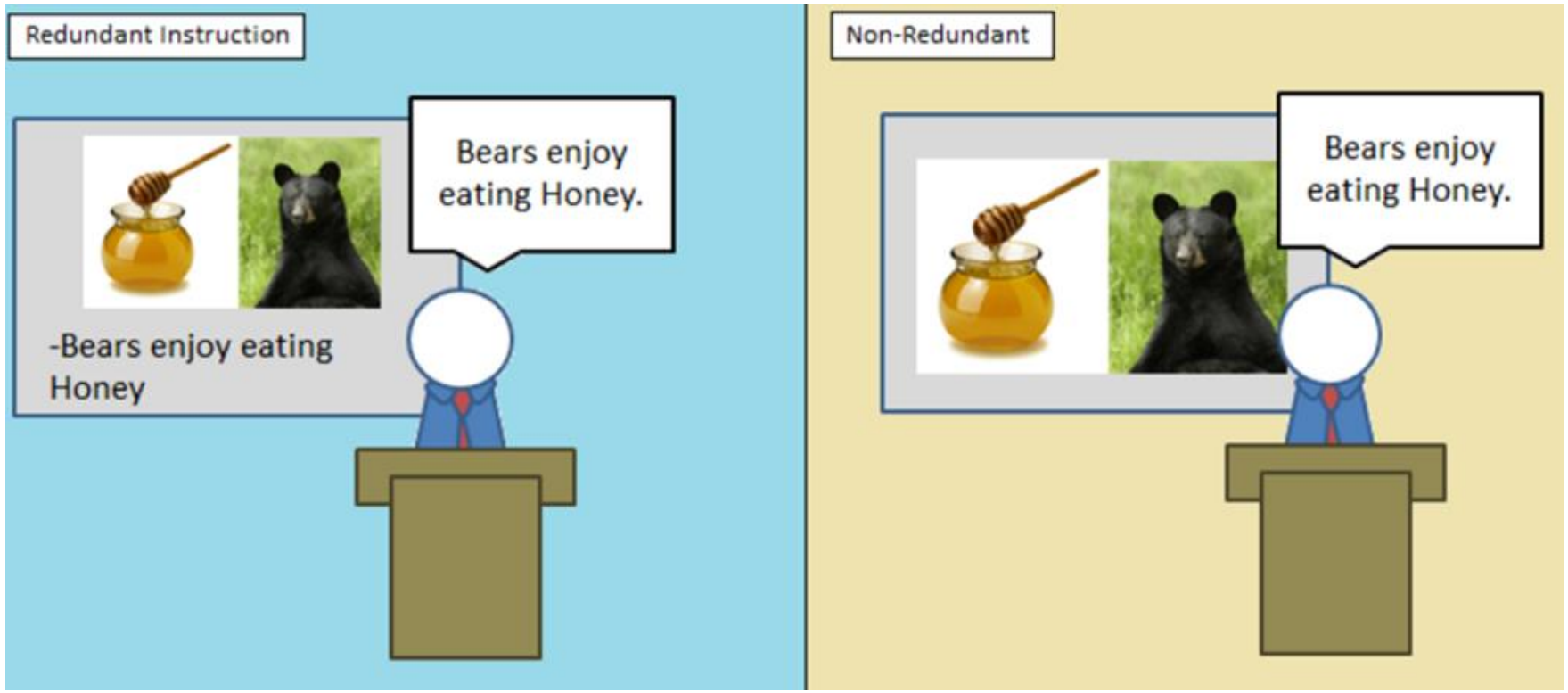



PRINCIPLES
COHERENCE PRINCIPLE
CONTIGUITY PRINCIPLE
SIGNALING PRINCIPLE
MULTIMEDIA PRINCIPLE
IMAGE PRINCIPLE
MODALITY PRINCIPLE
REDUNDANCY PRINCIPLE
PERSONALIZATION PRINCIPLE
PRE-TRAINING PRINCIPLE
PERSONALIZATION PRINCIPLE
VOICE PRINCIPLE

Redundancy Principle

Animation + Narration

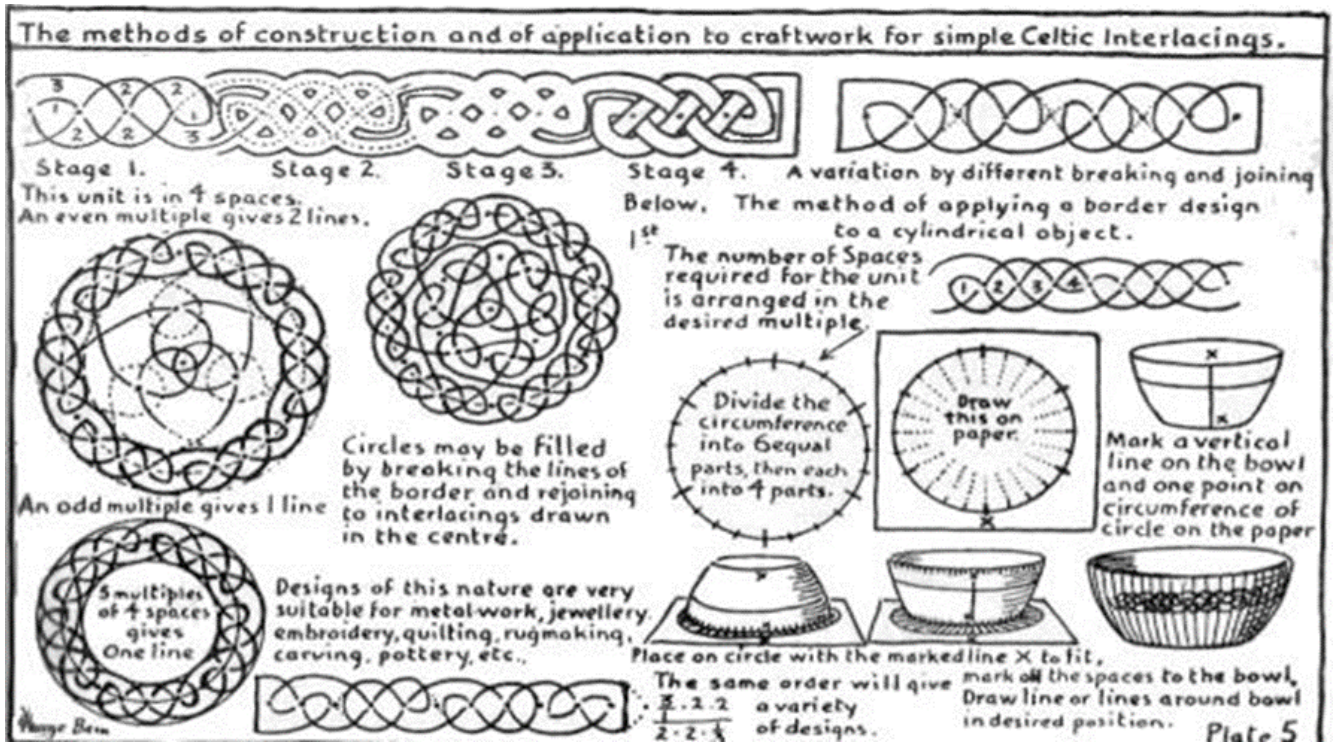
Animation + Narration + On-Screen Text (Redundant)



Coherence Principle

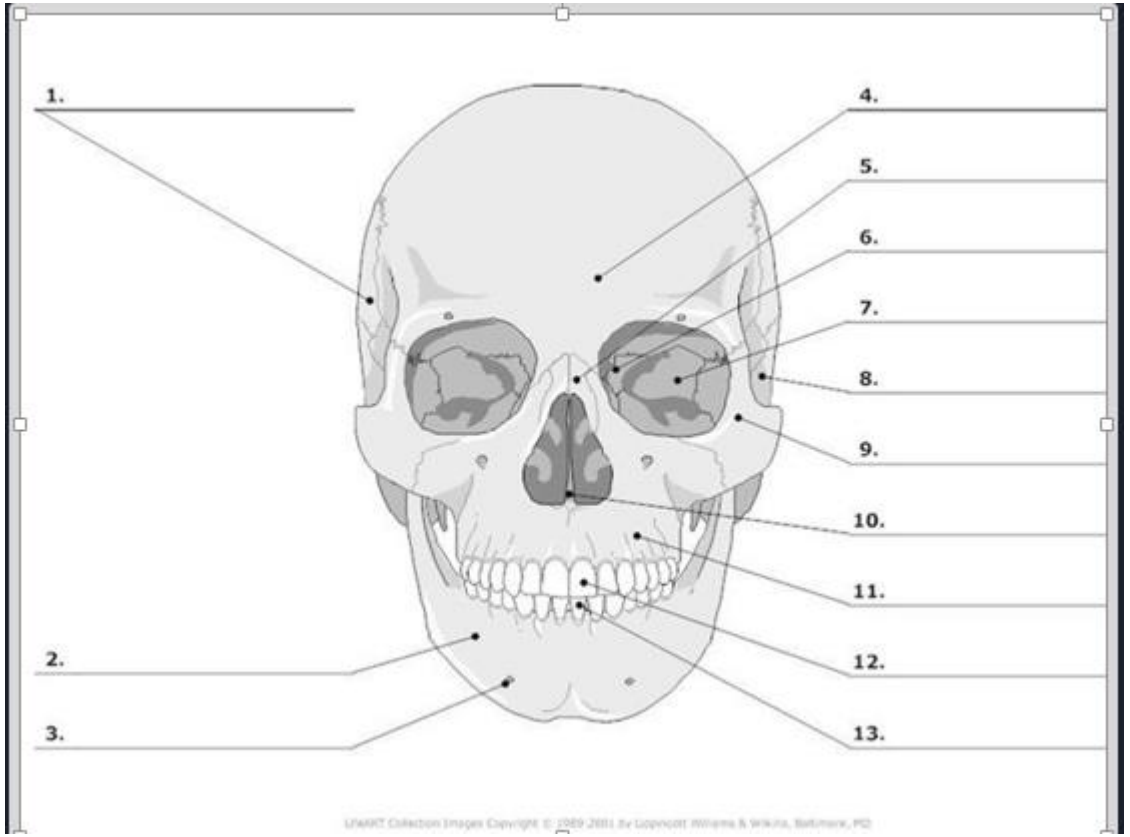
Avoid unnecessary graphics, words and sounds from the lesson.

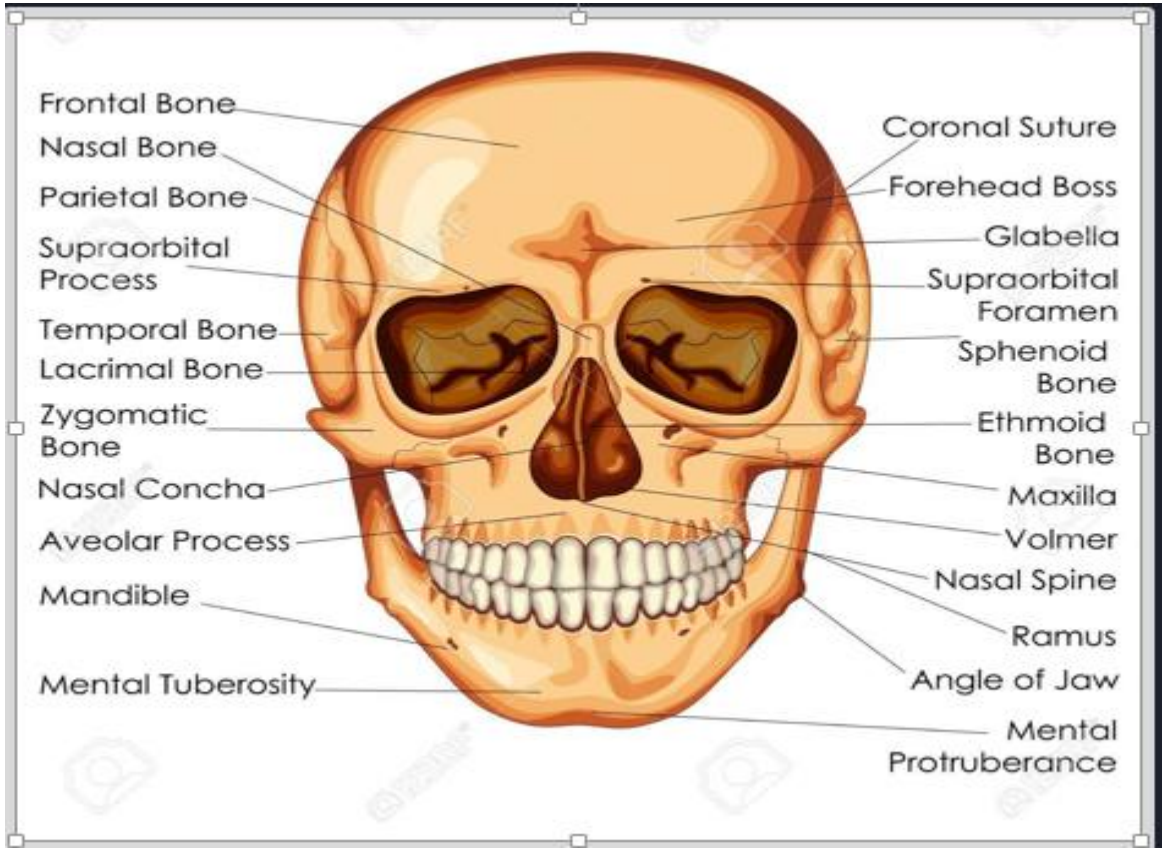
Less is More !!!



Multimedia Principle

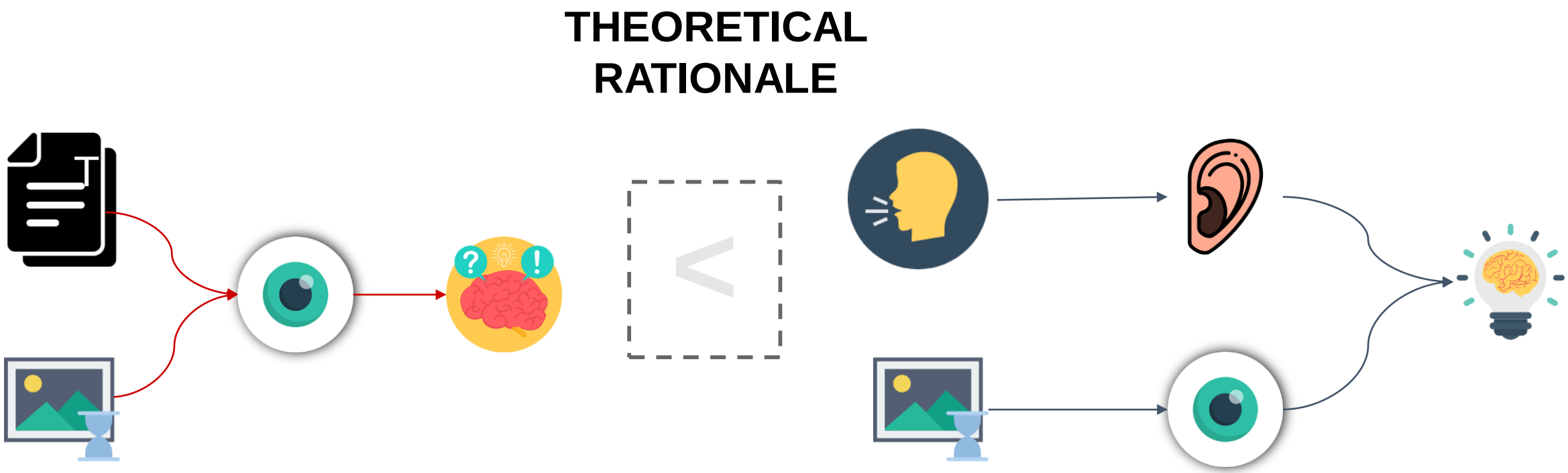
Pictures + Words





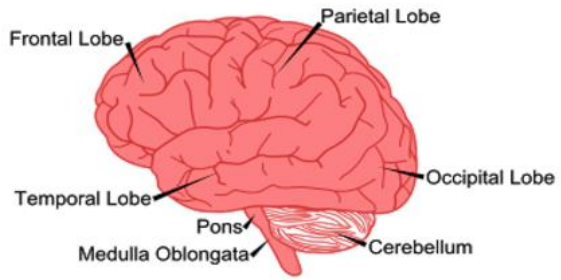
Modality Principle

Students learn more deeply from animation & narration than from animation & on-screen text.

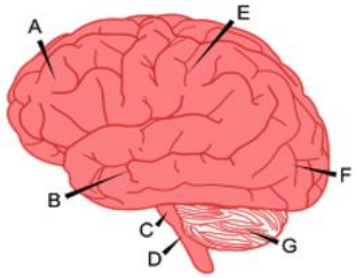


Contiguity Principle

Examples of the Contiguity Principle



In the above example, the contiguity principle is followed because the labels for the parts of the brain are placed physically near the parts of the brain to which they correspond.



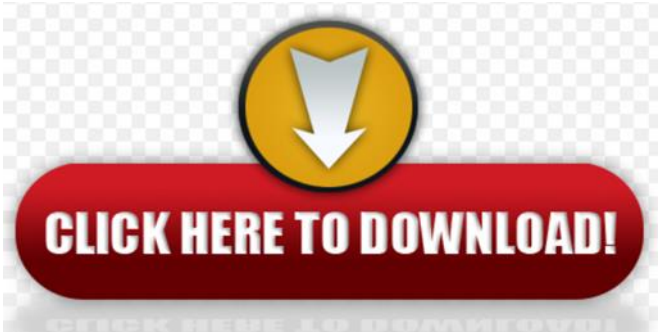
A - Frontal Lobe
B - Temporal Lobe
C - Pons
D - Medulla Oblongata

E - Parietal Lobe
F - Occipital Lobe
G - Cerebellum

In the above example, the contiguity principle is **violated** because the labels indicating the parts of the brain are physically separated from the image of the brain.

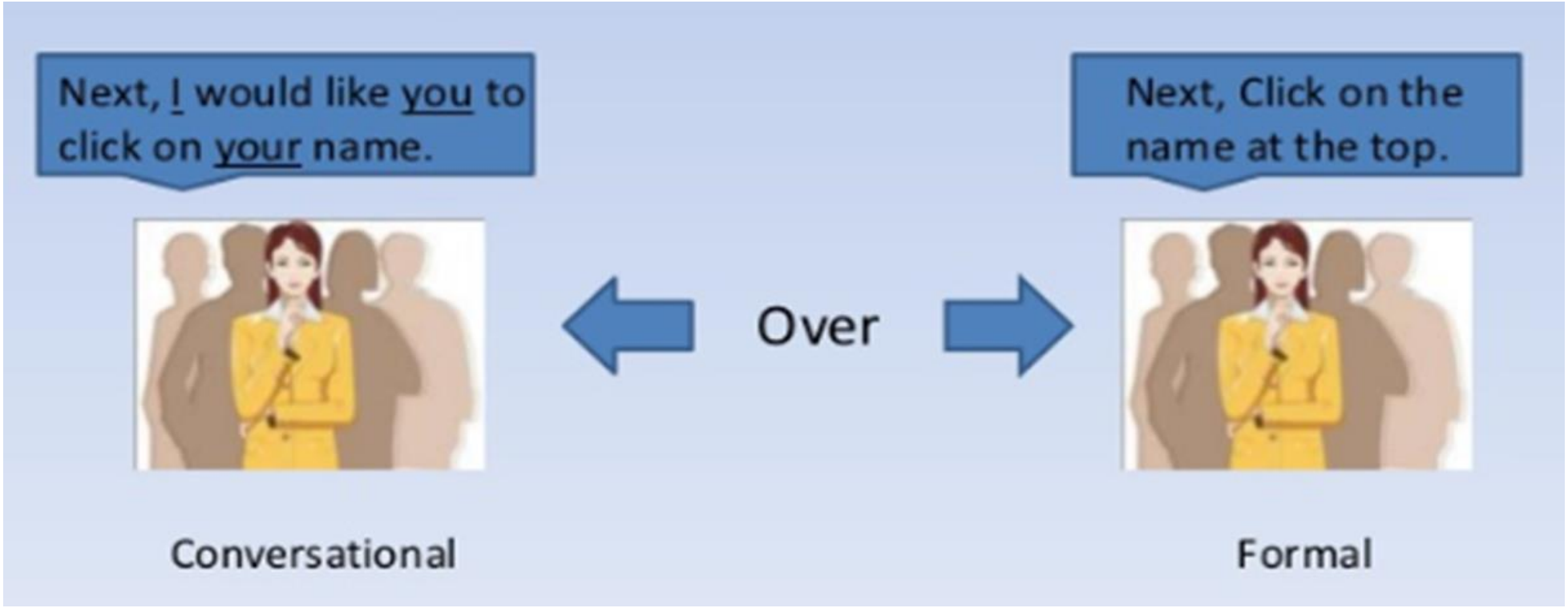
Signaling Principle

People learn more deeply from a multimedia message when cues are added that highlight the critical aspects of the presented information.



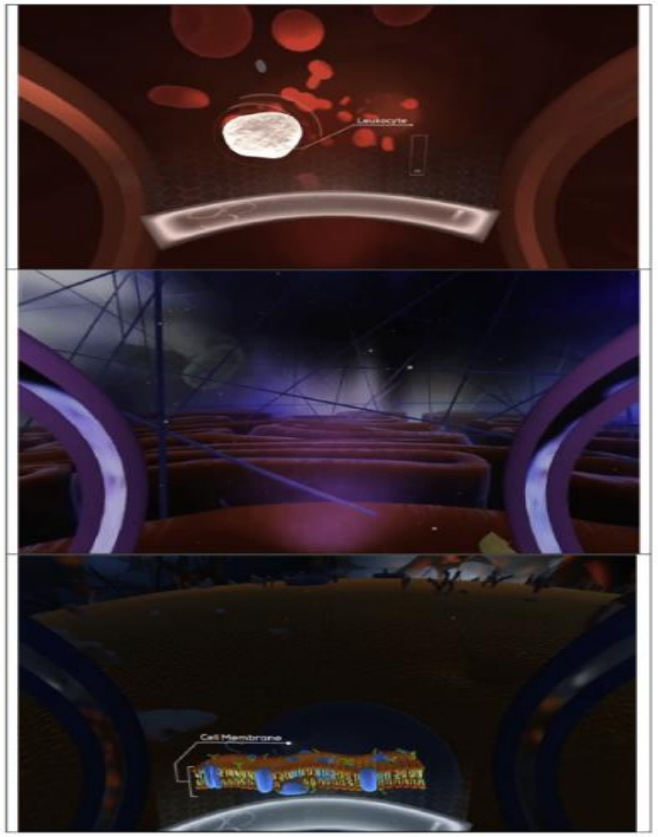
Personalization Principle

Students learn more deeply from animation and narration when the narration is in conversational rather than formal style

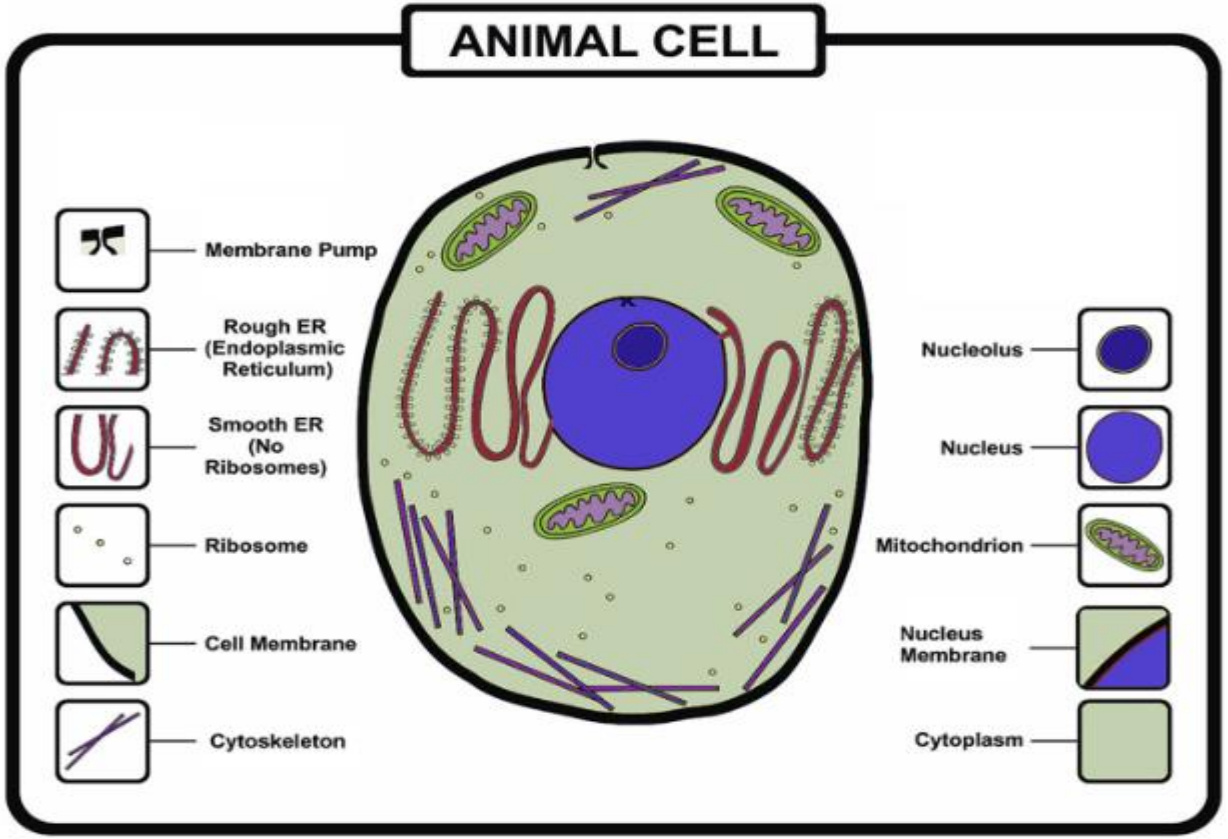


Pre-training Principle

Students learn more deeply from a multimedia when they know the names and characteristics of the main concepts



Body VR: Journey Inside a Cell

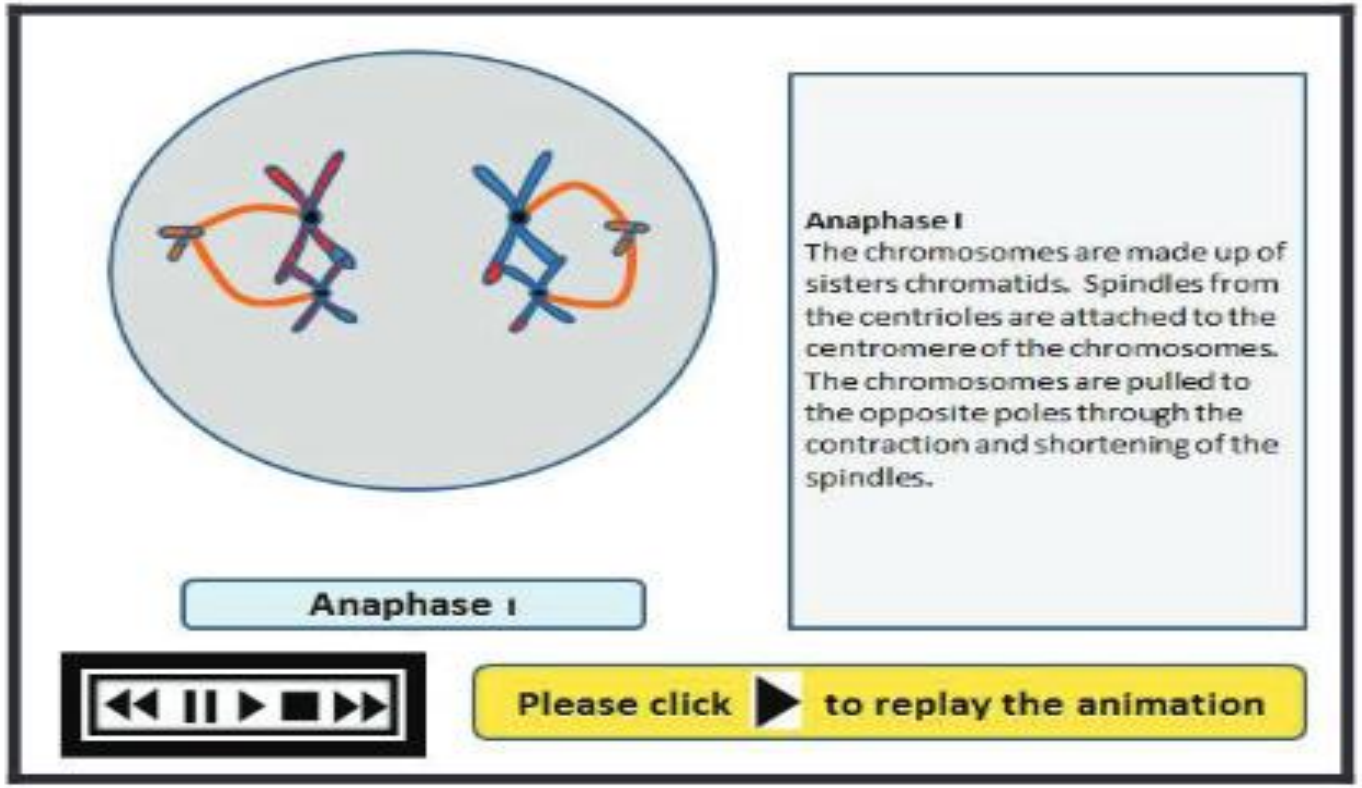


The pre-training material

Meyer, O. A., Omdahl, M. K., & Makransky, G. (2019). Investigating the effect of pre-training when learning through immersive virtual reality and video: A media and methods experiment. *Computers & Education, 140*, 103603. doi: https://doi.org/10.1016/j.compedu.2019.103603

Segmenting Principle

Students learn better when multimedia message is presented in user-paced segments than a continuous unit



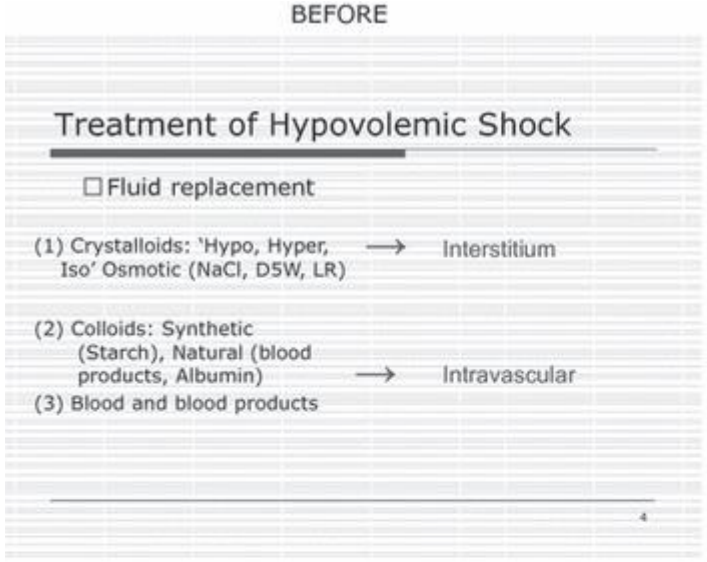
Fong, S. F., Lily, L. P. L., & Por, F. P. (2012). Reducing Cognitive Overload Among Students of Different Anxiety Levels Using Segmented Animation. *Procedia - Social and Behavioral Sciences, 47*, 1448-1456. doi: https://doi.org/10.1016/j.sbspro.2012.06.841

Voice Principle

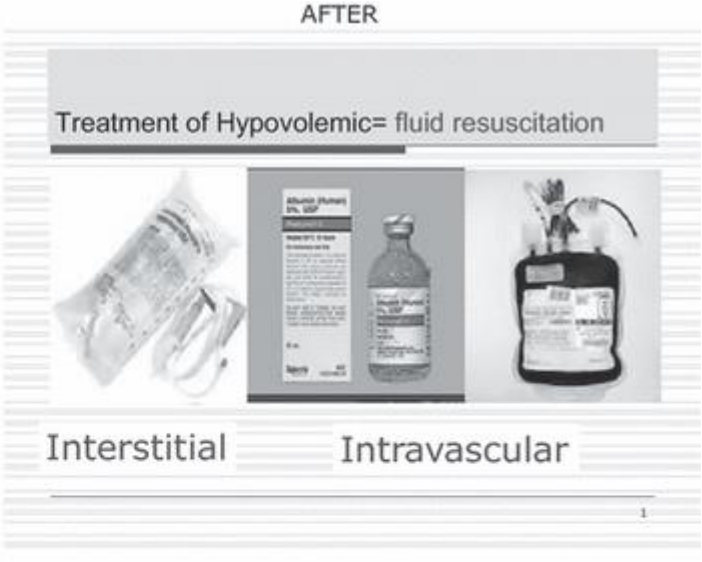
People learn better when narration is spoken in a human voice rather than a machine voice

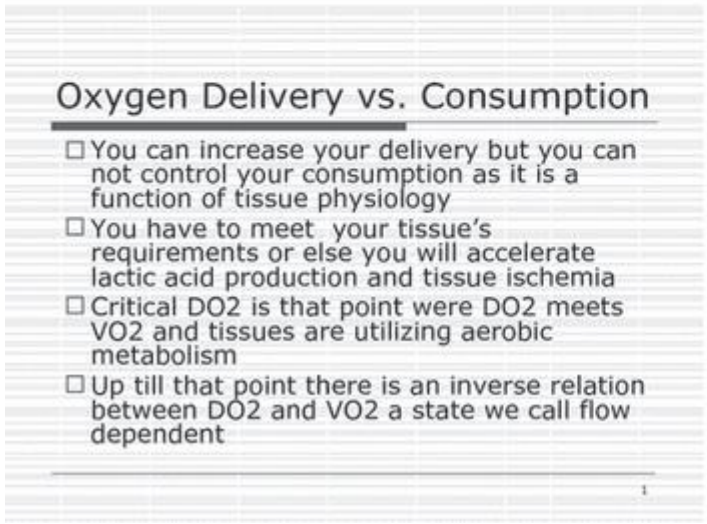
Example

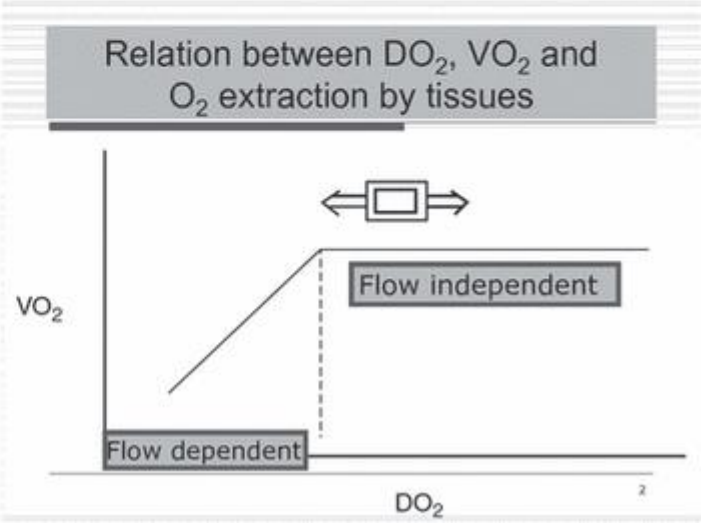
BEFORE



AFTER







Principle	Corresponding Change
Multimedia Principle	Bulleted text replaced by pictures
Coherence Principle	All pictures and text directly not related to context deleted
Spatial Contiguity	Graphs and related text appeared contiguously on the screen
Signalling Principle	Important points highlighted by larger font and different colour scheme
Temporal Contiguity	Graphs and related/explanatory text presented in same slide
Modality Principle	Slides representing complex phenomena converted to pictures or graphs and explained through narration

Issa, N. , Mayer, R. E., Schuller, M. , Wang, E. , Shapiro, M. B. and DaRosa, D. A. (2013), Teaching for understanding in medical classrooms using multimedia design principles. *Medical Education*, 47: 388-396. doi:10.1111/medu.12127

“You are not designing for yourself”