

A Beginner's Guide to Creating Short Videos for Geoscience Courses

Earth Educators' Rendezvous 2019

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Workshop Goals

1. Identify some basic steps to create a short instructional video
2. Apply those steps to create an outline for a mini-video that includes a script and associated images

Participant Goals?

Why make videos for geoscience courses?

Flipped Class Format

Students view brief videos as preclass assignments then . . .



Videos begin with learning objectives, often contain formative assessments, and end with a reflection activity

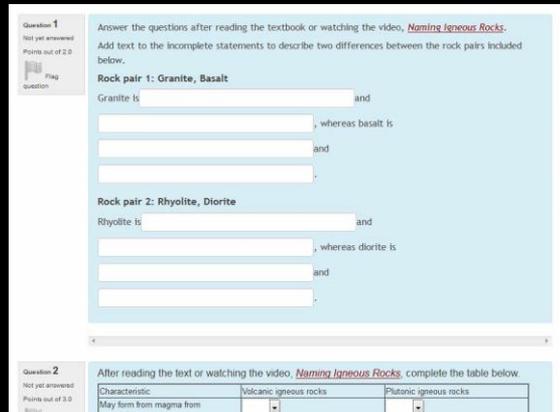
Flipped Class Format

Students view brief videos as preclass assignments then . . .



Videos begin with learning objectives, often contain formative assessments, and end with a reflection activity

. . . complete an online quiz



Average completion time ~30 minutes

Flipped Class Format

Early in next class

- Answer video review questions

I can classify common igneous rocks on the basis of texture and composition.



Name (classify) these igneous rocks on the basis of their texture and composition

What do geologists mean when they use the term "texture" in descriptions of igneous rocks?

A. The elements present in the composition of rocks found in the field.
 B. The size, shape, and arrangement of the mineral grains.
 C. The distribution of cooling rates among the mineral grains in the rock.

99% Correct

What is the most likely cooling rate and composition of a small grained, light-colored igneous rock?

A. Cooled rapidly, low silica
 B. Cooled rapidly, high silica
 C. Cooled slowly, low silica
 D. Cooled slowly, high silica

71%

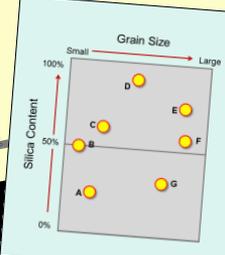
Which table best illustrates the classification scheme for igneous rocks?

	Silica content			
	Felsic	Intermediate	Mafic	Ultramafic
A	Granite	Andesite	Diorite	Gabbro
B	Granite	Andesite	Basalt	Gabbro
C	Granite	Andesite	Basalt	Gabbro
D	Granite	Andesite	Basalt	Gabbro

85%

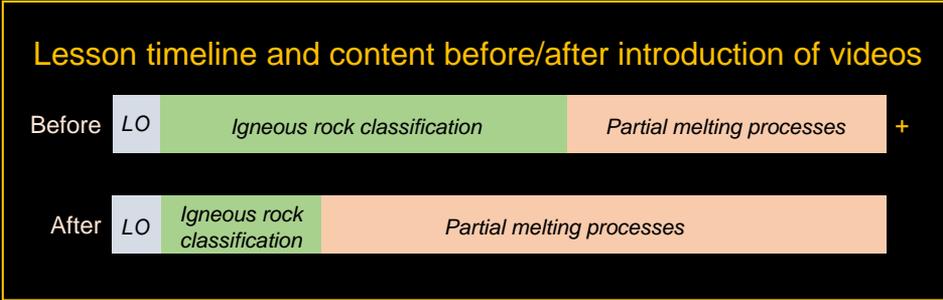
Match the names of the igneous rocks listed below with the lettered symbols on the diagram.

Granite
 Basalt
 Gabbro
 Andesite



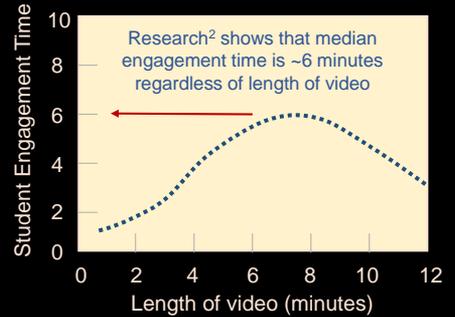
Flipped Class Format

- Some instruction presented online before class
- Frees 10-20 minutes of class for more challenging concepts and active learning exercises



LO = learning objectives

Flipped Introductory Class



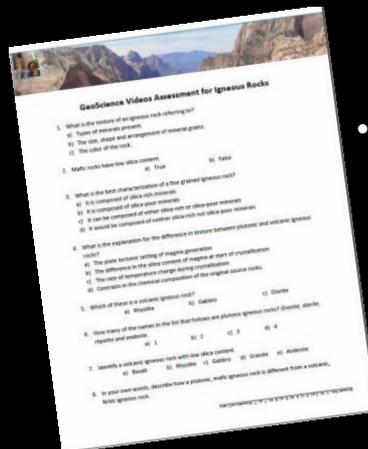
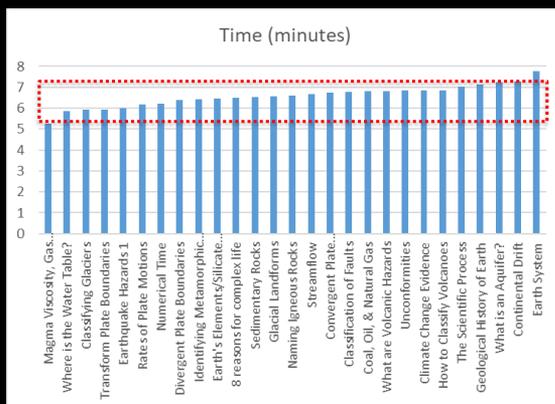
Topics reflect basic content for an introductory geoscience course

Brief videos to support flipped class model
<https://www.youtube.com/c/Geosciencevideos/>

²Guo et al., 2014, Proceedings ACM Conference, p. 41-50.

Video Characteristics

- Brief (~6-7 minutes)

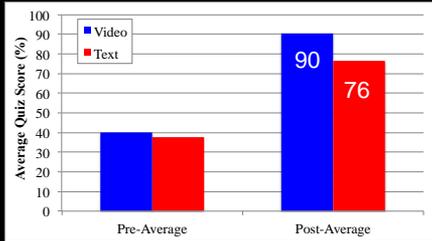


- Associated quizzes and other resources on blog

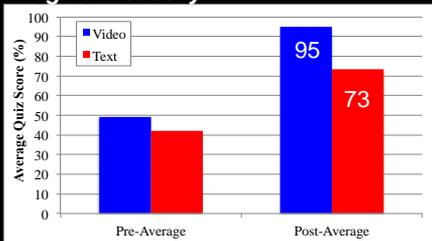
<https://geosciencevideos.wordpress.com/>

Student Performance: Text vs. Video

Classification of Faults



Magma Viscosity

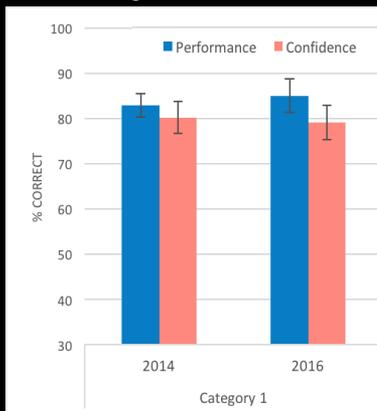


Learning with Video vs. Text

- 15 students read text, 15 students watched short (~6 minute) video
- Pre-treatment quiz scores → no significant difference
- Post-treatment quiz scores significantly higher ($p < 0.05$) for students who watched videos
- **Dual channel processing (visual + auditory) → greater learning**

Student Performance: Video vs. Lecture

content presented during lecture content presented by video only



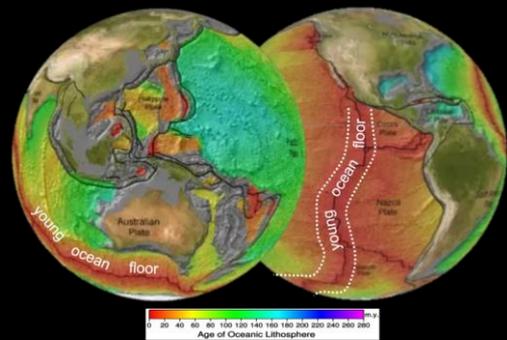
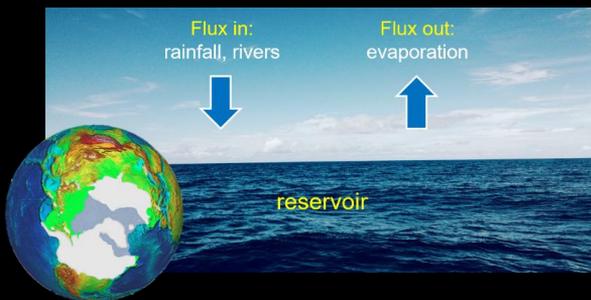
Learning with Video vs. Lecture

- Control (2014, n=94): basic content presented in class by lecture, activities
- Treatment (2016, n=91): basic content presented in pre-class videos w/online questions
- No significant difference in performance on the same related exam questions

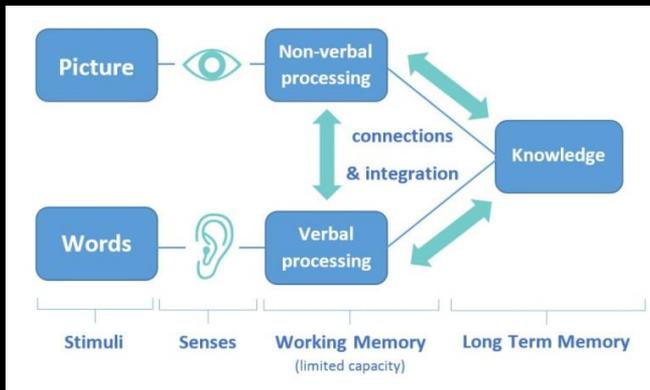
Watch the two short videos that follow

Compare and contrast how similar information is presented

Multimedia principle – People learn better from words (narration, text) and pictures (photos, maps, diagrams, animations, video) than from words alone



Cognitive theory of multimedia learning



Dual-channels principle:

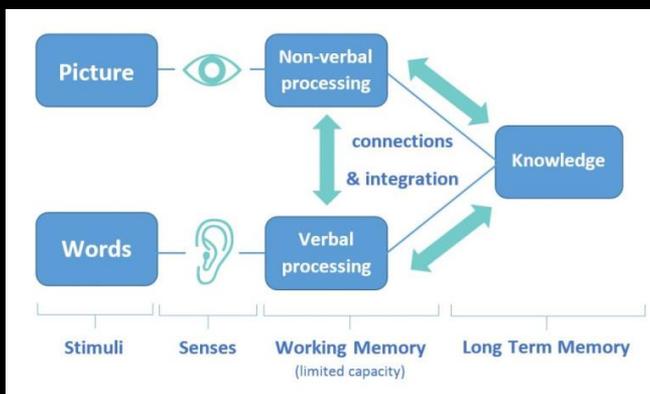
There are separate information processing channels for visual and verbal information

- Diagrams
 - Animations
 - Video demonstration
- } visual
- Narration
 - Text on slides
- } verbal

<https://3starlearningexperiences.wordpress.com/tag/dual-coding-theory/>

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Cognitive theory of multimedia learning



Limited-capacity principle:

Only a few items in each channel can be processed in working memory at a time

<https://3starlearningexperiences.wordpress.com/tag/dual-coding-theory/>

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Limited-capacity principle:

Only a few items in each channel can be processed in working memory at a time

I can define the porosity and permeability and explain how they change in earth materials

Holes in Earth Materials

Permeability

- Capacity of water to flow through earth materials
 - Water flows quickly and easily = High permeability
 - Water flows slowly or not at all = Low permeability

Water flows faster through materials with larger openings

How long would it take water to travel 1 meter through ...

- Gravel or fractured rock have high permeability
- Silt, clay have low permeability

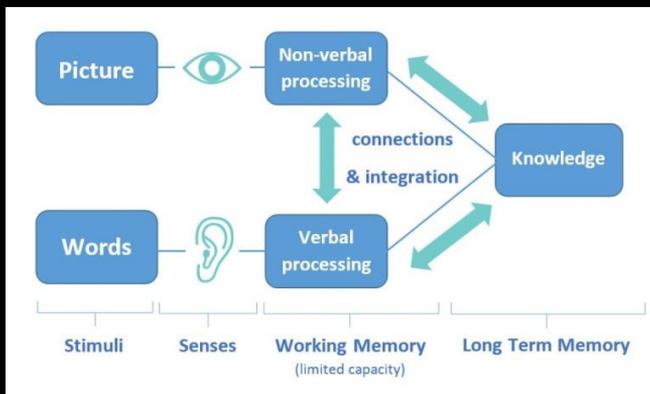
LO: I can define the terms porosity and permeability

Holes in Earth Materials

Permeability is the capacity of water to flow through earth materials

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Cognitive theory of multimedia learning



Active-processing principle: Learners need to engage in appropriate processing tasks including selecting, organizing and integrating information

Cognitive theory of multimedia learning – People learn better from words and pictures than from words alone

- **Dual-channels principle:** Separate channels for visual, verbal information
- **Limited-capacity principle:** A few items can be processed at a time
- **Active-processing principle:** Students organize and integrate information

Challenge: How to design lessons to encourage active-processing without overloading visual and verbal channels

- Caveat – experimental results, multimedia not necessarily the same as video

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Design Goals for Multimedia Learning Materials

1. **Reduce extraneous processing:** Minimize distractions, emphasize key information
2. **Manage essential processing:** Create suitable representations of necessary information
3. **Foster generative processing:** Design elements of lesson to motivate students to learn effectively

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Coherence Principle

Students learn better when extraneous details are excluded

Most significant when:

- Extra material is very interesting
- Lesson is cognitively demanding

Research-based Strategies for Reducing Extraneous Processing

Example:

Ocean waves lesson

- Group A: Reviewed more concise materials (653 words, 6 illustrations).
- Group B: Reviewed expanded materials (980 words, 11 illustrations) including related mathematical formulas and computations.

Essay Assessment Results:

Group A > Group B ($t(41) = 4.29, p < .01$)

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Signaling Principle

Include cues to help learner focus on essential content

- Bold, colored, highlighted text
- Arrows, labels
- Most significant for students with low prior knowledge

LO: I can explain how ocean basins form and grow.

How to Make an Ocean Basin

1. Start: Break a Continent
 - Proto-divergent boundary
 - East African Rift Valley
2. Birth of an Ocean
 - Early stage divergent boundary
 - Red Sea
3. Mature ocean
 - Late stage divergent boundary
 - Atlantic Ocean

Atmosphere

Scottpa Institution of Oceanography
NOAA Earth System Research Laboratory

400
380
360
340
320
PARTS PER MILLION

1960 1970 1980 1990 2000 2010

YEAR

coal burning forest fires decomposition

Air = 78% N + 21% O + **0.04% CO₂** + other trace gases

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Redundancy Principle

Graphics and narration better than graphics, narration and on-screen text

- Applies when text is redundant with narration; OK for few words
- Most significant effect for students with low prior knowledge
- Narration and text OK w/out graphics

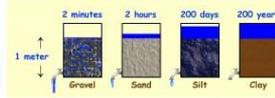
I can define the porosity and permeability and explain how they change in earth materials

Holes in Earth Materials

Permeability

- Capacity of water to flow through earth materials
- Water flows quickly and easily = High permeability
- Water flows slowly or not at all = Low permeability

Water flows faster through materials with larger openings
How long would it take water to travel 1 meter through ...



- Gravel or fractured rock have high permeability
- Silt, clay have low permeability

LO: I can discuss the variability of porosity and permeability in different earth materials

Permeability Demonstration



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Spatial Contiguity Principle

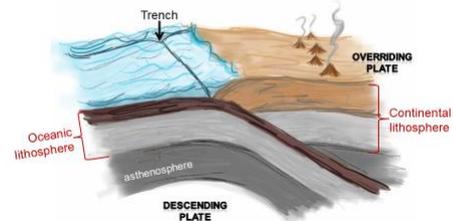
Place text near corresponding parts of images

- Text is not presented in standard "caption" format below figure



LO: I can describe the physical features and processes at a convergent plate boundary.

Convergent Boundary Features



Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

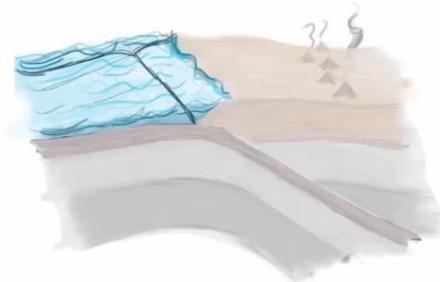
Temporal Contiguity Principle

Present graphics and text and/or narration simultaneously

- Successive presentation of text and images essentially doubles cognitive load
- May not apply with small amounts of information or easier material

LO: I can describe the physical features and processes at a convergent plate boundary.

Convergent Boundary Features



Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Strategies for Reducing Extraneous Processing

Signaling Principle

Include cues to help learner focus on essential content

Coherence Principle

Students learn better when extraneous details are excluded

Spatial Contiguity Principle

Place text near corresponding parts of images

Redundancy Principle

Graphics and narration better than graphics, narration and on-screen text

Temporal Contiguity Principle

Present graphics and text and/or narration simultaneously

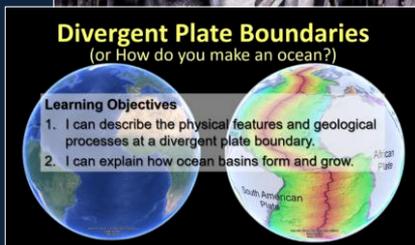


Effect Size

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Suggestions for Creating Videos

Identify Learning Objectives



Which principle(s) is/are best represented by identifying learning objectives?

Temporal Contiguity

Present graphics and text and/or narration simultaneously

Redundancy

Graphics and narration better than graphics, narration and on-screen text

Spatial Contiguity

Place text near corresponding parts of images

Coherence

Students learn better when extraneous details are excluded

Signaling

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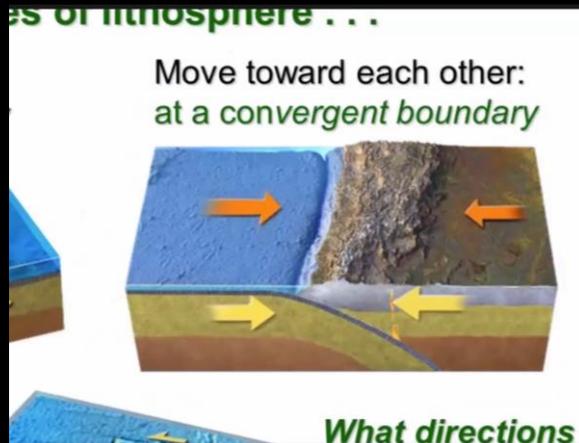
Design Goals for Multimedia Learning Materials

1. **Reduce extraneous processing:** Minimize distractions, emphasize key information
2. **Manage essential processing:** Create suitable representations of necessary information
3. **Foster generative processing:** Design elements of lesson to motivate students to learn effectively

Strategies for Managing Essential Processing

Segmenting Principle

Divide lesson into smaller, user-paced segments



Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Strategies for Managing Essential Processing

Modality Principle

Graphics and narrations are better than graphics and on-screen text

- More significant for non-segmented lessons, with dynamic (not static) graphics and learners w/low levels of prior knowledge

LO: I can describe the physical features and geological processes at a divergent plate boundary.

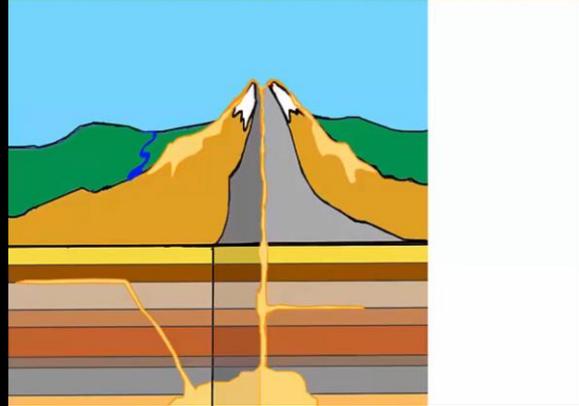
Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Strategies for Managing Essential Processing

Pre-training Principle

Introduce key terms before using them in a lesson

LO: I can explain how we can use texture to place an igneous rock into one of two major groups.



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Strategies for Managing Essential Processing

Pre-training Principle

Introduce key terms before using them in a lesson

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Effect Size

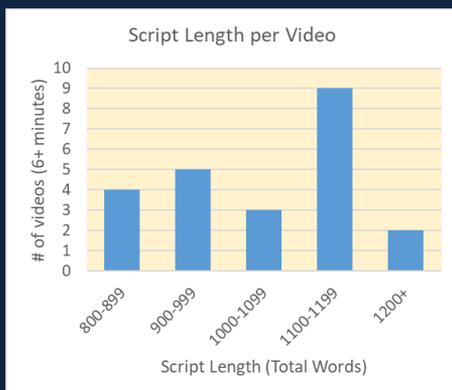
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How many words would you speak in a minute?

Suggestions for Creating Videos

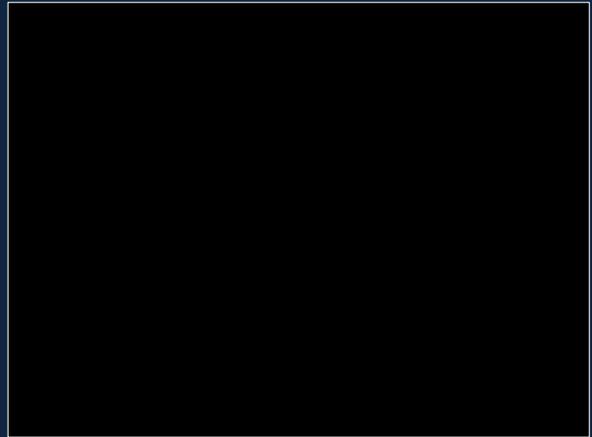
Write a Script

- Script length ~800-1200 words



Write a Script

- Narration rate average
 - ~150 words/minute



Write a Script

- Script length ~800-1200 words
 - Range = 90-200 words/minute

More likely to pause narration to include assessment exercises

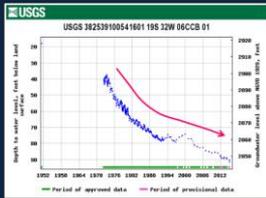


240

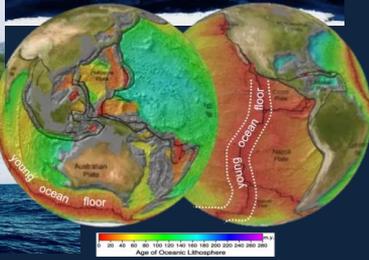
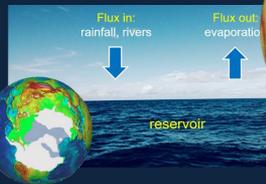
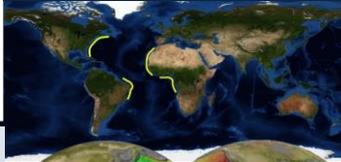
11

Suggestions for Creating Videos

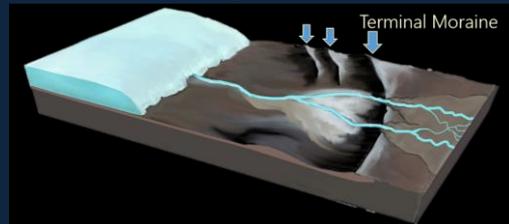
Break script into scenes/slides



Public domain (e.g., NOAA, NPS, USGS, USDA)



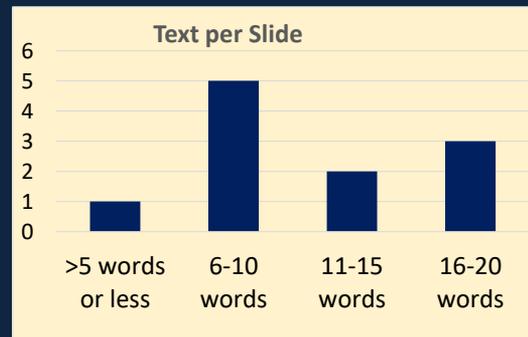
Created images and videos



Suggestions for Creating Videos

Use one or more slides/scenes per point

- Recent videos: average slide rate ~4 slides/minute
- ~10 text words per slide
- ~40 spoken words per slide



Sync Visuals and Narration

Suggestions for Creating Videos

Which principles are best represented in writing a script and adding appropriate visualizations, text and narration?

Temporal Contiguity

Present graphics and text and/or narration simultaneously

Redundancy

Graphics and narration better than graphics, narration and on-screen text

Modality

Graphics and narrations are better than graphics and on-screen text

Spatial Contiguity

Place text near corresponding parts of images

Coherence

Students learn better when extraneous details are excluded

Signaling

Include cues to help learner focus on essential content

Pre-training

Introduce key terms before using them in a lesson

Segmenting

Divide lesson into smaller, user-paced segments

Design Goals for Multimedia Learning Materials

1. **Reduce extraneous processing:** Minimize distractions, emphasize key information
2. **Manage essential processing:** Create suitable representations of necessary information
3. **Foster generative processing:** Design elements of lesson to motivate students to learn effectively
 - Social agency – sense of partnership between student and instructor

Strategies for Encouraging Effective Processing

**Embodiment
Principle**
On-screen
instructor uses
actions, movement

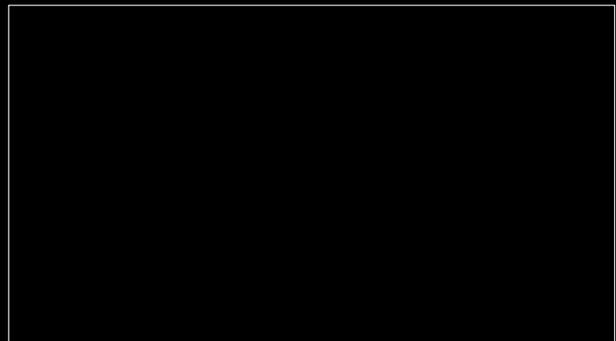
- Explain diagram on white board vs. Draw and label diagram on white board

Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

Strategies for Encouraging Effective Processing

**Embodiment
Principle**
On-screen
instructor uses
actions, movement

- May not apply for learners with high level of prior knowledge



Mayer, R.E., 2017, Journal of Computer Assisted Learning, v.33, p.403-423

People in video: Yes or No?

Limited personal appearances

- Careful to build connection without distraction
- Demonstrate methods, models



Strategies for Encouraging Effective Processing

Embodiment Principle
On-screen instructor uses actions, movement

Voice Principle
Better learning from human vs. machine-like voice

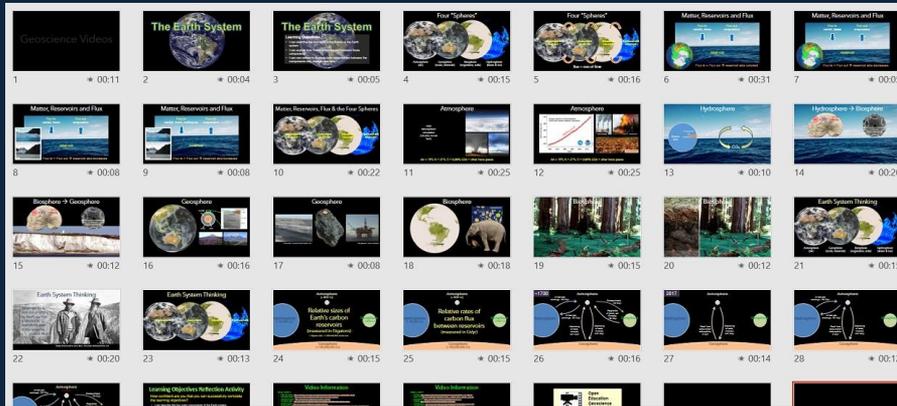
Personalization Principle
Present words in conversational, not formal, style



Suggestions for Creating Videos: Tech

Build video using familiar tools

- Create “base” slides in PowerPoint



- Insert blank placeholders for future images or video clips to be added in editing

Suggestions for Creating Videos: Tech

Recording visuals

Recording audio



Smartphone

DJI Osmo 2
smartphone gimbal



Blue Yeti
USB Mic



Lavalier
Mic



SONY
CX580



Canon EOS
Rebel T7i



Shotgun
Mic

Suggestions for Creating Videos: Tech

Creating and editing your video

- Finding your comfort level

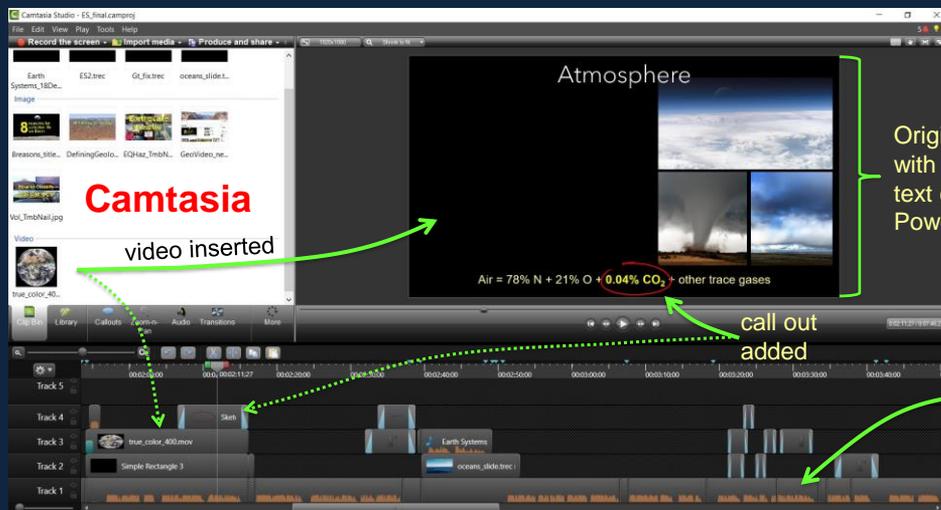


Camtasia

Basic/Free

Relatively Complex/
Pricey

Creating and editing your video



Camtasia

video inserted

call out added

Original slide with images & text created in PowerPoint

audio track recorded w/USB mic while running PowerPoint

Suggestions for Creating Videos for Courses

1. Identify learning objectives
2. Write a script
3. Break script into scenes/slides
4. Use one or more slides/scenes per point
5. Limited personal appearances
6. Build video using familiar tools
7. Select an appropriate video editing program

A Beginner's Guide to Creating Short Videos for Geoscience Courses

David McConnell

Based on work with

Jennifer Wigger

Jason Jones

<http://www.youtube.com/c/GeoscienceVideos>

<https://geosciencevideos.wordpress.com/> *Associated quizzes and other resources on blog*

