

PowerPoint Is Not Evil: Redesigning Slides for Better Student Learning

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Example 1

Student Learning Goal:

We have directly witnessed evolution in living animals

Abstract

PowerPoint and similar presentation software are often automatically criticized as ineffective teaching and learning methods. While this criticism may be accurate when traditional bullet lists and large tracts of text are used, some simple redesign principles can help students construct learning. Lecture slides were redesigned in General Biology, BIO 105 using some simple SOTL principles such as reducing cognitive load, reorganizing material to signal meaning, spatial contiguity of images and text, and using both visual and verbal registers. Examples of the original and redesigned slides will be presented with explanations of the teaching and learning principles that were considered in the redesign.

Original Slides

Pod Mrcaru lizards

- Adriatic sea, two small islets – Pod Kopiste, Pod Mrcaru
- Five pairs of lizard (*Podarcis sicula*) introduced in 1971 on Pod Mrcaru from Pod Kopiste
- In 2008 researchers returned to the islands to see what happened
- Pod Mrcaru lizard's had evolved larger heads

Why would this happen?

- Diet of the lizards had changed on Pod Mrcaru to include more vegetation and fewer insects
- Plant tissue is tougher to chew, larger head means larger bite force
- Evolution had happened in this species within 18-19 generations – Less than 40 years

Summer Diet of Lizards on the two Adriatic islands

New Slides

Pod Mrcaru lizards

1971 - moved 5 pairs of lizards from Pod Kopiste to Pod Mrcaru

Herrel et al. 2008 - What happened on Pod Mrcaru?

- Pod Mrcaru lizard's had evolved larger heads
- Longer
- Wider
- Thicker
- More force

Why big heads?

Have to eat more plants & less bugs

Pod Mrcaru Lizards Evolved a Cecal Valve in GI Tract – Used in Herbivores

Fast evolution

- Novel feature evolved
- Evolution in only 18-19 generations – < 40 years

✓ Use Visual Registers More

Original slide one had large amount of text. Images and graphics were used to convey information instead.

✓ Decrease Writing to Decrease Cognitive Load

Did so with slide 1 and slide 2 of original. Slide 2 in original converted to slide 3 and 4 in new version.

✓ Coherence

Removed title from original slide 3. Students don't need to know it's the summer diet.

✓ Signaling

Added slide 6 in new version, which emphasizes the learning goal at the end rather than at beginning

Added slide 5, which is a more significant (and new to students) case of evolution from the paper to help drive the learning goal home more firmly

Disadvantages in New Version

Extraneous text added to slides 4 and 5 with the reference and journal title.

Rationale for leaving: I downloaded the slides from PNAS; so, I felt compelled to include their required citation. In addition, I want students to start learning the importance of referencing literature.

My initial goals for improving PowerPoint

1. Use visual registers as much as possible

- Brain has separate visual and verbal input registers
- Each only hold about 7 items

2. Decrease writing per slide to decrease cognitive overload

New goals after attending Bill Cerbin's workshop Science of Learning for Teachers and reading Mayer RE, 2014.

Coherence – Eliminate extraneous material

Signaling – Reorganize material so the presentation signals meaning

Spatial Contiguity – Place text next to corresponding graphics

Example 2: Excerpted from 20 slides on chemistry so there is not good continuity of the story

Student Learning Goal:

- Electrons are found in shells in atoms.
- Atoms with shells that are not full try to fill those shells.
- Determining bond polarity

Original Slides

Electrons

- Electrons are found in orbitals around the nucleus of the atom. Maximum of 2 electrons per orbital.
- Orbitals are grouped into electron shells
- The first shell contains a maximum of 2 electrons. Any additional shells can contain a maximum of 8 electrons.
- Once one shell is full, additional electrons move to the next shell

Electrons

Electrons

- Electrons found in the outermost shell are called valence electrons
- Valence electrons prefer to be in full shells
- If an electron is not in a full shell, there are two options:
 - Share electrons - covalent bonds
 - Gain or lose an electron - ions

How can I tell if a bond will be polar?

Description	Examples
Nonpolar	<ul style="list-style-type: none"> Linear molecules: CO₂ Molecules with an angle: CH₄ Diatomic: O₂ Molecules with an octahedral: SF₆ Molecules with an octahedral: CH₄
Polar	<ul style="list-style-type: none"> Diatomic: H₂O Diatomic: HCl Diatomic: HF Diatomic: NH₃ Diatomic: CH₃Cl Diatomic: CH₃Br Diatomic: CH₃I Diatomic: CH₃F Diatomic: CH₃OH Diatomic: CH₃SH Diatomic: CH₃NH₂ Diatomic: CH₃NO₂ Diatomic: CH₃COOH Diatomic: CH₃CHO Diatomic: CH₃COCl Diatomic: CH₃COBr Diatomic: CH₃COI Diatomic: CH₃COF Diatomic: CH₃COCl Diatomic: CH₃COBr Diatomic: CH₃COI Diatomic: CH₃COF

Skip 3 slides

New Slides

Electron (e⁻) Shells

- Electrons live in orbitals.
- Max of 2 e⁻ per orbital.
- Orbitals layered into electron shells
- Shell 1 = 2 e⁻s
- Shell 2 = 8 e⁻s
- Shell 3 = 8 e⁻s
- Shells fill closest to farthest

Atoms want full e⁻ shells

Atoms try to fill shells

- 2 ways to fill a shell:
 - Form covalent bonds: Share electrons
 - Form ions: Gain or lose electron

Covalent bond

Loosing

Gaining

How can I tell if a bond will be polar?

Nonpolar	Polar
<ul style="list-style-type: none"> Some atoms share equally (2:0) C & H play well together (2:1) 	<ul style="list-style-type: none"> O and N are greedy C-O H-O H-N C-N C-F

• Oxygen is the greediest

Skip 5 slides

Acknowledgements:

Cerbin W. 2014. Science of Learning for Teachers Workshop

Mayer RE. 2014. Research-based principles for designing multimedia instruction. In V.A. Benassi, C.E. Overson, & C.M. Hakala (Eds.). *Applying science of learning in education: Infusing psychological science into the curriculum*. Soc. Teaching Psych.

✓ Use Visual Registers More Slide 3 into slide 3

✓ Decrease Writing to Decrease Cognitive Load Slides 1, 3, & 4 into slides 1, 3, & 4

✓ Coherence Slide 2 eliminated mass number. Slide 3 eliminated valence electrons. Slide 4 eliminated complicated chemistry.

✓ Signaling Slide 3 and 4 converted to tables that allow students to organize information better.