

Designing for Geospatial Information Technologies

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Geographic Information Systems

- Map, visualize, and analyze geo-referenced data
 - Industry, businesses, education
- Contribute to science learning
 - Rich contextual learning
 - Critical thinking skills
 - Problem-solving skills
 - Authentic inquiry-based learning

(Baker & Case, 2000; Bednarz, 2000; Kerski, 2008)

Real-world Design

- Design task
 - Design science instruction supported by a GIS.
 - 8-week instruction
- First-time GIS users
 - Takes time for teacher to learn and teach students.
 - Students get easily frustrated.
- Accepted process model
 - Use Understanding by Design to design instruction

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Real-world Design (still more)

- Learners
 - Diverse ethnic backgrounds
 - 19% ESL students
 - 41% lower scores on reading PA state standardized test
 - 78% lower scores on science PA state standardized test
- Content
 - Generated by subject matter experts (SMEs)
 - Developed materials approved by design team

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Real-world Design: Implications

- Science Ed experts knew the content **really** well.
- Environmentally conscious folks.
- Drafts versions of the materials had a few faults...
 - Not very easy to read, particularly given learner group
 - Layout could be stronger...
 - Too much text on one page (so can print on both sides)
 - Small illustration with no arrows or labels
 - Too much highlighting and too many kinds of highlighting
 - Only design model was UbD.

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Selected Instructional Design Theories

- Behaviorism
 - Direct instruction
 - Emphasize extensive practice and correct responses
- Constructivism
 - Modify and refine what they know
 - Collaborate on tasks
- Inquiry teaching
 - Hands-on activities
 - Use evidence like scientists
 - Tenet of science education reform

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Design Process Models: ADDIEs

Analyze-Design-Develop-Implement-Evaluate

- Dick, Carey & Carey (2005)
- Understanding by Design (Wiggins & McTighe, 2005)
- ARCS Motivational Model (Keller, 1983)

- Guiding principle of ID:
 - Steal only from the best!


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Design Models I Used (see last pages of handout)

1. Behaviorism
 - Gagnés (1974) Nine Significant Events Model
2. Constructivism
 - Jonassen's (1999) Constructivist Learning Environments Model
 - Black & McClintock's (1996) Interpretation Construction (ICON) Model
3. Inquiry teaching
 - Bybee's 5E Model (1989) / Eisenkraft's 7E Model (2003)
 - National Research Council's Inquiry Model (2000)

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Derived Instructional Model



1. Confirm learners have necessary background.
2. Present instruction using appropriate model.
 - Content presentation sub-model
 - Computer-supported activities sub-model
 - Laboratory activities sub-model
3. Confirm instruction is meeting goals and objectives.
4. Confirm learners have acquired desired knowledge, skills, and attitudes.
 - Meta-principles also!

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Derived Instructional Model

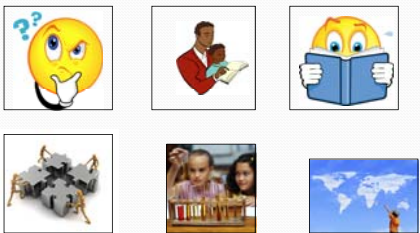


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 - **Meta-principles also!**

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META-PRINCIPLE 1

Use multiple ways of learning to address learner differences.




(Gardner, 1999)

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META-PRINCIPLE 2


Use procedural facilitators to guide learners' responses.



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META-PRINCIPLE 3

Use icons consistently to enhance and reinforce student learning and use illustrations to reduce learner dependence on text.

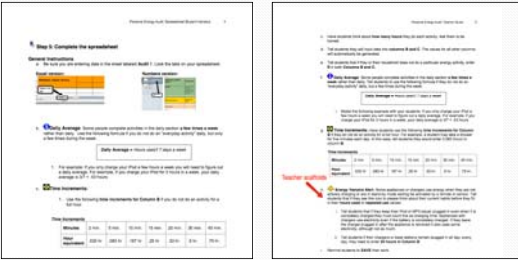


The screenshot shows two panels from the ELI interface. The left panel is titled 'Energy - Student Resources' and lists various resources with small icons. The right panel shows a detailed view of a resource with red arrows pointing to specific elements: 'Left alignment' points to the text, 'Proximity of tags, colors, text, and background' points to the layout, and 'Consistent use of icons' points to a small icon.

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META-PRINCIPLE 4

Facilitate the process of modifying instructional materials to meet the needs of different learners.

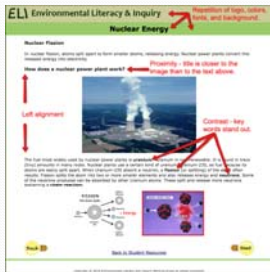


The screenshot shows two panels from the ELI interface. The left panel shows a table of resources with columns for 'Resource', 'Date', 'Author', 'Title', 'URL', 'Description', and 'Keywords'. The right panel shows a detailed view of a resource with red arrows pointing to specific elements: 'Consistent use of icons' points to a small icon, and 'Proximity of tags, colors, text, and background' points to the layout.

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META-PRINCIPLE 5

Use contrast, repetition, alignment, and proximity (CRAP) design.




The screenshot shows a detailed view of a resource titled 'Nuclear Energy' with red arrows pointing to specific elements: 'Left alignment' points to the text, 'Proximity of tags, colors, text, and background' points to the layout, and 'Consistent use of icons' points to a small icon. Below the text is a diagram of a nuclear reactor core.

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INSTRUCTIONAL MODEL: STEP 2.1 Sub-model for content presentation

ELI Environmental Literacy & Inquiry
Biodiversity



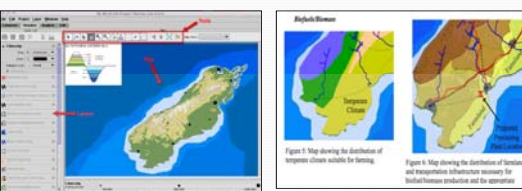
Exploring Workbooks

Answer the following questions as you read about Biodiversity/Workbooks

1. Define Biodiversity.
2. List 3 examples of habitats.
3. How is biodiversity related to extinction?
4. How does energy flow from the sun and up to a plant?
5. Why are habitats considered a renewable energy resource?
6. Why is energy at the higher level not an energy source?

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INSTRUCTIONAL MODEL: STEP 2.2 Sub-model for computer-supported activities




Biodiversity

Figure 5: Map showing the distribution of temperate climate suitable for farming.

Figure 6: Map showing the distribution of landmass and temperature in the tropics necessary for high human production and for agriculture.

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INSTRUCTIONAL MODEL: STEP 2.3 Sub-model for laboratory activities



Step 1: Conducting the Experiment

1. Mark test tubes 1-4 on the white start space with blue pencils.
2. Place test tubes in test tube rack in order given.
3. Measure and place exactly with same pencils of 3 cm and 6 cm from the bottom of the test tubes.
4. Put pluggers on.
- 5a. After the test tubes look evenly heated into the water. Empty any water into the basin.
- 5b. Wash, rinse, and dry test tubes.

Predicting

1. Which solution do you think will release the sugars from the cellulose paper? Why?

Data Collection

Complete the following table:

NOTE: A color change indicates the presence of a reducing sugar!

Step 4: Analysis and Conclusions

1. Which solutions showed a change in color?
2. What did the color change indicate?

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Contact

For information go to:

http://www.lehigh.edu/~vak4/KuloCatesandBodzin_GITDesign.pdf

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