DESIGNING AND MANAGING FOR REUSE

The NSDL Reusable Learning Project
(nsdl@reusablelearning.org)

Presented on 26 July, 2006 to the MERLOT International Conference

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ABOUT THIS PRESENTATION

TITLE: Designing and Managing for Reuse
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LOCATION: www.resuablelearning.org/workshops
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COPYRIGHT: The NSDL Reusable Learning project (nsdl@reusablelearning.org)
DESCRIPTION: Presents and illustrates guidelines and techniques for recognizing, evaluating and improving the reusability of digital learning resources. Discusses features that digital libraries and portals can incorporate to support reuse.
LEVEL: College, Graduate, Adult
AUDIENCE: Authors and designers of digital educational resources; Designers and curators of educational digital libraries.
About the Reusable Learning Project

- Goal: *Increase the value and impact of the NSDL by increasing the reusability of its content*
- Deliverables
  - Workshops ✓
  - Web site ([www.reusablelearning.org](http://www.reusablelearning.org)) ✓
  - Reusability Guidelines ✓ ([www.reusablelearning.org/guidelines](http://www.reusablelearning.org/guidelines))
  - Suggested policies for collections ✓
  - Impact through implementation ✓
  - Examples and best practices ✓
  - Learning content and opportunities ✓
1. Perspectives on Reusability
2. Reusability guidelines
3. Metadata Guidelines
4. Rights Guidelines
5. Reusable Design
   • Context and Pedagogy
   • Structure and Presentation
6. Interoperability
7. Resources
8. Discussion
PERSPECTIVES ON REUSE

Who are Reusers?
What are their requirements?
Definition of REUSE

USING OR MODIFYING A RESOURCE FOR USE IN A NEW CONTEXT OR SETTING

Some reusers **adopt** resources, i.e. use them “as is”. Others **adapt** resources, i.e. alter them for new uses.
Reusers

• Authors
  – Repurpose and integrate content into their own work
• Instructors
  – Reuse content for teaching
  – Assemble content from multiple sources
• Students
  – Access content for learning
• Collections (Digital Libraries)
  – Support reuse
  – Support reusers
Can I Find It?

Metadata

- Is it useful?
- Will it work?
- May I use it?
May I Use It?

Can I find it?

Is it useful?

Will it work?

Rights
Will it Work?

Can I find it?

Is it useful?

May I use it?

Interoperability
Is it Useful?

Can I find it?

Context & Pedagogy

Reusable Design

Structure & Presentation

May I use it?

Will it work?
REUSABLE DESIGN GUIDELINES

TITLE
DESCRIPTION
EXPLANATION
PRIORITIVITY
TECHNIQUES
Guidelines

• For authors (developers, etc.)

*Maximize reusability* by
- Informing authoring & design processes
- Defining requirements for tools

• For collections, digital libraries and librarians

*Support reuse* by
- Informing policies and practices
- Suggesting requirements for interfaces
- Providing information for contributors
Structure of Guidelines

• Patterned after Web Accessibility guidelines (www.w3.org/TR/WCAG10/)

• Guidelines:
  – Statement of the Guideline
  – Guideline Explanation

• Techniques: How to apply the guideline

• Priorities:
  – Priority 1: Must be followed to ensure reusability. (P1)
  – Priority 2: Should be followed to increase reusability. (P2)
  – Priority 3: May be followed to enhance reusability. (P3)
Accessing the Guidelines

Full set of guidelines
www.reusablelearning.org/guidelines/ (Guidelines page)
www.reusablelearning.org/guidelines/guidelines.pdf (Latest version)

One page guidelines checklist
www.reusablelearning.org/guidelines/checklist.pdf (TBD)
METADATA

DESCRIPTIVE
CONTEXTUAL
TECHNICAL
RIGHTS
USAGE
Can I Find It?

- Metadata
- Is it useful?
- Will it work?
- May I use it?
Types of Metadata

• **Basic descriptive information** (Bibliographic Metadata)
  – Enables resources to be found.
  – Includes: title, author, description, identifier and keywords

• **Contextual information**
  – Helps find resources that present the right content in the right way
  – Includes grade level and intended audience

• **Technical information**
  – Enables resources to be used (technologically)
  – Includes format, platform requirements and software requirements

• **Rights information**
  – Enables resources to be used (legally)
  – Includes copyright information & terms of use

• **Usage information**
  – Enables resource to be used (practically)
  – Includes documentation and instructor / student / user guides
Provide rich, searchable metadata for resources.

**Explanation:** Helps the resource to be cataloged, found and used.

**GUIDELINES:**

1.1 – Adopt a consistent means for expressing and exchanging metadata (P1) [Use a standard]
1.2 – Provide basic descriptive Information (P1)
1.3 – Provide basic contextual Information (P1)
1.4 – Provide basic technical Information (P2)
1.5 – Provide basic usage Information (P3)

*Context is often missing in full text searches*
EXAMPLE: Content Before ...

Hello!

This site contains some problems for Mr. Murphy's 11th Grade Math Class. None of the problems require using a paper or pencil or a calculator to solve - at least not if you look at them in the right way. The problems are listed on the next few pages. These are followed by some interactive applets that let you explore the problems. Hints and explanations come next and, just for jollies, there is a quiz at the end.

Examples available from www.reusablelearning.org/examples

Quit
WELCOME TO MR. MURPHY'S GARDEN OF MATHEMATICAL DELIGHTS

This site contains mathematics problems meant to delight and challenge students and enthusiasts. None of the problems require using a paper or pencil or a calculator to solve - at least not if you look at them in the right way. Each problem includes a problem statement followed by a solution and explanation.

There is also a quiz that is related to the themes of the problem.

Problems
1. High Jumping on the Moon
2. Tiling a Chessboard
3. The Monty Hall problem
4. Belt around the Earth

Interested in using these problems in your course? See instructions for downloading and modifying this site.

About this site (information about the author, purpose, educational objectives, technical requirements, etc.)

This work is licensed under a Creative Commons License. Metadata
<metadata>
  <schema>ADL SCORM</schema>
  <schemaversion>1.2</schemaversion>
  <lom xmlns="http://www.imsglobal.org/xsd/imsmd_rootv1p2p1">
    <general>
      <title>
        <langstring>Mr. Murphy's Garden of Mathematical Delights</langstring>
      </title>
      <language>EN-USA</language>
      <description>
        <langstring>Course generated to illustrate reusable design principles</langstring>
      </description>
      <structure>
        <source>
          <langstring xml:lang="x-none">LOMv1.0</langstring>
        </source>
        <value>
          <langstring xml:lang="x-none">Hierarchical</langstring>
        </value>
      </structure>
      <aggregationlevel>
        <source>
          <langstring xml:lang="x-none">LOMv1.0</langstring>
        </source>
        <value>
          <langstring xml:lang="x-none">3</langstring>
        </value>
      </aggregationlevel>
    </general>
    <lifecycle>
      <version>
        <langstring>1.0</langstring>
      </version>
    </lifecycle>
  </lom>
</metadata>
The Josephus Problem: Background

In Herstein and Kaplansky's wonderful book *Matters Mathematical* (Chelsea Publishing, 1978), the following legend about the famous first-century historian Flavius Josephus is recounted:

Set the parameters and press **Start** to see the elimination order when you start with \( n \) people and eliminate every \( k \)th one.

- **Background Information**
- **Student Activities**
- **Instructor's Guide**

Copyright Doug Ensley. Available through MathDL.
Collection Examples

- ENCDL - www.encdl.org
- MERLOT - www.merlot.org
- DLESE - www.dlese.org/dds/index.jsp
Drop-down Metadata

Screenshot from April 15, 2005.
May I Use It?

- Can I find it?
- Is it useful?
- Will it work?
- Rights
What Rights are Typically Granted?

- Rights that are granted or denied:
  - Right to view or use
  - Right to copy and distribute
  - Right to modify
  - Right to use commercially
  - Right to create derived works

- Conditions that are imposed:
  - Proper attribution
  - Payment
  - Restrictions on time and place
  - Restrictions on type of use (commercial / non-commercial)
  - Inclusion of the same terms and conditions
Note: Copyright is Tricky

• Most resources are copyrighted when created
• It is important to obtain permissions
• It is important to *grant* permissions
• Links are usually OK, but watch out for
  – “deep linking”
  – “framing”
  – “in-lining”
• Reference
  – Stanford Copyright and Fair Use Site
Note: Fair Use is Tricky

U.S. Copyright Law: S. 108 - Limitations on Exclusive Rights

... the fair use of copyrighted work ... for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research is not an infringement of copyright. In determining whether the use made of a work in any particular case is fair use the factors to be considered shall include –

1. the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes;
2. the nature of the copyrighted work;
3. the amount and substantiality of the portion used in relation to the copyrighted work;
4. the effect of the use upon the potential market for or value of the copyrighted work.

• “Fair Use” is subject to limitations, interpretation and ambiguity
• Clearly specifying terms and conditions eliminates the need for your audience to rely on fair use
Provide a statement of rights and permissions.

Explanation: A resource cannot be reused if doing so would violate the terms and conditions imposed by copyrights, licenses or contracts. A statement of rights and permissions tells potential users what they are allowed to do with a resource.

GUIDELINES:

2.1 – Provide a statement of Copyright (P1)
2.1 - State Terms of Use (P1)
2.3 - Adopt a Workable Licensing Policy (P2)
2.4 - Grant Modification Rights (P2)
Which Rights are Important to Grant?

• Important for reuse:
  – Use, copy, distribute
  – Help the user by providing a license and contact information for obtaining permissions

• Important for authors:
  – Modify & create derived works
  – Help authors by providing source code and granting them the right to use it

• Attribution is important
  – Help the user by providing by providing a citation for attribution
Creative Commons Approach

• Use a small set of standardized licenses
  – Backed by legalese
  – Available in plain English
  – Suitable for a community of practice

• **Licenses grant some rights and reserve others**

• **Licenses do not assign copyright**

• [www.creativecommons.org](http://www.creativecommons.org)
Expressing Rights in Metadata

- <rights>
  - <cost>
    - <source>
      <langstring xml:lang="x-none">LOMv1.0</langstring>
    </source>
  - <value>
    <langstring xml:lang="x-none">no</langstring>
  </value>
</cost>
- <copyrightandotherrestrictions>
  - <source>
    <langstring xml:lang="x-none">LOMv1.0</langstring>
  </source>
  - <value>
    <langstring xml:lang="x-none">yes</langstring>
  </value>
</copyrightandotherrestrictions>
- <description>
  <langstring>http://creativecommons.org/licenses/by-nc/2.0/</langstring>
</description>
</rights>
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Providing Source Code & Modification Rights

OSSLETS

What's an Osslet?

Osslets bring the power of the open source movement from software development to curriculum development. For the casual user, osslets offer free, high-quality, ready-to-use, interactive curriculum materials. For progressively more adventurous users, osslets are open-ended and flexible. The curriculum materials accompanying each osslet are written in generally available formats – for example, Microsoft Word – and users are encouraged to modify them. There are only two rules – you must give credit to the original author and cite the source and you must agree to the open source philosophy – that is, you must provide permission for further use and modification.

Each osslet also includes at least one interactive component. As of now, osslet interactive components are written in Java, Macromedia Director (Shockwave), or Macromedia Flash. The players for all these are free. These interactive components are written for flexibility. You will find that you can modify their behavior without knowing any programming. But, these interactive components are also open source and users are welcome to modify them subject to the same two rules above. Osslets include source code, complete documentation for use at various levels, and they explicitly include permission for re-use and modification. All the materials you need are included with the osslets.

Thus, each osslet includes all of the following:

- An interactive component written in Java, Director (Shockwave), or Flash. The component is flexible and ready-to-use with no knowledge of programming. However, source code is also included for those who want to modify it.
- At least two ready-to-use curriculum units. The editable documents are included for those who want to make modifications.
- Several shorter examples illustrating the flexibility of the interactive component.
- Supporting files and documentation.
- Explicit permission for re-use and modification.
Rights Information in Results Set

IDLER Search Results

Your search for " " was ignored. However, a typical set of results would look like:

**The life and times of Digital Libraries**
Author: John Jafferis
Description: A Web site that never existed
Terms of Use: Attribution required. Non-commercial use only.
Source Code: Not Available

**The life and death of Digital Imaging**
Author: Karen K. Loomis & Dorothy Meeps
Description: A Web site that never existed may never exist.
Terms of Use: No restrictions known
Source Code: Not Available

**The Game of Life** (Applet)
Author: Carlos Harrada
Description: Another phony description
Terms of Use: Open Source License
Source Code: [Games for the Mind - Downloadable Sources](#)

[more results...](#)
How Far to Go?

1. Creating Rights Awareness
   – Including and expressing rights information
   – Tracking usage and attribution

2. Engendering Rights Respect
   – Policies
   – Education

3. Implementing Rights Enforcement
   – Restricting access (authentication / authorization)
   – Document protection & watermarks
   – Persistent protection (e.g. RMS)
INTEROPERABILITY

“Plug and play” on different platforms
Modify using available tools
Exchange and correctly interpret data
Will it Work?

- Can I find it?
- Is it useful?
- May I use it?
- Interoperability
Two Approaches to Interoperability

“STANDARDS”

- HTML
- XML
- Learning Object Metadata
- SCORM
- IMS Questions & Test Interoperability
- MathML
- And many others . . .

COMMON FORMATS

- PDF™
- Flash™
- Java™
- MS PowerPoint™ / Word™
- \( \text{T}_{\text{E}}\text{X} \)
- And many others . . .

Standards may exist within a small community – e.g. the British systems of weights and measures or \( \text{T}_{\text{E}}\text{X} \)
Interoperability - Guidelines

**Description:** Ensure that content can run properly in as many computing and learning environments as possible. Support authors and developers by providing versions of content that can be edited and modified.

**Explanation:** Ensuring interoperability - primarily through the use of standards - will make it possible for the widest possible audience to adopt or adapt a resource.

**GUIDELINES:**

5.1 – Use standardized and portable formats (P1)
5.2 – Use standards for communication, sequencing and navigation (P3)
5.3 – Provide editable versions (P2)
Techniques & Tips

• Avoid proprietary formats
  – Content should not be tied to a Course Management System (Use “standards” like SCORM)
  – Content should not require specialized plug-ins or software

• Use XML
  – Can be converted to other formats even if proprietary

• Use tools that use standards

• Collections
  – Store or link to editable versions of resources
  – If needed, store multiple versions of the same content for use on different platforms or with different software. This includes archiving older versions.
Example: Content Created in SCORM Authoring Tool

NSDL Reusable Learning

- Pre Test
- Reusability Framework
- Content Model

Welcome

Student Name

26 July, 2005  Designing & Managing for Reuse
Content exported to a SCORM package

Type of content package to export

Export destination
Exported Content as a SCORM Package
Sign on to LMS and Import Content

- Search content
- Administration
  - Content Display Settings
  - Manage Files
  - Manage Content
  - Add Module
  - Add Topic
  - Import Course
  - Scorm Reporting

Choose a source to import from:
- Select a file to upload:
- Select a shared learning object from the Learning Object Repository

Choose file:
- File name: NSCL Content Reusability.zip
- Files of type: All Files (*)
### Status, Score, Accesses, Time – Sent to LMS

<table>
<thead>
<tr>
<th>Status</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2/4</td>
<td>50.00%</td>
</tr>
<tr>
<td>COMPLETED</td>
<td>2/4</td>
<td>50.00%</td>
</tr>
</tbody>
</table>

#### Single User Single Course for DEMO STUDENT (GC)

<table>
<thead>
<tr>
<th>Course</th>
<th>Progress</th>
<th>Last Accessed</th>
<th>Completed</th>
<th>Score</th>
<th># Accesses</th>
<th>Time Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCORM Samples - 206470</td>
<td></td>
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<td></td>
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<tr>
<td>SCORM Detective</td>
<td>Completed</td>
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<td>Flash Quiz Sample</td>
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<tr>
<td>Flash SCORM Demonstrator - 212594</td>
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<tr>
<td>Flash SCORM Demonstrator</td>
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<td>NSDL Content Reusability - 214141</td>
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<tr>
<td>NSDL Content Reusability</td>
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<td></td>
<td>50</td>
<td>2</td>
<td>0000:01:37.00</td>
</tr>
</tbody>
</table>
A different SCORM Authoring Tool: InSite Studio
REUSABLE DESIGN

CONTENT
CONTEXT
PEDAGOGY
PRESENTATION
STRUCTURE
Is it Useful?

Can I find it?

Context & Pedagogy

Reusable Design

May I use it?

Structure & Presentation

Will it work?
CONTENT IS AT THE CORE

• **CONTENT**
  
  – The **stuff** in the resource
  – The **meaning** conveyed by a resource and the **words and images** used to convey it
  – **Information** contained in a resource that is intended to affect a change in cognitive state
• CONTENT
  – The stuff in the resource
  – The meaning conveyed by a resource and the words and images used to convey it
  – Information contained in a resource that is intended to affect a change in cognitive state

• CONTEXT
  – Language, cultural knowledge, subject knowledge, relations to other learning resources and other factors needed to properly interpret a digital learning resource
Pedagogy is about teaching & learning

- **Content**
  - The **stuff** in the resource
  - The **meaning** conveyed by a resource and the **words and images** used to convey it
  - **Information** contained in a resource that is intended to affect a change in cognitive state

- **Context**
  - Language, cultural knowledge, subject knowledge, relations to other learning resources and other factors needed to properly interpret a digital learning resource

- **Pedagogy**
  - How a digital learning resource is used as part of a **learning strategy** or **instructional design**
STRUCTURE IS ABOUT ORGANIZATION & NAVIGATION

• CONTENT
  – The **stuff** in the resource
  – The **meaning** conveyed by a resource and the **words and images** used to convey it
  – **Information** contained in a resource that is intended to affect a change in cognitive state

• CONTEXT
  – Language, cultural knowledge, subject knowledge, relations to other learning resources and other factors needed to properly interpret a digital learning resource

• PEDAGOGY
  – How a digital learning resource is used as part of a **learning strategy** or **instructional design**

• STRUCTURE
  – How a digital learning resource is structured into **smaller units**, and how these are **navigated** or **sequenced**
PRESENTATION IS ABOUT HOW THINGS LOOK

• **CONTENT**
  – The **stuff** in the resource
  – The **meaning** conveyed by a resource and the **words and images** used to convey it
  – **Information** contained in a resource that is intended to affect a change in cognitive state

• **CONTEXT**
  – **Language, cultural knowledge, subject knowledge, relations to other learning resources** and other factors needed to properly interpret a digital learning resource

• **PEDAGOGY**
  – How a digital learning resource is used as part of a **learning strategy** or **instructional design**

• **STRUCTURE**
  – How a digital learning resource is structured into **smaller units**, and how these are **navigated** or **sequenced**

• **PRESENTATION**
  – How a resource is rendered and what visual and auditory elements will be used to render it
## PRINCIPLE: SEPARATION OF LAYERS

<table>
<thead>
<tr>
<th>INSTRUCTIONAL DESIGN LAYERS</th>
<th>LEARNING RESOURCE DESIGN LAYERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context</strong></td>
<td><strong>Presentation</strong></td>
</tr>
<tr>
<td><strong>Pedagogy</strong></td>
<td><strong>Structure</strong></td>
</tr>
</tbody>
</table>

- Recognize all five layers
  - Content
  - Context
  - Pedagogy
  - Structure
  - Presentation

- Recognize them as separate
- Separate them to the extent possible
REUSABLE DESIGN: CONTEXT & PEDAGOGY

Increasing Your Audience
How Context and Pedagogy Affect Reuse

• Context is the friend of learning and the enemy of reuse
  – Cultural dependencies, prerequisites and external references may aid learning but limit the audience

• A learning resource is more reusable if it can be used in multiple learning environments
  – In-class / Online / Mentored Study / Self-study
  – Dependencies on a specific environment limit reuse
Design: Context and Pedagogy - Guidelines

**Description:** Design resources for use by as wide an audience as possible.

**Explanation:** Unnecessarily restricting the audience limits reuse possibilities

**GUIDELINES:**

3.1 – Design for multiple Educational Settings (P2)
3.2 – Design for multiple Educational Levels (P2)
3.3 – Design for Multilingual and Multicultural Support (P2)
Design Tips & Techniques For Developers

• Reduce limiting physical and location requirements
• Separate learning experiences that require human intervention
• Writing style, graphical style and structure affect the audience
• Use tools that support multiple languages
• Use language, images, scenarios and examples that make sense in as many cultural contexts as possible.

• REAL-WORLD EXAMPLES:
  – www.mcs.drexel.edu/~crorres/Archimedes/contents.html
    • Can be used in many different ways
    • Does not assume a particular pedagogical approach
    • Fairly independent of the cultural background of the user
    • Contains simple and complex topics
    • Separates topics for selective use
REUSABLE DESIGN: STRUCTURE & PRESENTATION

Reusable Learning Objects
## Granularity & Reuse

<table>
<thead>
<tr>
<th></th>
<th><strong>Asset</strong></th>
<th><strong>Information Object</strong></th>
<th><strong>Learning Object</strong></th>
<th><strong>Learning Component</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Author</strong></td>
<td>Highly Reusable</td>
<td>Reusable</td>
<td>Reusable</td>
<td>Usually too big</td>
</tr>
<tr>
<td><strong>Instructor</strong></td>
<td>Sometimes Reusable</td>
<td>Reusable</td>
<td>Highly Reusable</td>
<td>Reusable if it fits the application</td>
</tr>
<tr>
<td><strong>Learner</strong></td>
<td>Sometimes Useful</td>
<td>Supports self-directed learning</td>
<td>Supports multiple learning modes</td>
<td>Useful if it fits; Useful in parts</td>
</tr>
</tbody>
</table>

*Learning objects appear to be the most reusable for instructors and learners*

Model adapted from Learnativity ([www.learnativity.org](http://www.learnativity.org))

*From work of Robert Horn*
Description: Create self-contained learning experiences that allow presentation and navigation to easily be revised. Follow accessible design practices.

Explanation: Instructors and learners wish to access just the parts they need. Navigation and presentation may need to change when a resource is used in a new context.

GUIDELINES:

4.1 – Structure content to consist of self-contained learning experiences, each addressing a single topic or objective (P1)

4.2 – Separate Content from Presentation (P1)

4.3 – Separate Content from Navigation (P2)

4.4 – Adhere to Accessible Design guidelines (P2)
TECHNIQUES FOR DEVELOPERS

• Organize content around learning objectives
• Structure content into sections
  – with the smallest logical granularity
  – with well-defined learning objectives
• Eliminate interdependencies among sections
  – Use a navigation section or frame instead of “Previous” & “Next” buttons
  – Isolate components that are used repeatedly
• Use styles, style sheets, and XML-based formats
• Use neutral styles and language whenever possible
• Use standards and specifications to encode the sequencing of content
• Follow published guidelines for accessible design
Separating content from other layers

**Less Reusable**
- Forcing a sequence through previous and next buttons (Ties content to structure of resource)
- Referring to a lab experiment throughout a resource (unnecessarily ties content to context)
- **Elementary School Styles and Images** (mixes content with presentation)

**More Reusable**
- External Sequencing & Navigation
- Isolating components that require specific educational settings
- Using neutral styles
- Using style sheets that allow styles to be easily altered
EXAMPLES

• Chemistry Coach -
  www.chemistrycoach.com/home.htm
  - Look at Stoichiometry 2 The Mole Ratio. The tutorial addresses a specific concept. It include concepts, examples, and practice problems. There are no ‘hard-coded’ links to other tutorials.

• Zen Garden” www.csszengarden.com/
  - Demonstrates the reformatting of presentation that can be achieved through style sheets, without touching the actual content. This separation allows designers to reuse the content of authors, and authors to reuse the work of designers.

• Ph Factor - www.miamisci.org/ph/default.html
  - Demonstrates direct navigation to different learning objects (as opposed to forcing navigation through the content in a pre-defined order.)
Hello!

This site contains some problems for Mr. Murphy's 11th Grade Math Class. None of the problems require using a paper or pencil or a calculator to solve - at least not if you look at them in the right way. The problems are listed on the next few pages. These are followed by some interactive applets that let you explore the problems. Hints and explanations come next and, just for jollies, there is a quiz at the end.
This site contains mathematics problems meant to delight and challenge students and enthusiasts. None of the problems require using a paper or pencil or a calculator to solve - at least not if you look at them in the right way. Each problem includes a problem statement followed by a solution and explanation.

There is also a quiz that is related to the themes of the problem.

Problems

1. High Jumping on the Moon
2. Tiling a Chessboard
3. The Monty Hall problem
4. Belt around the Earth

Interested in using these problems in your course? See instructions for downloading and modifying this site.

About this site (information about the author, purpose, educational objectives, technical requirements, etc.)

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BEFORE – Learning Objects Not Self-contained

Learning objects split over multiple, non-contiguous pages

Two learning objects start on same page

Problem 1:
Suppose a man 2 meters tall can clear a high jump bar placed at 2.3 meters on Earth. About how high of a bar could he clear on the Moon? (For information on the moon, see "Exploring our World - 11th grade physics," page 192.)

Problem 2:
Picture a checkerboard with two opposite corners removed. Suppose you have a box of dominoes, each of which is exactly covers two squares of the board. Can you cover the board with dominoes so that no squares are left uncovered and no dominoes overlap?

Quit
BEFORE – Learning Objects Not Self Contained

Reference to an external text

Explanations and solutions not linked to problems.

11th Grade Problem Solving

MR. MURPHY'S GARDEN OF MATHEMATICAL DELIGHTS Problems...

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Quit
AFTER – Self contained learning object

Problems grouped with solutions and separated into problem-solution blocks

Direct link to reference information

Solutions and explanations linked to problems

Problem 1: High Jumping on the Moon

Suppose a man 2 meters tall can clear a high jump bar placed at 2.3 meters on Earth. About how high of a bar could he clear on the Moon?

Information on the Moon from NASA

Solution on next page.
Problem 1 Solution:

The Moon's gravity is about 1/6 that of the Earth's. This might lead you to believe that the man can jump six times as high. But when a person jumps and clears a high jump bar, it is the person's center of gravity that is being raised. If a 2 meter tall man clears a 2.3 meter bar, then his center of gravity has been raised approximately 1.3 meters*. In the Moon's gravity, the man could raise his center of gravity about 6 x 1.3 = 7.8 meters. It starts off one meter above the ground, so a better estimate of the height he could clear is 8.8 meters.

*Question: What assumption is being made and is it justified?
This is the famous "Monty Hall" problem. The problem comes from the game show "Let's Make a Deal" in which a lucky contestant would be faced with three doors. A great prize was behind one of them and non-so-great prizes behind the other two. The game, as it is often now described, goes as follows:

1. A contestant would be faced with three doors. Undesirable goats were behind two of them. A desire able car was behind one of them.
2. The contestant would pick a door.
3. The host (Monty Hall) would open a door the contestant had not picked, revealing a goat. Now there were two doors left, one hiding a goat and one hiding a car.
4. The contestant would be given the option of sticking with her original pick or switching.

Is it better to stick or to switch? How much better?
BEFORE – Forced, embedded navigation

MR. MURPHY’S GARDEN OF MATHEMATICAL DELIGHTS

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Quiz not available until the end
WELCOME TO MR. MURPHY'S GARDEN OF MATHEMATICAL DELIGHTS

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Problem 4: A Belt around the Earth

Assume the Earth were perfectly round and that you had a humongous belt that fit snugly around the equator. Suppose you added one meter of length to the belt and that the extra slack were uniformly distributed around the Earth. What is the largest creature that could conveniently walk under the belt:

- An Elephant?
- A grown person?
- A toddler?
- A cat?
- An ant?
- None of the above?

Solution on next page.
RESOURCES

From the Reusable Learning Site
### Freely Available Resources

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THANKS
nsdl@reusablelearning.org
www.reusablelearning.org

Next Scheduled Workshop:
E-Learn (www.aace.org/conf/elearn)
October 24, 2005
Vancouver, BC

Please feel free to contact us for workshops at your institution