Teaching Sustainable Design Through Lifecycle Thinking

American Society for Engineering Education, Vancouver BC
Dawn Danby | Sr. Sustainable Design Program Manager, Autodesk

Presentation modified with extra info for easier reading. For sharing by ASEE.
Carmanah Pacific Provincial Park, BC 1992 - family trip to a threatened watershed
Grade 10 Environmental Science, Ontario 1993: basics of plant biology, carbon cycle, human impact on climate, nuclear reactor mechanics, OPEC, coal plant visit, etc
Today:

1. Toolsets and Mindsets
2. Diving into Whole Systems & Lifecycle Thinking. Workshop with your Participation.
3. Using the Autodesk Sustainability Workshop
How can we **identify and solve** the most important problems?
How can we *inspire* young engineers & designers - and give them a sense of *agency*?

Former sustainability intern Rachel Deller, 2008
Autodesk Clean Tech Partner Program: Tesla Motors
Autodesk Clean Tech Partner Program: Pi Mobility Electric Bike
Autodesk Inventor, Eco Materials Adviser: Granta Materials data for H2O, GHG, etc...
But wait a minute! How do I know that (for example) material selection is important? What about pollution, energy, water?

Everything has impact. But those impacts are often “invisible”. Humans tend to focus on what they can “see”.
oil spill #1: visible and immediate

Deepwater Horizon, Gulf of Mexico 2010
oil spill #2: vast, but ‘far away’

Athabasca oil (tar) sands, Alberta Canada
Suburban construction, USA. Building use = largest segment of Energy use & GHG

oil spill #3: everywhere, yet invisible
Our challenge is to include both the visible and invisible impacts.
3 quick working definitions:
1. sustainable design
2. whole systems thinking
3. lifecycle thinking
1. **Sustainable Design** reduces (or even eliminates!) the use of energy, materials, water and land; and the impact on humans + other living things.
2. Whole Systems Thinking helps you consider all the social, environmental, and technical systems that a product is a part of.
3. Lifecycle Thinking
looks at all of the stages involved in a product’s life: raw materials extraction, manufacture, transport, use, and disposal.
VIDEO: Introduction to Whole Systems Design on the Autodesk Sustainability Workshop:
http://students.autodesk.com/?nd=sustainable_strategy&course_id=1#introductiontowholesystemsd preference
We have great tools to help teachers with the principles of sustainable design. But students will grasp these ideas through practice, by applying sustainability in hands-on, applied projects.
Get in a group of 5-6 and pick a product
(We’ll show a refrigerator example)
1. Define the problem by looking at the whole system.
2. Prioritize objectives by assessing lifecycle impacts
Define the system boundaries.
Where are my redesign opportunities?
<table>
<thead>
<tr>
<th>Where are the environmental impacts?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raw Materials</strong></td>
</tr>
<tr>
<td>Depletes non-renewable resources, causes pollution, uses land.</td>
</tr>
<tr>
<td><strong>Manufacturing</strong></td>
</tr>
<tr>
<td>Uses energy, causes pollution (solid waste, air pollution)</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
</tr>
<tr>
<td>Uses energy and fuel, causes air pollution</td>
</tr>
<tr>
<td><strong>Energy Use</strong></td>
</tr>
<tr>
<td>Uses electricity. Impacts vary based on energy source (coal, nuclear, wind).</td>
</tr>
<tr>
<td><strong>Disposal</strong></td>
</tr>
<tr>
<td>Land use (landfilling), may release some pollutants into the environment</td>
</tr>
</tbody>
</table>
Where do the Environmental Impacts Come From?

Data from Okala Curriculum for Sustainable Design, available from IDSA.org
3. Brainstorm Solutions by looking at the whole system
how to brainstorm: **RULES**

- **DEFER JUDGEMENT**
- **GO FOR VOLUME**
- **ONE CONVERSATION** at a time
- **BE VISUAL**
- **HEADLINE**
- Build on the Ideas of Others
- **Stay on TOPIC**
- **Encourage WILD IDEAS**
Ways to change the size and shape of the refrigerator
Changing the energy source and end-of-life options.
Reducing losses when opening and closing the fridge. Or avoiding the fridge altogether.
1. Define the problem by looking at the whole system

2. Prioritize objectives by assessing lifecycle impacts

3. Brainstorm Solutions by looking at the whole system

4. Use metrics to evaluate and choose solutions
Autodesk Sustainability Workshop

FREE: videos - tutorials - lesson plans - software

autodesk.com/sustainabilityworkshop
FREE Teaching materials + software available now at: autodesk.com/sustainabilityworkshop

**Whole Systems Design**
- Whole Systems and Lifecycle Thinking Lesson Plan
- Rocky Mountain Institute’s Factor 10 Engineering (RMI 10xE) principles
- RMI 10xE case studies
- Whole Systems: Quick Reference Guide
- Life Cycle Assessment Primer

**Design for Product Lifetime**
- Quick Reference Guide: Design for Durability
- BLOOM Laptop Student Final Report (& dataset)

**Lightweighting**
- Solar Tracker Lightweighting Case Study
- Material Inputs Quick Reference Table

**Material Selection**
- Introduction to sustainable material selection with Granta Design

*Coming soon in Fall 2011! Material selection, Energy Effectiveness, and Green Building.*
Say hi:

Dawn Danby
dawn.danby@autodesk.com
Autodesk Sustainability Workshop
www.autodesk.com/sustainabilityworkshop
twitter @ecoworkshop

Send me a note and I will send you key teaching guides. Let us know how it goes!
also, check out the K-12 Autodesk® Digital STEAM Workshop

and say hi to its leader,
Linda Sellheim
linda.sellheim@autodesk.com
www.autodesk.com/digitalsteam