SolidWorks and SolidWorks Sustainability

Marie Planchard
Director of World Education Markets

Welcome Kentucky Teachers – SolidWorks is already here

Product Design Engineer

Big Ass Fans - Lexington, KY

modeling software; **SolidWorks** preferred. • Ability to handle multiple tasks, set priorities and meet schedule...

www.beyond.com - June 16 - Save this job

Mechanical Designer, Structural Engineer, Document Control

B Rowland Technical Staffing - Louisville, KY

drafting, **SolidWorks** CAD, and Bill of Materials development. The work will be performed on CAD and on the shop floor...

www.careerbuilder.com - June 16 - Save this job

Design and Development Engineer

JobTarget - Bowling Green, KY - Holley, NY

a plus. Experience in ProE Wildfire and/or **Solidworks**, Approx. 2000 hrs. Broad knowledge in different materials for manufacturing...

www.jobtarget.com - June 15 - Save this job

Plastics Mechanical Engineer

EngineeringClassifieds - Bowling Green, KY - New Orleans, LA - $80000 - 90000 per year

Must have experience with several of the following: **Solidworks**, Adobe3D, CAD and or Auto CAD plus the ability to understand RF and Electronic circuits...

www.engineeringclassifieds.com - June 15 - Save this job

What is CAD?

- Computer Aided Drafting/Design
- But that is only the words that make it an acronym
- Here is a little hint:

What is CAD?

- **How are these similar**

English

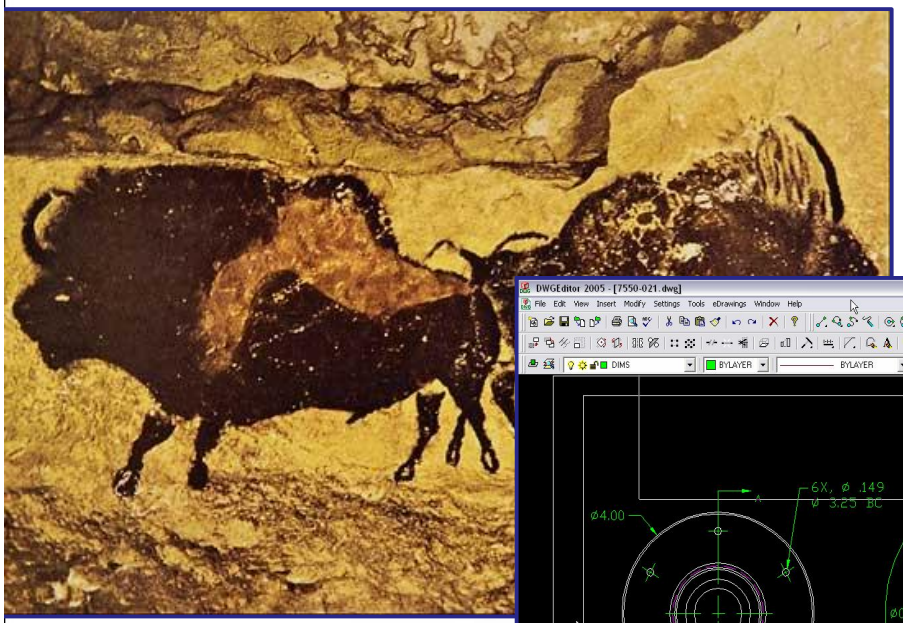
Newspapers

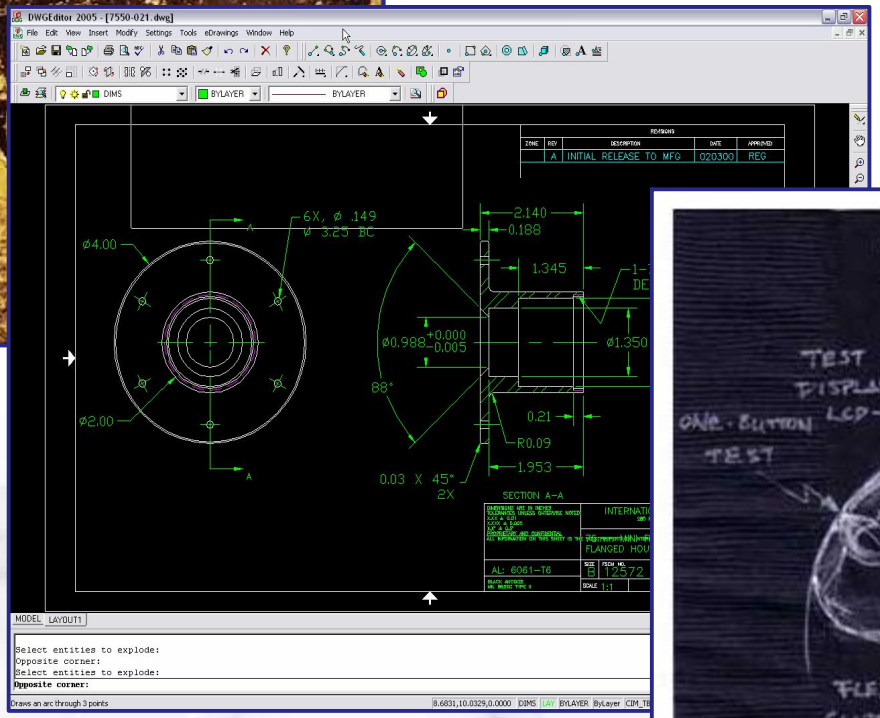
Television

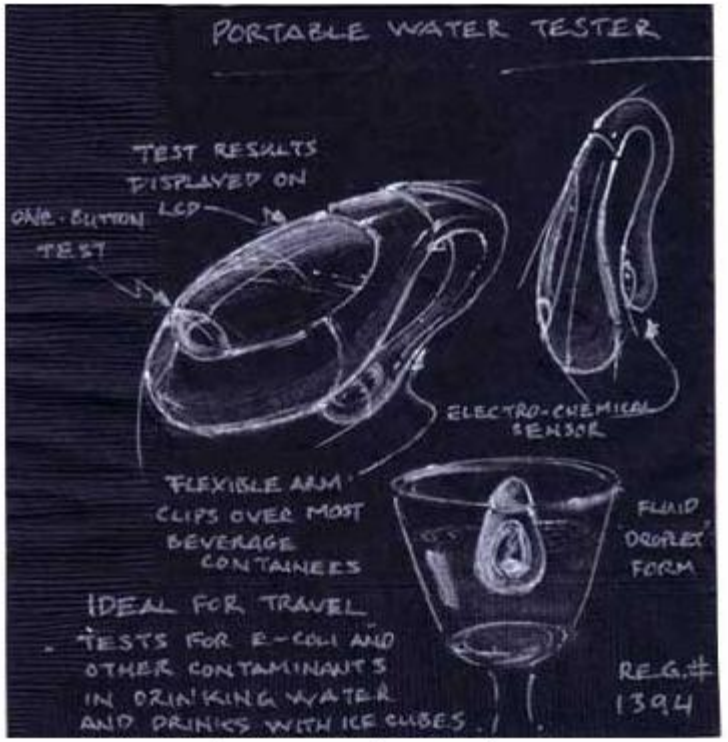
CAD

email

How are these similar?







Miles Hammond, Scott Gales

What is SolidWorks?

- **Is SolidWorks CAD too?**

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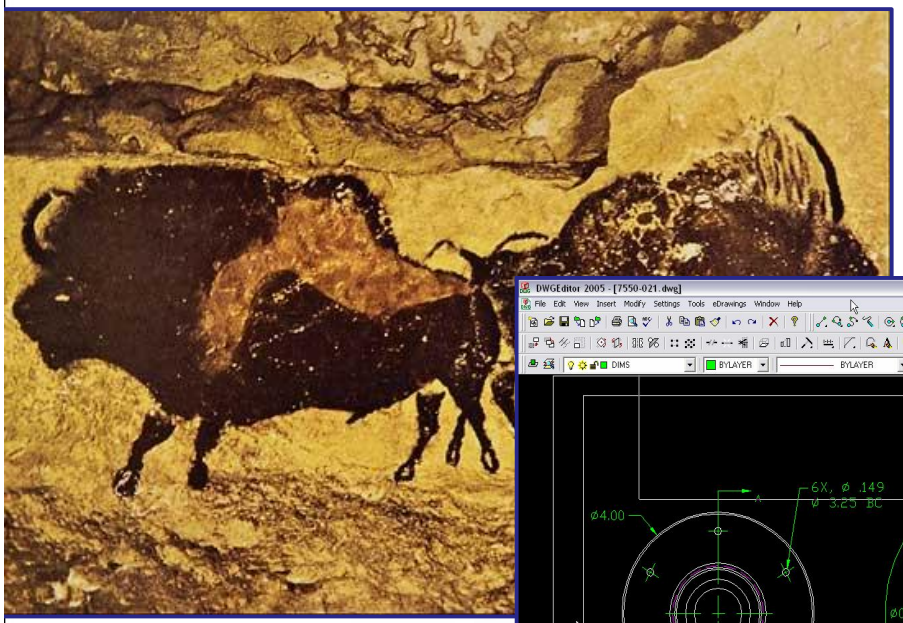

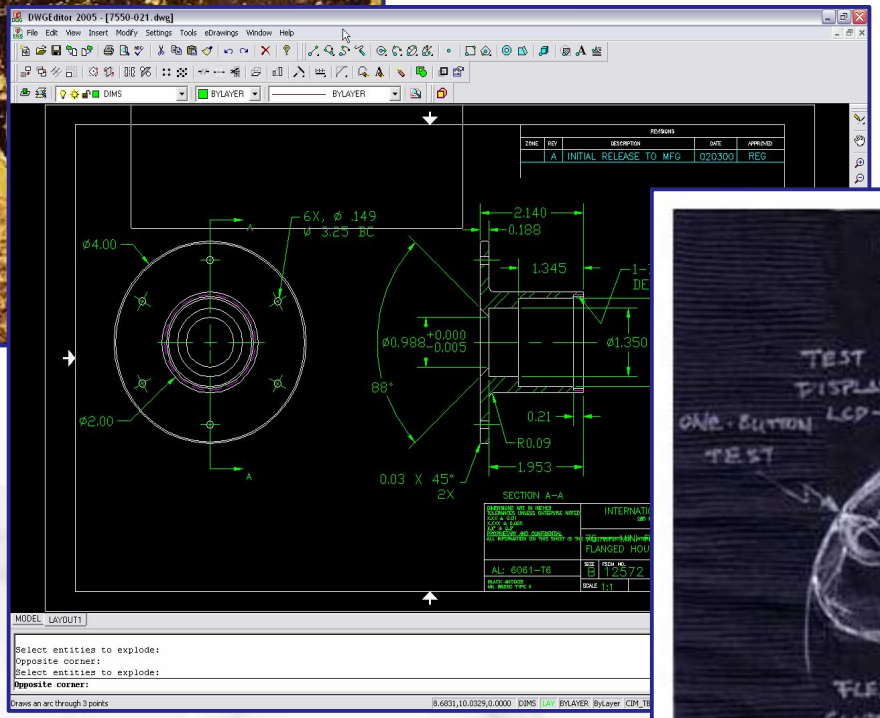

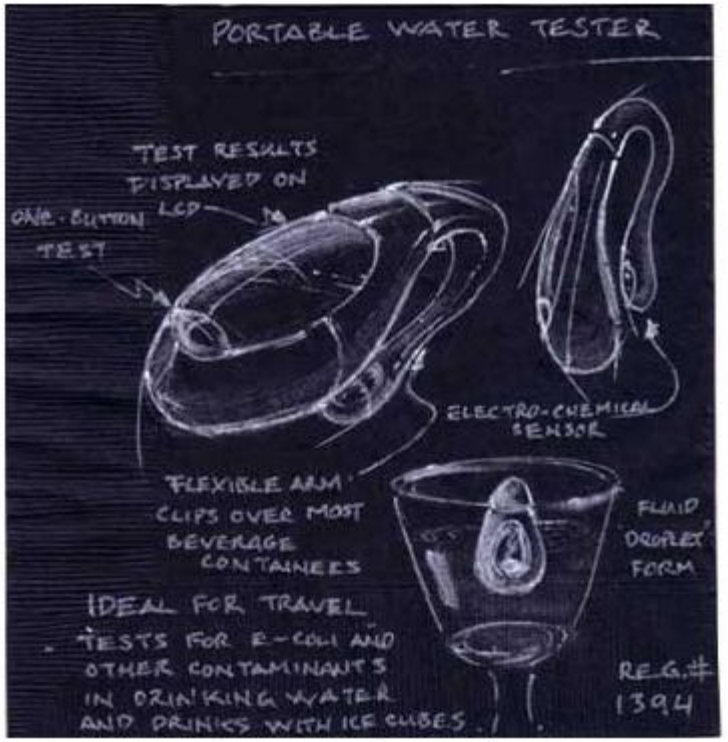

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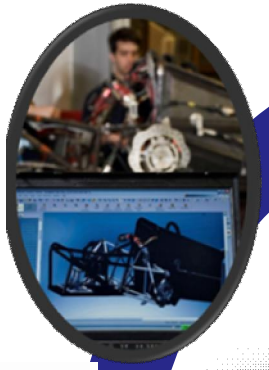
What is SolidWorks?

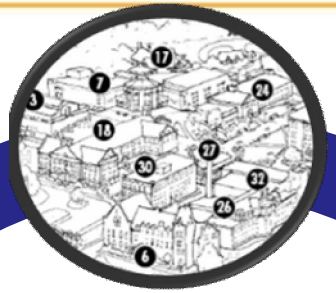
- **Is SolidWorks CAD too?**

Our Customers Design Everything

Innovative Solutions For Educators

SolidWorks Education

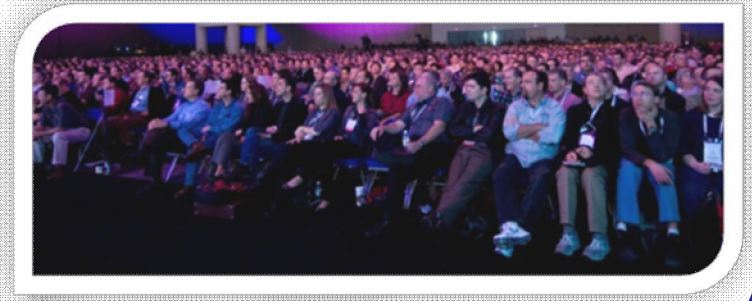




Student Access

Tutorials & Curriculum

Sustainability

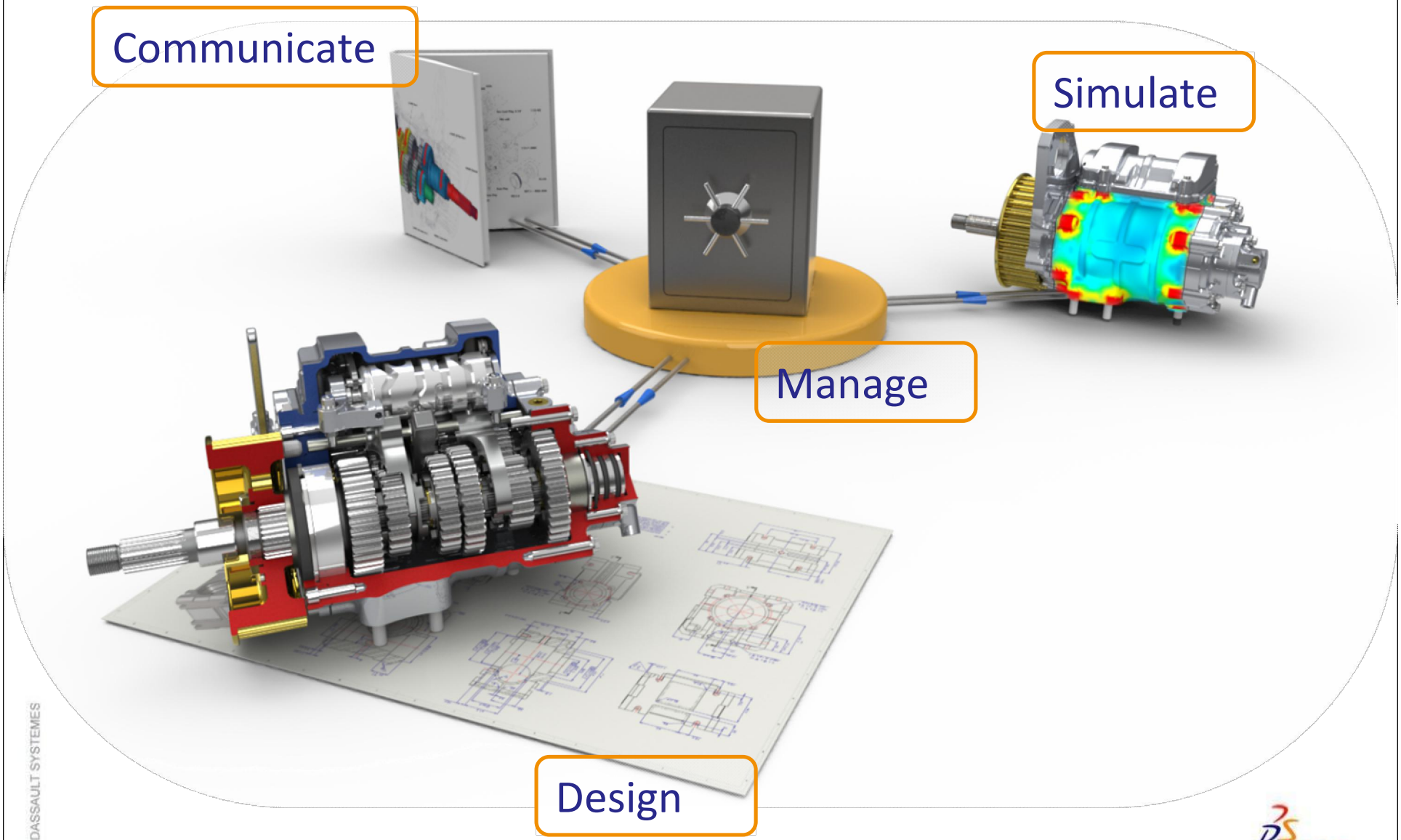


SolidWorks Community

Training Support, & Resources

Industry Certification

Intuitive Solutions For Every Stage of Design



SolidWorks

SolidWorks makes math and science relevant

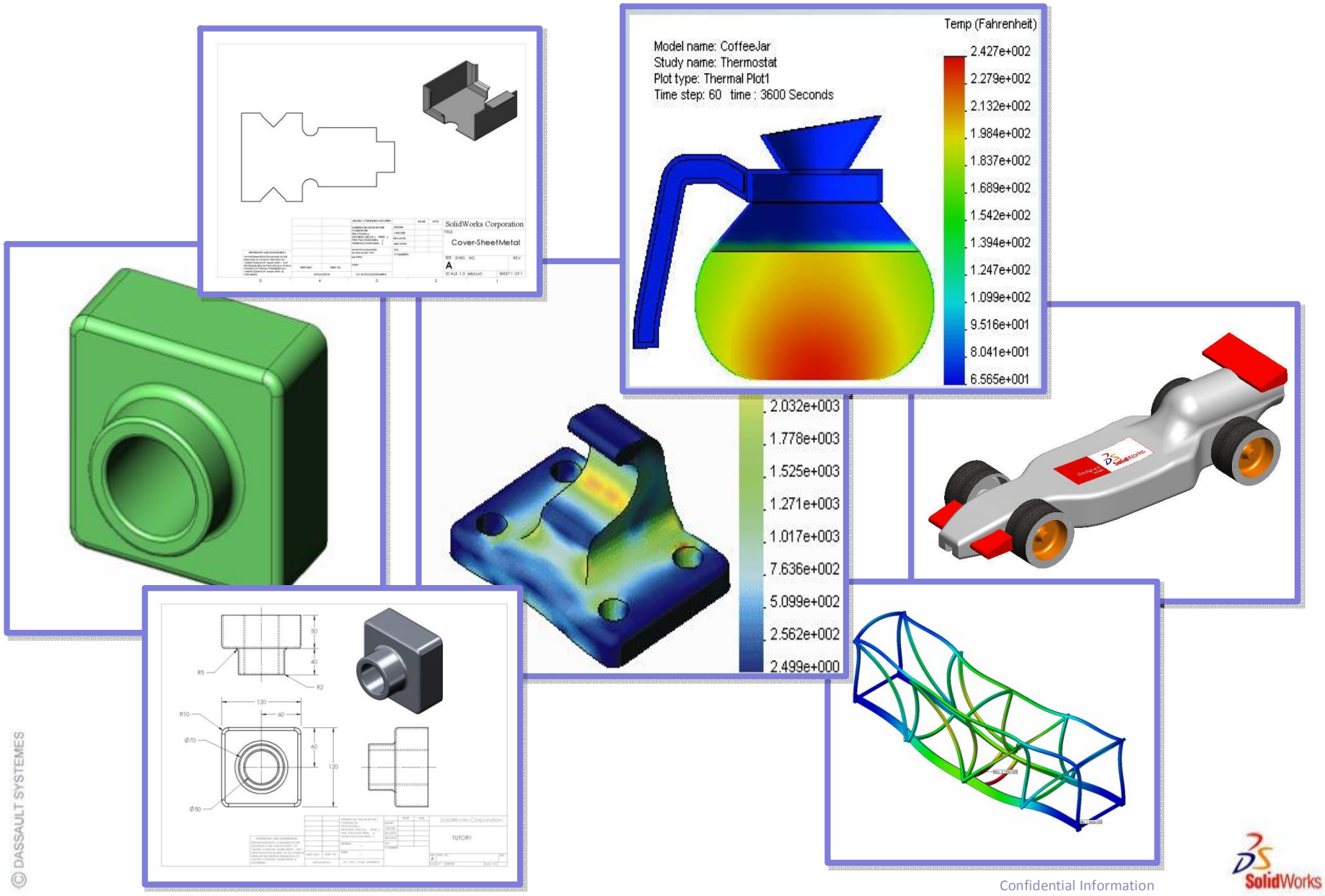
Math and Science

- Geometry, Algebra and Calculus
- Physics, Chemistry and Environmental Science
- Biology – medical products

Communication Skills

- Work as a team
- Describe a problem, formula solutions
- Enhance oral and written technology skills
- Accept failure and try again to make it better

Tutorials and Curriculum



SolidWorks

Intuitive Solutions For To Empower Your Students

Sustainability

What is Sustainable Engineering?

- **Sustainable engineering** is the integration of social, environmental, and economic conditions into a product or process
- Soon all design will be **Sustainable Design**
- **SolidWorks Sustainability** allows students to be environmentally conscious about their designs
- Successful products are developed by integrating **Life Cycle Assessment (LCA)** directly into engineering design process

Life Cycle Assessment - LCA

- A method to quantitatively assess the environmental impact of a product throughout its entire lifecycle, from the procurement of the raw materials, through the production, distribution, use, disposal and recycling of that product.

LCA – Life Cycle Assessment

- **Raw Material Extraction**
  - Planting, growing, and harvesting of trees
  - Mining of raw ore (example: bauxite)
  - Drilling and pumping of oil
- **Material Processing -** The processing of raw materials into engineered materials
  - Oil into Plastic
  - Iron into Steel
  - Bauxite into Aluminum
- **Part Manufacturing** - Processing of material into finished parts
  - Injection molding
  - Milling and Turning
  - Casting
  - Stamping

LCA – Life Cycle Assessment

- **Assembly** – Assemble all of the finished parts to create the final product
- **Product Use** – End consumer uses product for intended lifespan of product
- **End of Life** – Once the product reaches the end of its useful life, how is it disposed of
  - Landfill
  - Recycled
  - Incinerated

Life Cycle Assessment Key Elements

- **Identify and quantify the environmental loads involved**
  - the energy and raw materials consumed
  - the emissions and wastes generated
- **Evaluate the potential environmental impacts of these loads**
- **Assess the options available for reducing these environmental impacts**

Environmental Impact Factors

Carbon Footprint

Total Energy

Air Acidification

Water Eutrophication

What is Carbon Footprint?

- Carbon Dioxide CO_2 and other gasses which result from the burning of fossil fuels accumulate in the atmosphere which in turn increases the earth's average temperature in kilograms (kg).
- Carbon footprint acts as a proxy for the larger impact factor referred to as Global Warming Potential (GWP).
- Global Warming is responsible for the loss of glaciers, extinction of species, more extreme weather, and other environmental problems.

What is Total Energy Consumed?

- **Measure of the non-renewable energy sources associated with the part's lifecycle in mega joules (MJ). Impact includes:**
  - upstream energy required to obtain and process these fuels
  - embodied energy of materials which would be released if burned
  - electricity or fuels used during the product's lifecycle
  - Transportation?
- **Efficiencies in energy conversion (e.g. power, heat, steam) are taken into account.**

What is Air Acidification?

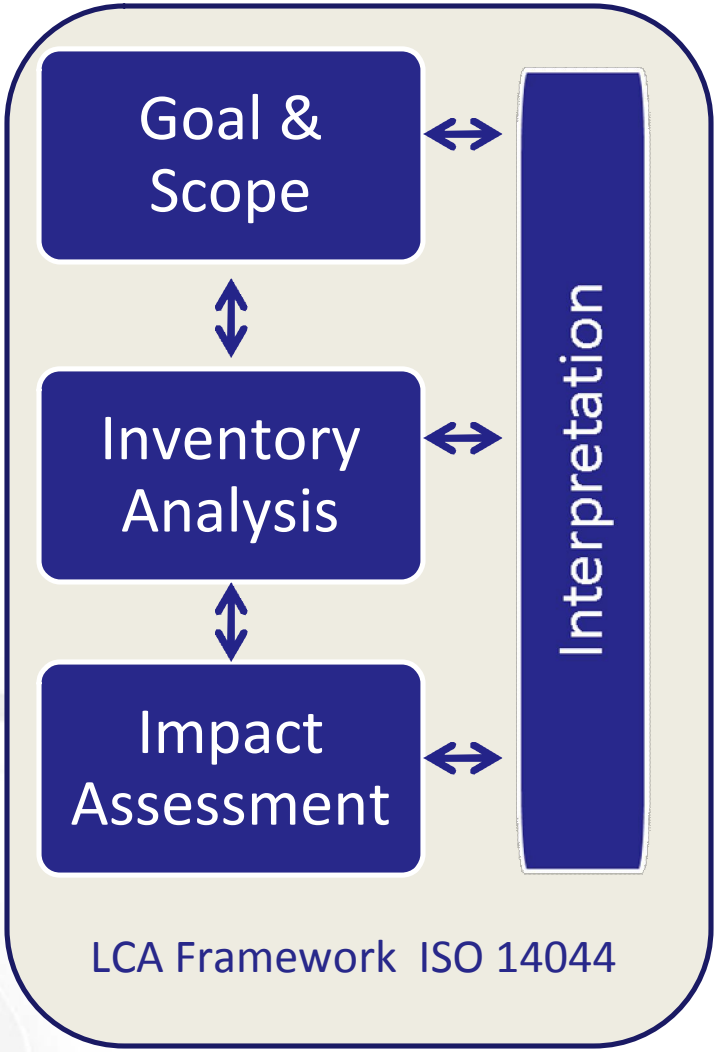
- Sulfur Dioxide SO_2, Nitrous Oxides NO_x and other acidic emissions to air that result in acid rain.
- Makes the land and water toxic for plants and aquatic life.
- Slowly dissolves manmade building materials such as concrete.
- Measured in units of kilograms Sulfur Dioxide equivalent (SO_2e)

What is Water Eutrophication?

- Over abundance of nutrients added to a water ecosystem.
- Nitrogen (N) and Phosphorous (PO_4) from waste water and agricultural fertilizers cause an overabundance of algae to bloom, which depletes the water of oxygen and results in the death of plant and animal life.
- Measured in kilograms Phosphate equivalent (PO_4e).

References

- **Underlying LCA Technology: PE International**
  - 20 years of LCA experience
  - LCA international database
  - GaBi 4 - leading software application for product sustainability
  - www.pe-international.com
- **International LCA Standards**
  - Environmental Management Life Cycle Assessment Principles and Framework ISO 14040/44 www.iso.org
- **US EPA LCA Resources**
  - http://www.epa.gov/nrmrl/lcaccess/

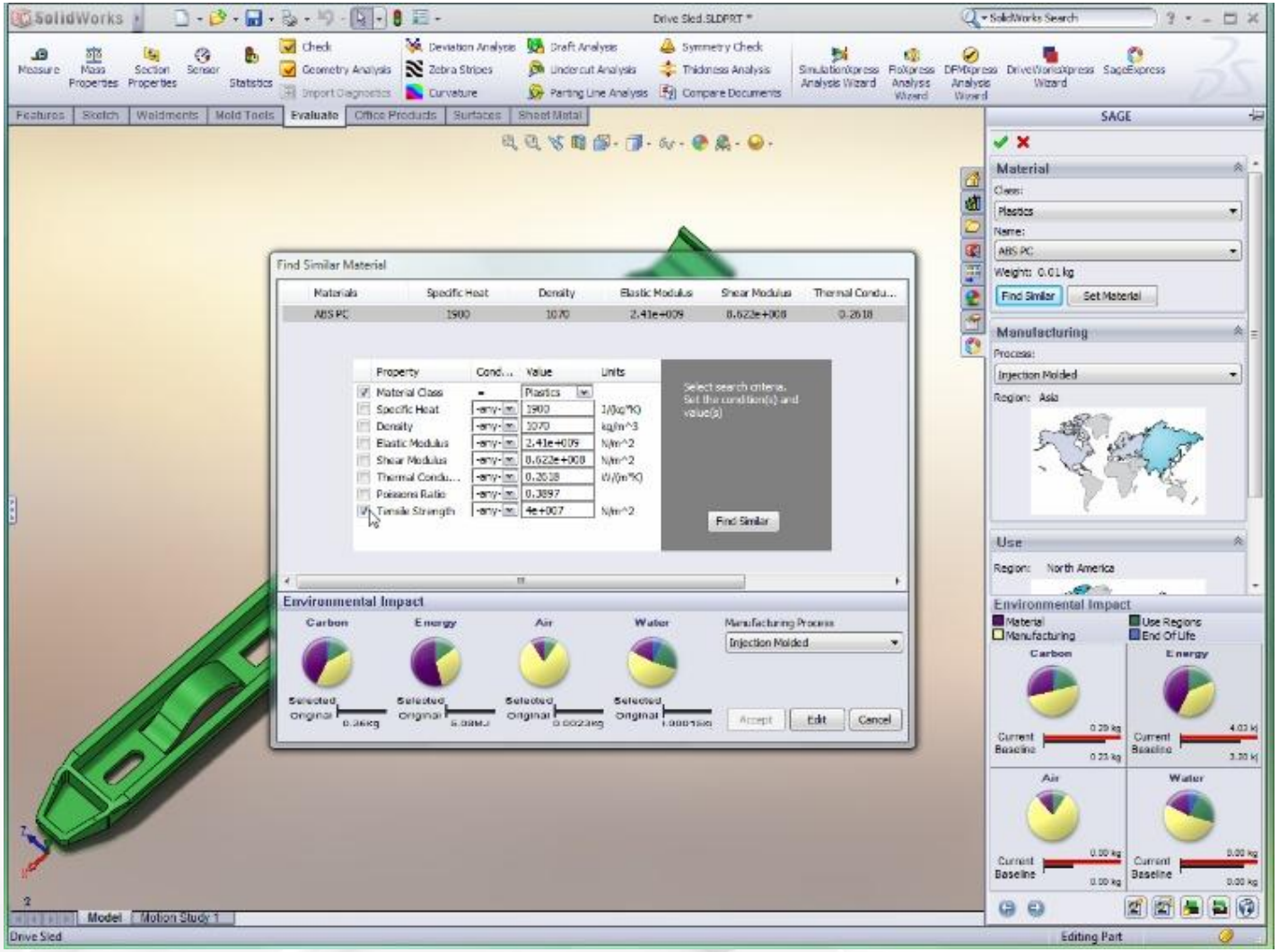


Why SolidWorks Sustainability?

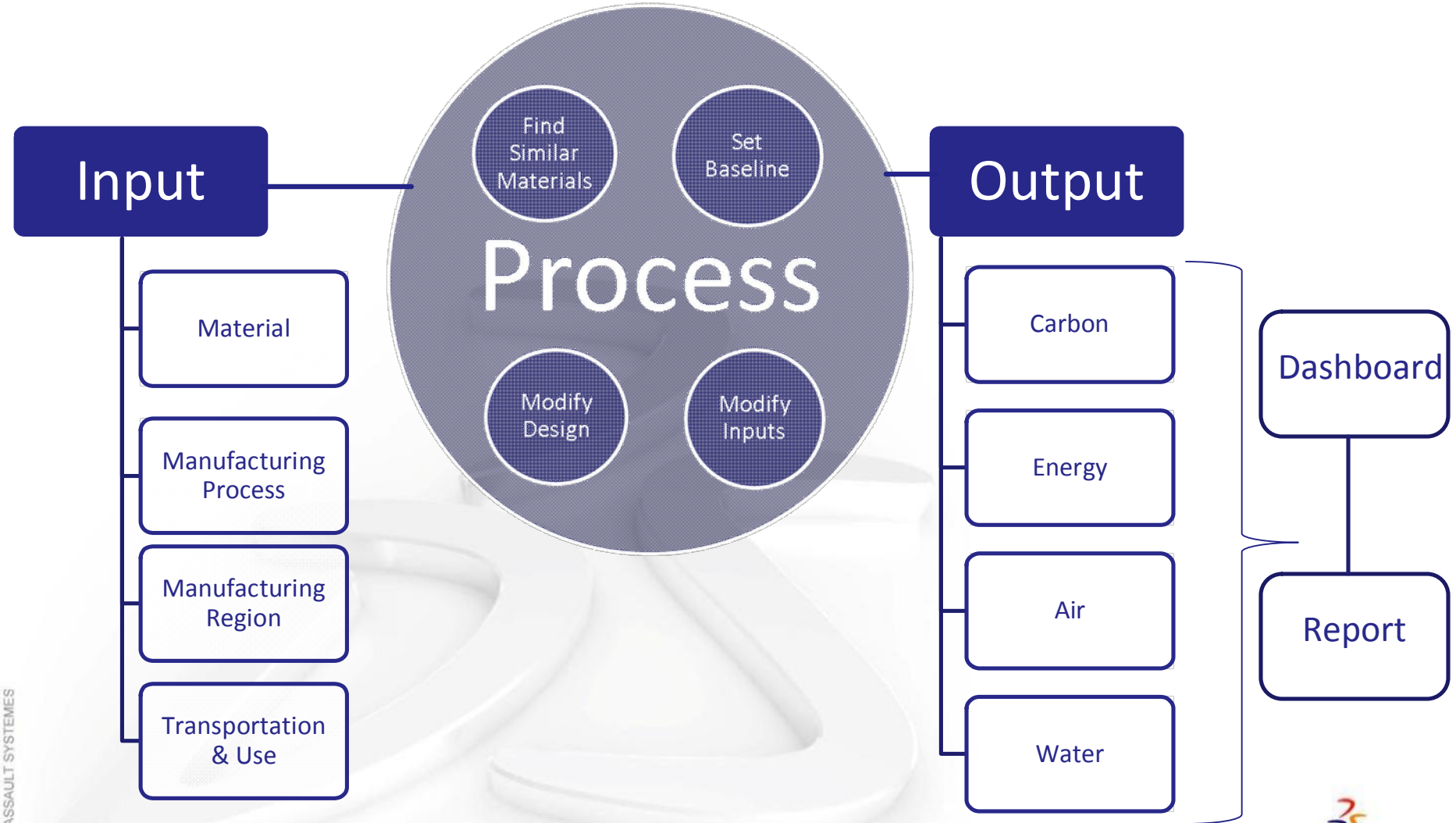
Soon all design will be Sustainable Design

- **More consumers want "greener" products**
- **New and unfamiliar challenge for businesses**
- **Sustainable design is a strategy for success**
- **SolidWorks Sustainability**
  - Easy to use and to understand
  - Reduces the environmental impact of product designs
  - Communicates effectively through reports and graphic display
  - SolidWorks SustainabilityXpress[1] is available to EVERY SolidWorks user at no cost

Why SolidWorks Sustainability in the classroom?



SolidWorks Sustainability Methodology



Input Material Class and Material Name

- **Material Class and Name Hierarchy**

Material Class		Material Name Material Class: Plastics	
Steel	Plastics	ABS PC	Acrylonitrile Butadiene Styrene Polycarbonate
Iron	Other Metals	Acrylic	
Aluminum Alloys	Other non-metals	Delrin® 2700 NC010	**Polyoxymethylene** (POM, polyacetal or polyformaldehyde) mfg by Dupont
Copper Alloys	Generic Glass Fibers	Nylon 101	
Titanium Alloys	Carbon Fibers	PE High Density	Polyethylene
Zinc Alloys	Silicons	PVC Rigid	Polyvinyl Chloride
Other Alloys	Woods	And many more	

Input Manufacturing Process

Available manufacturing depends on material class

	Class: Aluminum Alloys	
Manufacturing Process	Die Casted	Sand Casted
	Extrusion	Stamped/ Formed Sheet Metal
	Forged	Machined Sand Casted
	Milled	Turned

	Class: Plastics
Manufacturing Process	Injection Molded
	Extrusion

Input Manufacturing Region

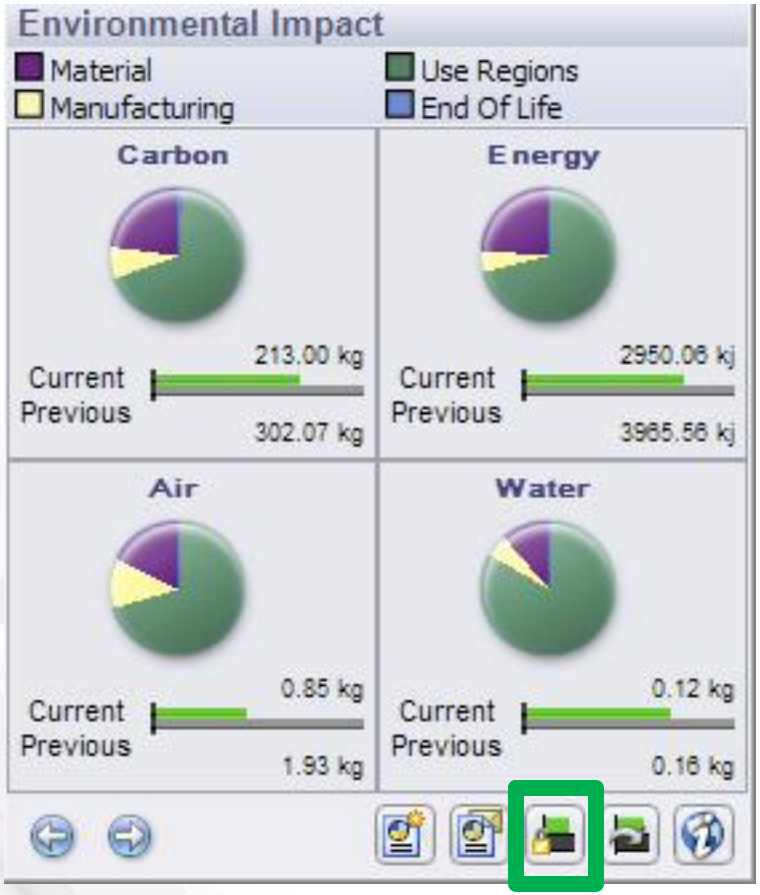
- **Each region produces energy by different method combinations. Impact of a kWh is different for each region. Example methods include:**
  - Fossil Fuels
  - Nuclear
  - Hydro-electric
- **Determines the resources consumed by manufacturing processes in that region**
- **Region Choices**
  - Asia
  - Europe
  - North America
  - Japan

Input Transportation and Use Region

- **Determines the energy sources consumed during the product's use phase (if applicable) and the destination for the product at its end-of-life.**
  - Asia
  - Europe
  - North America
  - Japan
- **Estimates the environmental impacts associated with transporting the product from its manufacturing location to its use location.**

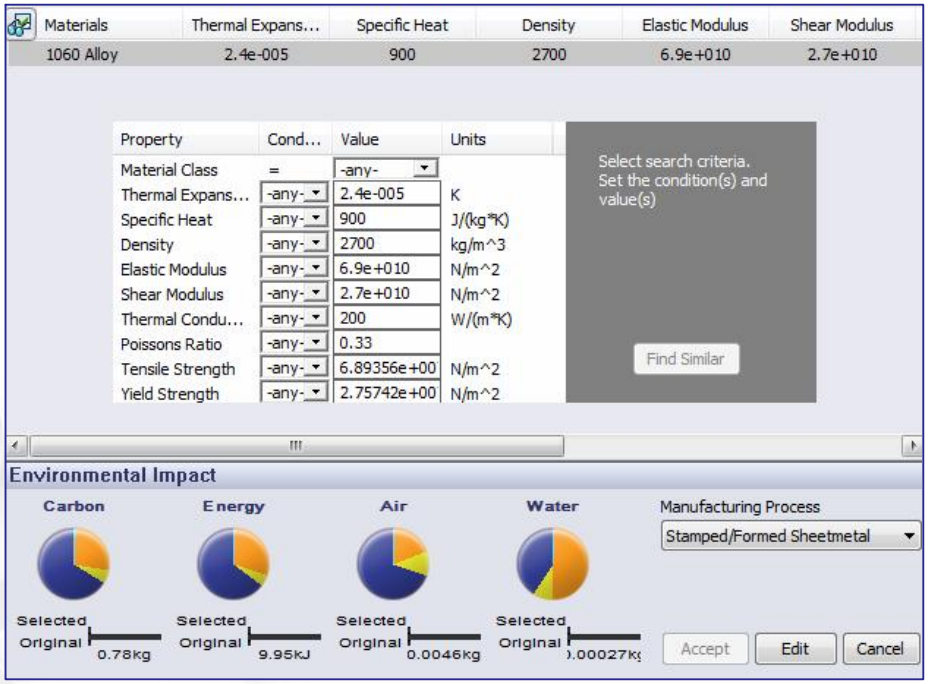
SolidWorks Calculates Environmental Impact

- **Parameters**
  - **Carbon** Footprint
  - **Air** Acidification
  - **Water** Eutrophication
  - **Energy** Consumed
- **Factor Percentage**
  - Material
  - Manufacturing
  - Use Regions
  - End of Life
- **Set Baseline**



Find Similar Materials based on Material Properties

- Thermal Expansion
- Specific Heat
- Density
- Elastic Modulus
- Shear Modulus
- Thermal Conductivity
- Poisson's Ratio
- Tensile Strength
- Yield Strength

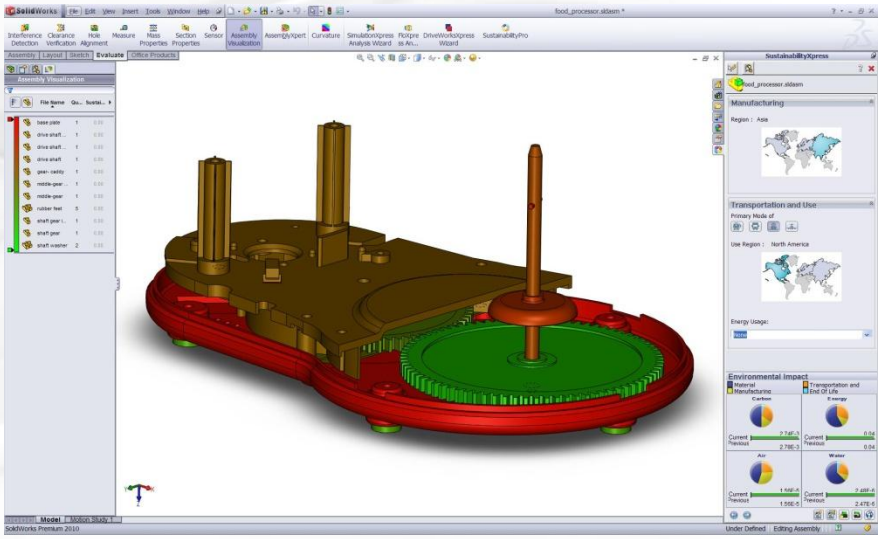


Definitions of Material Properties

- **Thermal Expansion** - the change in length per unit length per one degree change in temperature (change in normal strain per unit temperature) (K)
- **Specific Heat** - quantity of heat needed to raise the temperature of a unit mass of the material by one degree of temperature. (J/kg K)
- **Density** - Mass per unit volume. (kg/m^3)
- **Elastic Modulus** (Young's Modulus) - ratio between the stress and the associated strain in a specified direction (N/m^2)
- **Shear Modulus** (Modulus of Rigidity) - the ratio between the shearing stress in a plane divided by the associated shearing strain (N/m^2)
- **Thermal Conductivity** - rate of heat transfer through a unit thickness of the material per unit temperature difference. (W/m K)
- **Poisson's Ratio** - ratio between the contraction (traverse strain), normal to the applied load to the extension (axial strain), in the direction of the applied load. Poisson's ratio is a dimensionless quantity.
- **Tensile Strength** –the maximum amount of tensile stress that a material can be subjected to before failure (N/m^2)
- **Yield Strength** – Stress at which the material becomes permanently deformed (N/m^2)

SolidWorks Sustainability

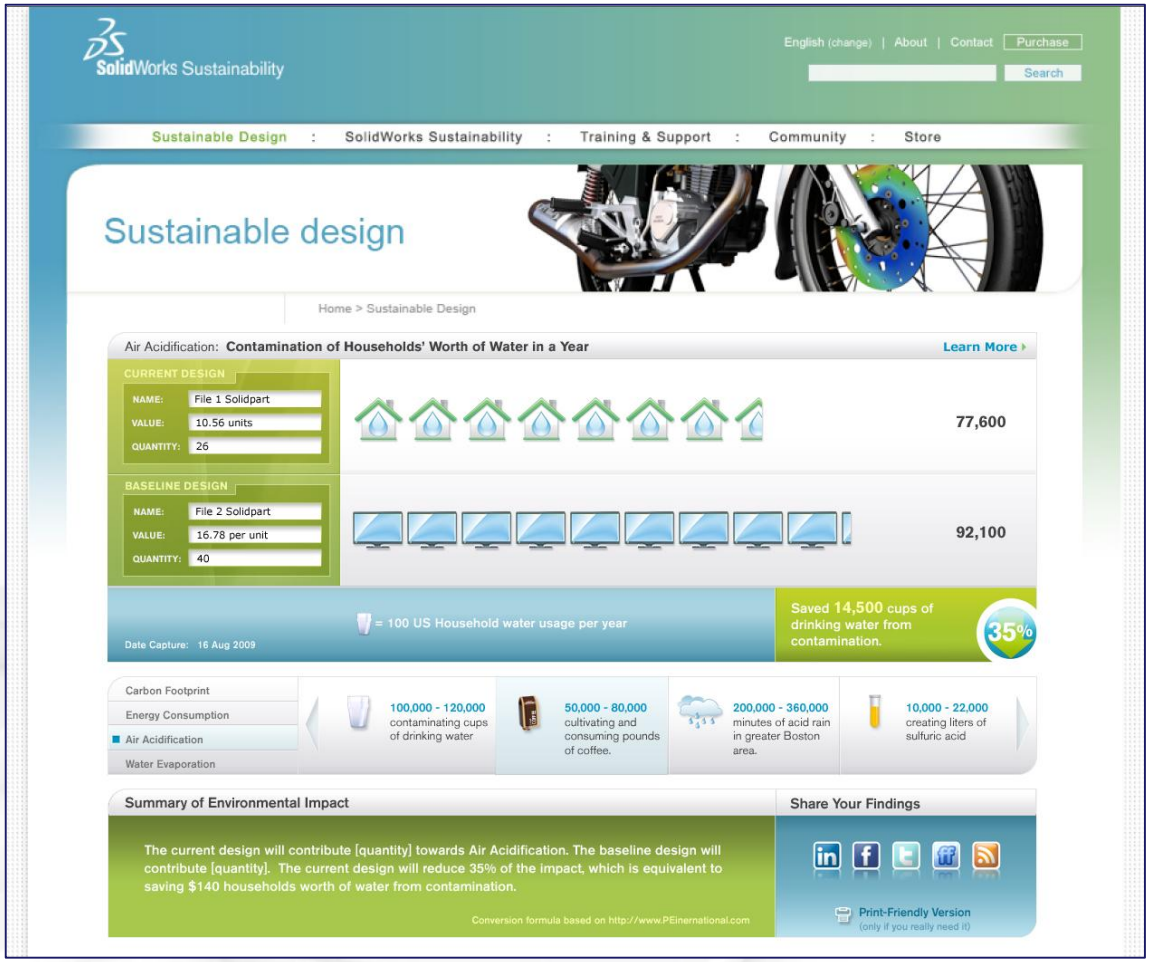
- Same functions as SustainabilityXpress
- LCA of assemblies
- Configuration support
  - Save inputs and results per configuration
- Expanded reporting capabilities for assemblies
- Specify amount & type of energy consumed during use
- Specify method of transportation
- Support for Assembly Visualization



Sustainable Report

SolidWorks Sustainability - Online Calculator

Converts environmental impacts into human scale parameters
Example: Carbon Footprint converted into miles driven in a car



Why SolidWorks Sustainability in the classroom?

- **Students need** to learn, understand, improve, and communicate the environmental impact of their design
- **Educators can** provide insights on how choices in material and manufacturing processes affect the environment.
- **Instruction combines** design and technology with the social, environmental, and economic conditions

THANK YOU

SolidWorks