Tuesday, April 5, 2016 11:13 PM

Week 1

Week 2

Learning Goals

By the end of this section, you should be able to:

- ***Describe*** the difference in perspective between engineers, scientists, and technicians
- ***Explain*** the operating principles of an RC servo motor
- ***Evaluate*** and ***refine*** several candidate concept designs by applying an engineering perspective
- ***Describe*** the elements of risk, and how risk affects decision-making in an engineering project

Briefly explain how engineers and scientists are related/connected, and how engineers and technicians are related/connected.

Engineers & technicians	• Engineers devise the solution, technicians implement it • Both prototype, tinker, and apply practical skills, (but engineers also apply analytical skills)
Engineers & scientists	

Briefly explain how engineers and scientists are related/connected, and how engineers and technicians are related/connected.

Engineers & technicians	• Engineers devise the solution, technicians implement it • Both prototype, tinker, and appl[Any 1]cal skills, (but engineers also apply analytical sk...
Engineers & scientists	• Discovery vs application: Scientists are involved in the discovery of new scientific knowledge; Engineers apply scientific knowledge to create new things • "Scientists study the world as it is, engineers create the world that has never been" • Both require fluency in math and science, (but engineers also apply math and science in practical ways)

Servomechanism Components

1 Motor
2 Gears
3 Position sensor
4 Electronic control system

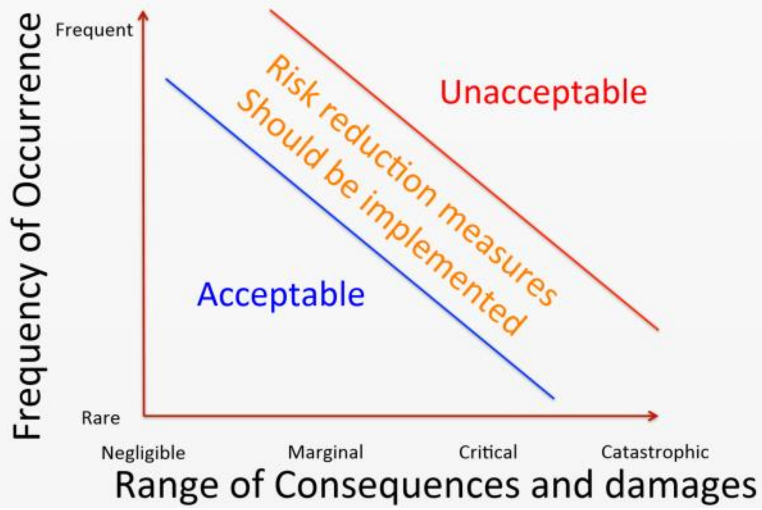
What is the "Risk"?

"The chance of that incidents or damages occurring"

i.e.

Risk = **Potential severity of harm/ consequence/ damage** X **Likelihood of event occurring**

Elements of Risk



Risk Matrix

Likelihood	4 Frequent	4 Tolerable	8 Significant	12 Unacceptable	16 Unacceptable
	3	3 Insignificant	6 Tolerable	9 Significant	12 Unacceptable
	2	2 Insignificant	4 Tolerable	6 Tolerable	8 Significant
	1 Rare	1 Insignificant	2 Insignificant	3 Insignificant	4 Tolerable
		1 Negligible	2	3	4 Catastrophic
		Consequence			

Risk Assessment and Reduction Strategy

- Identify the incidents
- Evaluate the risks
- Design control measures required to eliminate or reduce risks to acceptable levels

Week 3

Week 3 - Engineering Drawings - Projection

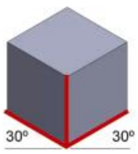
Learning Goals

- ***Describe*** what is meant by "projection" in the context of engineering drawings
- ***Explain*** how isometric and orthographic projection drawings are produced, and the pros and cons of each
- ***Explain*** why hidden lines are used in orthographic drawings
- ***Interpret*** isometric and orthographic drawings

Week 3 - Engineering Drawings - Projection

Isometric Projections

- Vertical lines on the object are vertical on the page
- Horizontal axes on the object rise at 30° on the page
- Equal distances along each of the axes on the object are equal on the page



The choice of *<u>three dimensional view</u>* that is visible on our *<u>two-dimensional plane</u>* is known as *<u>Projection</u>*.

Week 3 - Engineering Drawings - Projection

Isometric Projections

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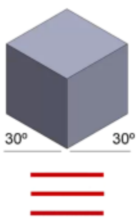
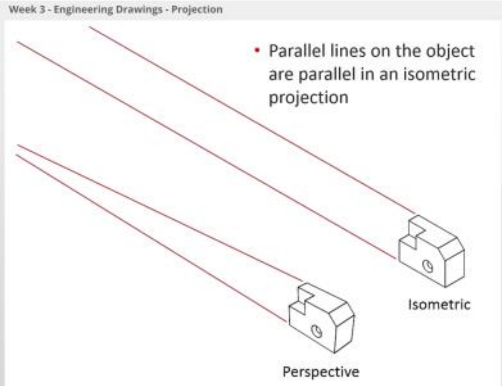
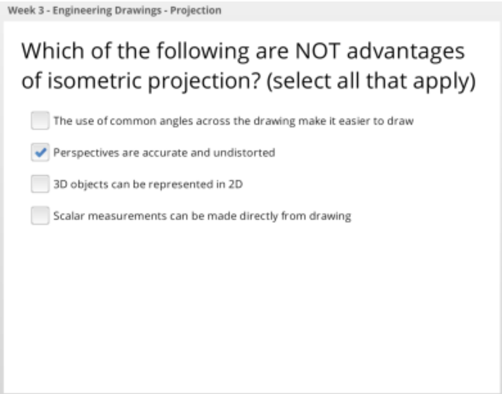
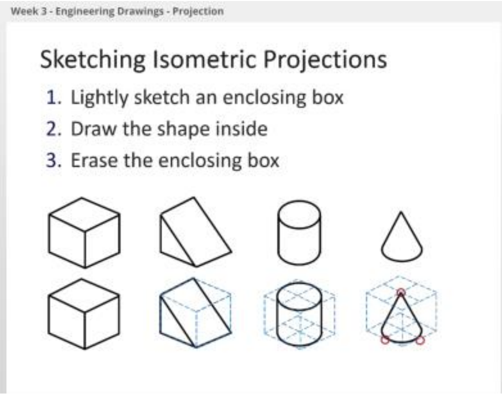
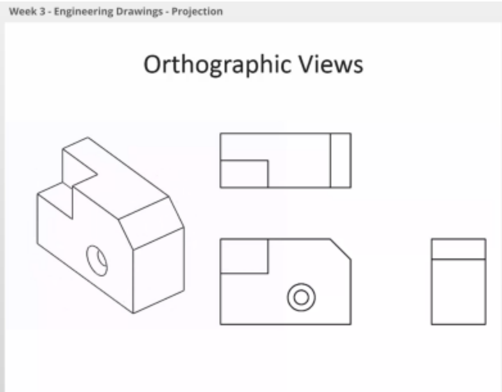


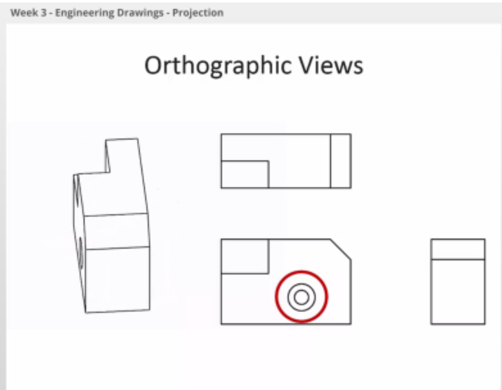




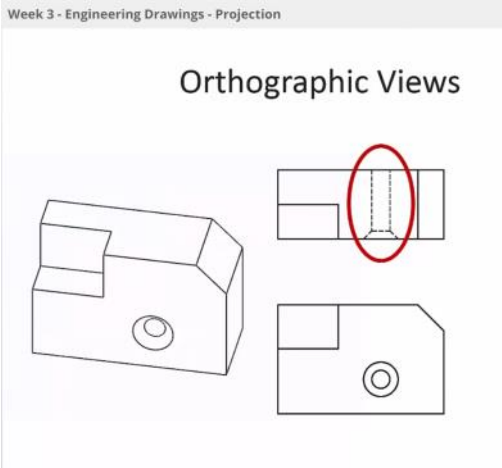




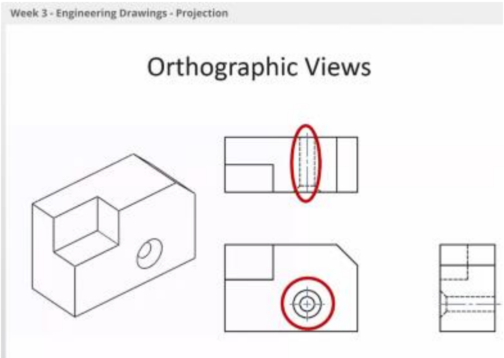
We generally show Orthographic View by <u>Front</u>, <u>Top</u> and <u>one of the Ends</u>



Cons:- We do not know how deep the *hole* is.

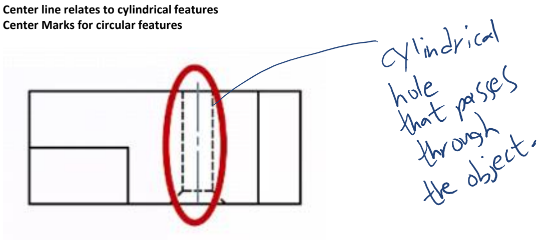


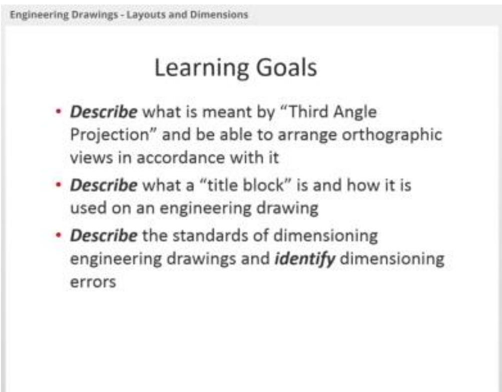
The way we address this issue is to show hidden lines these are shown using dashed line and they reveal features inside or on the back of the part that would not be visible to the eyes

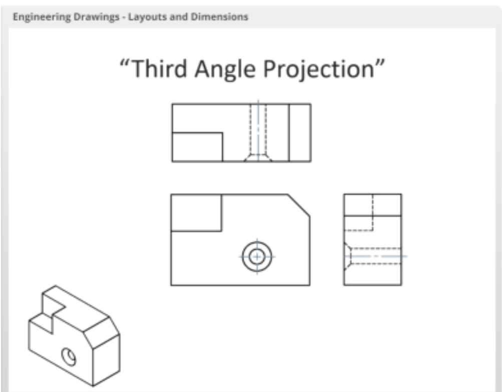


Circular features or cylindrical features are usually identified by center marks and center lines

Center line relates to cylindrical features
Center Marks for circular features

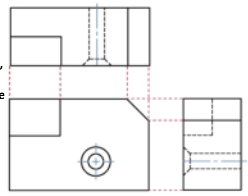


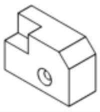




Engineering Drawings - Layouts and Dimensions

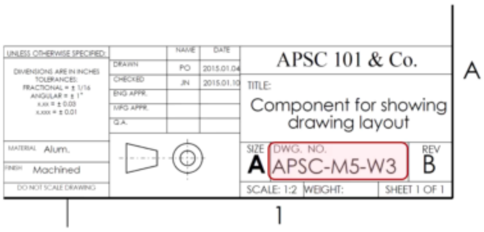
This arrangement of views, with *TOP VIEW* above and the *RIGHT END VIEW* to the right is known as "Third Angle Projection."





Engineering Drawings - Layouts and Dimensions

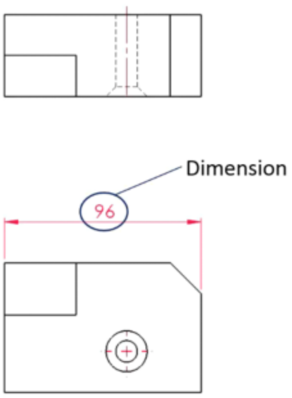
A title block is contains all the vital information about what this part is and where this drawing came from.



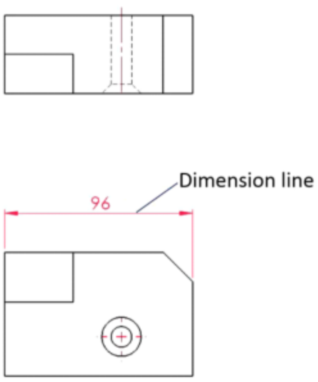
Things Found Common:

- **Drawing Name**
- **A number for the drawing**
- **A revision Number or Letter**
- **The Drawing Scale**
- **Who prepared the Drawing and Who Checked it**
- **Units and Precision of Dimensions**

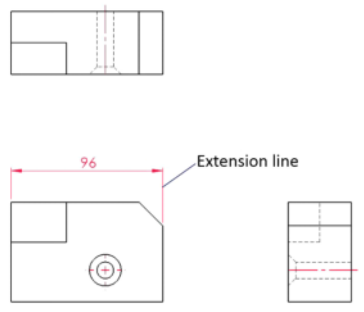
Engineering Drawings - Layouts and Dimensions



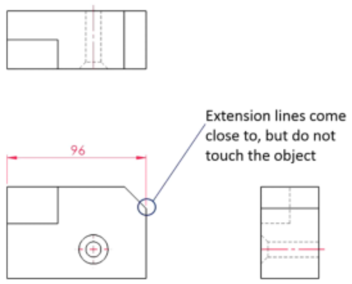
Engineering Drawings - Layouts and Dimensions



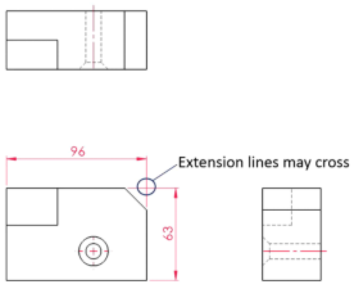
Engineering Drawings - Layouts and Dimensions



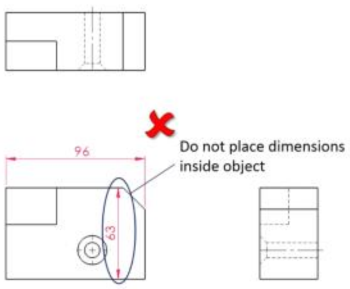
Engineering Drawings - Layouts and Dimensions



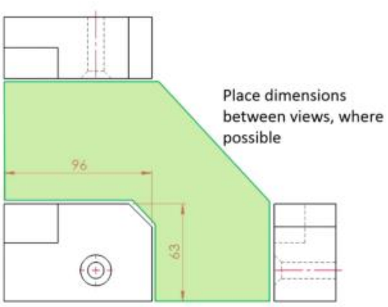
Engineering Drawings - Layouts and Dimensions

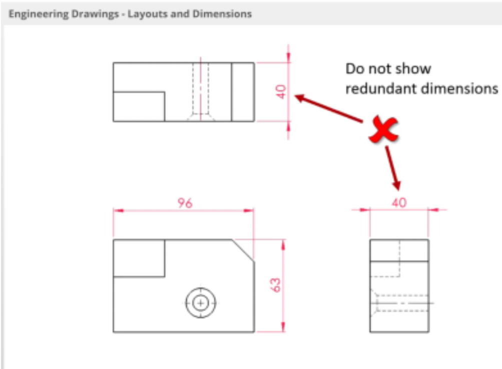


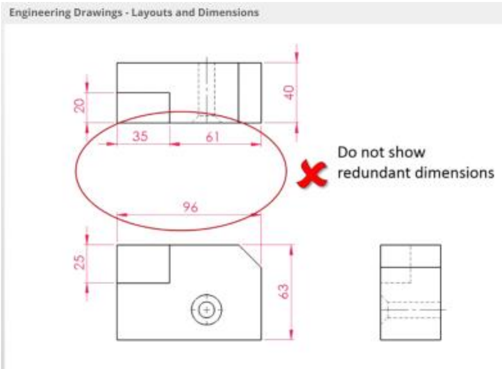
Engineering Drawings - Layouts and Dimensions



Engineering Drawings - Layouts and Dimensions







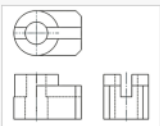
Engineering Drawings - Layouts and Dimensions

Dimensioning Guidelines

- Do not show redundant dimensions
- Do not place dimensions inside the object
- Place dimensions between views, when possible
- Dimension the view that most clearly shows the feature
- Extension lines may cross, dimension lines may not

Use of Each Type of Projection

- Isometric
  - Conveys shape in a way that is generally easier to understand
  - Very appropriate in conceptual design
- Orthographic
  - Provides additional views and reveals “hidden” features
  - Very appropriate for dimensioned drawings



Week 4

Helpful feedback is:

1. Descriptive, not judging
2. Specific with enough detail
3. Honestly given and viewed as credible
4. Expressed in terms of receiver's needs
5. Given in a timely way
6. Wanted by the receiver
7. Usable and can be enacted

Week 5

Module 6 Week 1 - Engineering and Sustainability

Learning objectives:

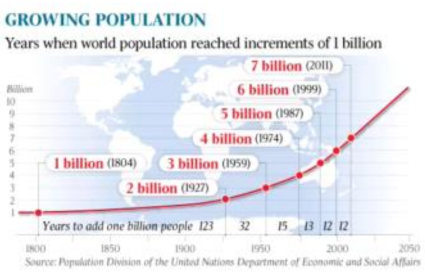
By the end of this video, you should be able to:

- Define sustainability
- State the three imperatives for sustainability
- Describe the drivers for sustainable development
- Explain engineering waves of innovation that influence society

Module 6 Week 1 - Engineering and Sustainability

Drivers for Sustainable Development

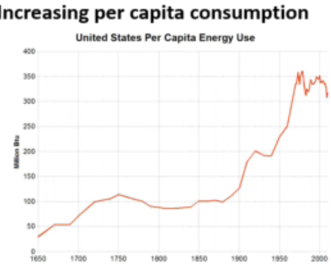
- **Population growth**



Module 6 Week 1 - Engineering and Sustainability

Drivers for Sustainable Development

- **Increasing per capita consumption**



Module 6 Week 1 - Engineering and Sustainability

Definition - Sustainability

Sustainbable development is the development wihc
Meets the needs of the presesnt generation without comporomising the abilty of futre generationsto meet their own needs.

Sustainable development is the development which meets the needs of the

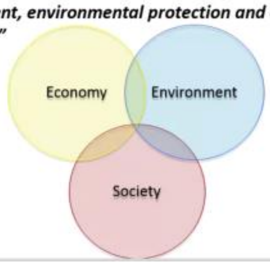
Definition - Sustainability

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
(http://www.un-documents.net/ocf-02.htm).

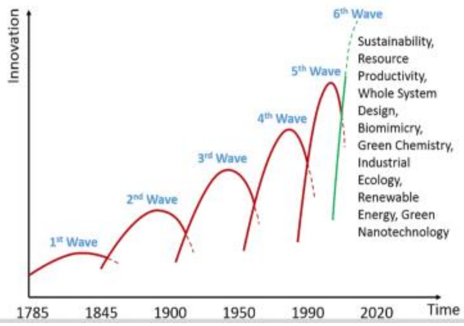
Module 6 Week 1 - Engineering and Sustainability

Summary: Definition of Sustainability

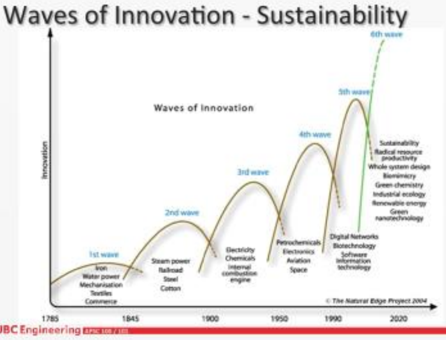
"Meeting the needs of current and future generations through a simultaneous achievement of social development, environmental protection and economic prosperity."



Module 6 Week 1 - Engineering and Sustainability



Waves of Innovation - Sustainability



UBC Engineering

Water for Sustainable Development – The Societal Imperative → need

- Access to drinking water – **quantity & quality**
- Access to sanitation – more people die due to a lack of sanitation than to a lack of access to clean drinking water
- Water is essential for food production - Approximately 2/3 of the water that we consume directly or indirectly is related to agriculture (e.g. the production of 1 kg of beef requires about 2,000 L of water)
- Poverty: Access to water is essential to reduce poverty, - MORE than this: poverty results in pollution and unsustainable use of water

UBC Engineering

Sustainbable development is the development wihc
Meets the needs of the presesnt generation without comporomising the abilty of futre generationsto meet their own needs.

Sustainable development is the development which meets the needs of the present genearation without comprosmising the abilty of future generation to meet their own needs.

Sustainable development is the development

Water for Sustainable Development – The Economic Imperative

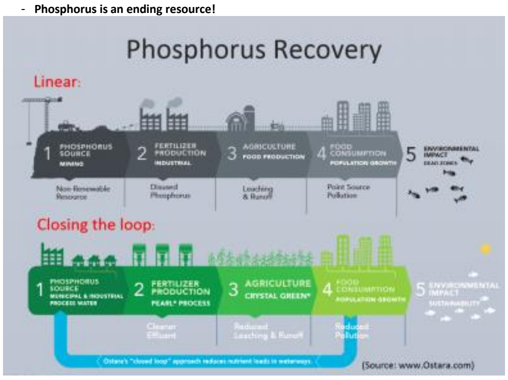
- Water is an essential resource for the production of goods and services
- Water supply (infrastructure) has to be reliable to reduce risks from water scarcity & water related disasters thereby supporting a financially sustainable economy
- Neglectful water management such as deforestation results in degradation and desertification of watersheds and catchment areas

UBC Engineering

Water for Sustainable Development – The Environmental Imperative

- Climate change has a substantial effect on water related issues
  - e.g. melting of arctic ice
  - Acidification of oceans
- Loss of species due to lack of access to clean water
- Eutrophication due to wastewater and agricultural run off

- **Phosphorus is crucial for food production -- essential fertilizer!**
- **Phosphorus is an ending resource!**



Week 6

Module 6 Week 6 - Sustainability and Engineering Design

Learning Goals

By the end of this video, you should be able to:

- Describe the engineering design stages that can be informed by sustainability
- Explain what is meant by "the systems approach" to engineering design
- Describe an example of a systems approach to engineering design

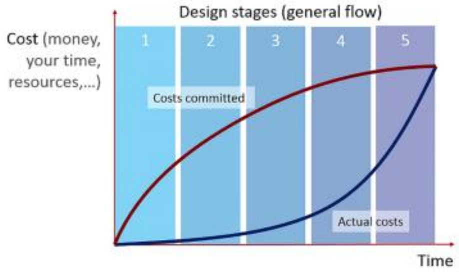
Module 6 Week 6 - Sustainability and Engineering Design

Sustainability and Engineering Design

Construct or detail the final solution.

Module 6 Week 6 - Sustainability and Engineering Design

Work in the early stages of the design process is inexpensive, but it commits future spending. Take the time to get the early parts right!



Module 6 Week 6 - Sustainability and Engineering Design

When should sustainability be considered within the design process? Please select the best answer.

- ○ During the early stages of the design process.
- ○ During the final stages of the design process.
- ◉ During the early and all following stages of the design process.
- ○ Sustainability should be considered particularly following the design process - i.e. during operation.

Module 6 Week 6 - Sustainability and Engineering Design

Which of the following are benefits of considering and implementing sustainability throughout a formal design process? (select all that apply)

- [x] More likely to get a better final solution
- [ ] Fewer design cycle iterations
- [x] More likely to implement the concept of sustainability into the project at lower costs
- [ ] Likely less complex problem solving

Sustainability

- Sustainability is about relationships, not objects
- It is a property of systems, not objects
- It is dependent on context, space, and tim
- Sustainability is the primary driver of val

Learning Objectives

- Describe the steps involved in applying the systems approach
- Explain why the Systems Approach to design is an integrated process
- Briefly explain the term "Water distribution system"
- Define the term "resiliency"

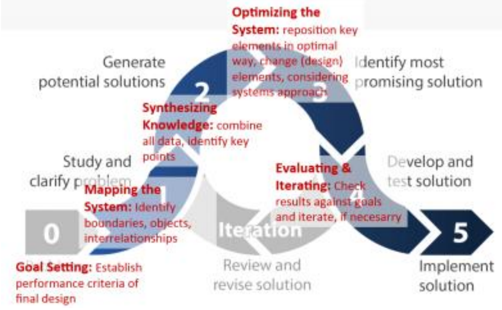
UBC Engineering

Systems Approach to Engineering Design

The Systems Approach Design Process

	Design Process Stages / Actions	
→ **Step 1** Design Context	**Goal Setting:** Establish performance criteria of final design	**Mapping the System:** Identify boundaries, objects, interrelationships
→ **Step 2** Network Scale Analysis	**Synthesizing Knowledge:** combine all data, identify key points	**Optimizing the System:** reposition key elements in optimal way, considering systems approach
→ **Step 3** Three Pillar Impacts	**Evaluating & Iterating:** Check results against goals and iterate as necessary	

How does the Systems Approach Map onto the Engineering Design Process?



Systems Approach to Engineering Design

The systems approach to design is integrated because the process aims to:

- consider all aspects of the object – including its influence at different scales of systems
- evaluate the object design options within the context of the design, and respecting the systemic impact of the design at different scales and over time
- include all stakeholders in the important design decisions

Defining Resiliency

The ability of a system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.
(adapted from the Intergovernmental Panel on Climate change)

Resiliency is the ability of a system to absorb disturbance while
retaining the same basic structure and ways of functionioning,

Resiliency is the ability of a system to absorb disturbances and retain its basic structure and ways of functioning, the capacity to adapt to stress and change

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Resiliency is the abilty ofa system to adopt to disturbance while retained it s basic strucure and way of functioning

Summary

- Sustainability to be considered in first stages of the design process and during all of the following stages
- **The systems approach is key** to making sustainable design decisions (**"an object cannot be sustainable"**)
- **Resiliency** is a characteristic of a healthy system. This is achieved if sustainability is considered in **all stages of the design process AND also after implementation (i.e. during operation)**

Week 7:

Learning Goals

By the end of this video, you should be able to:

- Explain the difference between environmental assessment and assessing for sustainability
- Define Life Cycle Assessment (LCA)
- Explain the applications of LCA
- Describe the Stages of a life cycle
- Describe the stages of LCA

M6 W7 - Assessing for Sustainability

Assessing for Sustainability (Environmental Assessment?)

Sustainability Goals include:
Eco-system well being (environment) & human well being (society & economy)

- Not about trade offs - human versus eco-system (in large/overall scale, trade offs might be necessary in smaller scale)
- Positive contribution, not mitigation of adverse effects
  - Much fuller recognition of benefits that results from activities or projects
  - Bar set higher

Assessing sustainability means more than environmental assessment.

Definition Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) is a tool for the systematic evaluation of the environmental* aspects of a product or service system through all stages of its life cycle. LCA provides an adequate instrument for environmental decision support. Reliable LCA performance is crucial to achieve a life-cycle economy. The International Organisation for Standardisation (ISO), a world-wide federation of national standards bodies, has standardised this framework within the series ISO 14040 on LCA.

M6 W7 - Assessing for Sustainability

Application Life Cycle Assessment (LCA)

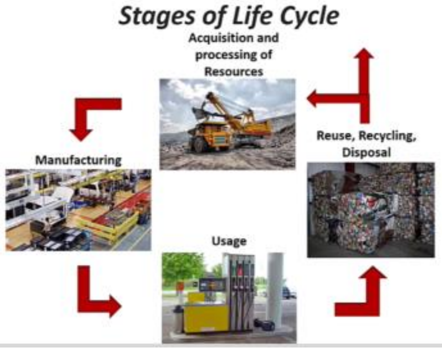
The implications of the outcomes of a LCA depends on the circumstances.

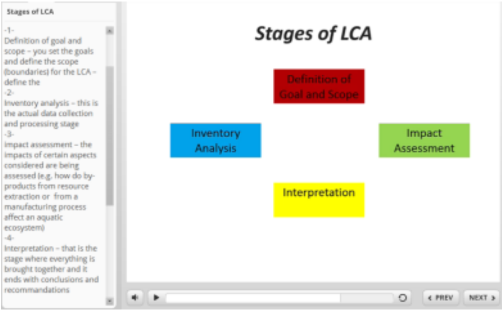
Proactive (early design stage) – design for sustainability:
- **Design recommendations**
- **Comparison of different alternatives**

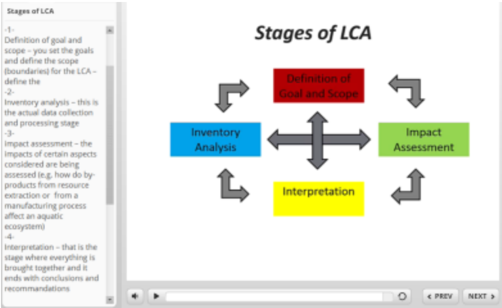
Best current practice (design finalized):
- **Suggestions regarding best practice for existing system – pollution prevention (in case of environmental LCA)**

M6 W7 - Assessing for Sustainability

Stages of Life Cycle







M6 W7 - Assessing for Sustainability

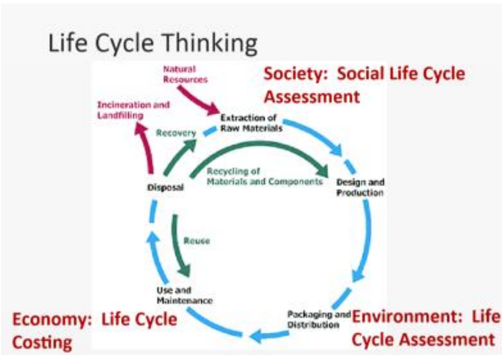
Which of the following aspects is considered to a greater extent when assessing for sustainability than during an environmental assessment?

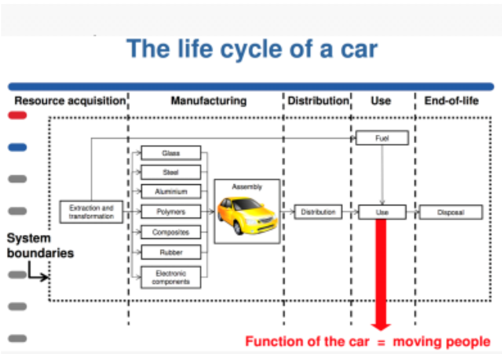
- ( ) Mitigation of adverse effects
- ( ) Trade of … well being
- (•) Positive …

Correct

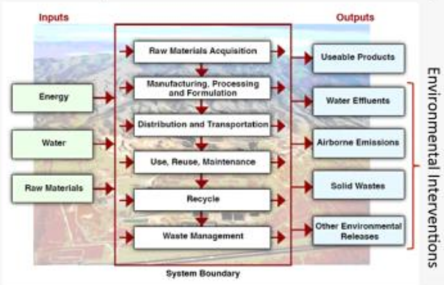
That's right! Assessing for sustainability is more about positive contributions. Considering the 3 pillars of sustainability, it provides a much fuller recognition of benefits that results from certain activities or projects.

Continue

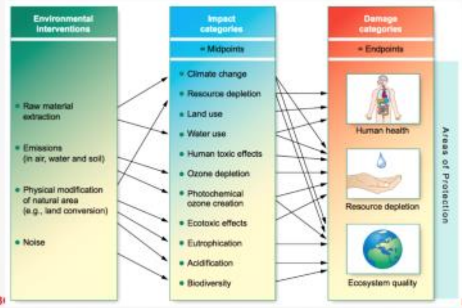




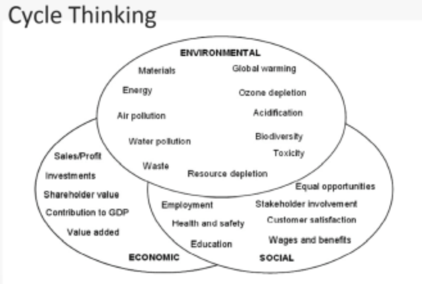
LCA – Step 2 The Material Flow Inventory



Step 3: What are the IMPACTS of the car on human health, Ecosystem Quality, and



Sustainability Issues relating to Life-Cycle Thinking



Learning Objectives

- Describe the 4 steps in an LCA
- Define the role of the functional unit in an LCA
- Identify an appropriate functional unit for an LCA
- Describe the difference between an SLCA and an LCA

Week 8:

Appropriate Technology

Learning Goals

By the end of this video, you should be able to:

- Explain the concept of Appropriate Technology
- List common features of Appropriate Technology
- Explain the importance of community for Appropriate Technology
- Explain the main objective of Res'Eau Waternet

Appropriate Technology

Appropriate Technology Attributes

Common attributes of appropriate technology:

- Small scale, decentralized
- Energy efficient
- Environmentally sound
- Locally controlled
- Simple & sophisticated technology

Appropriate Technology

Appropriate Technology - Approach

Appropriate technology – approach:

- **Appropriate technology considers context**
- Social constraints limitation
- Economic constraints
- Environmental constraints
- Bottom up approach - Design for and with the community

  Often, local people understand their needs better
  - Planners and developers need to include local people meaningfully

Appropriate Technology

Water treatment for small, rural and remote communities in Canada - Technology

Simple high tech / advanced technologies: Novel

Example: Novel Technology - Vacuum UV Example

- UV light at very low wavelength – i.e. high energy
- Ability to remove (oxidize) contaminants
- Ability to disinfect the water
- Simple, robust process,
- Does not require chemicals
- Cost effective at small scale

Appropriate Technology

Water treatment for small, rural and remote communities in Canada - Technology

Simple high tech / advanced technologies:

Example: Advanced Technology - Membrane Filtration

- Membranes: filters with very small pores - absolute barrier for contaminants and pathogens
- Very robust process
- Well suited for small system
- However, usually quite complex

Water treatment for small, rural and remote communities in Canada – Community

Community involvement:

- **Design for the needs of the community – design for and with the community**
- Social, economic, environmental constraints
- Relationship important for success (empathy, trust)
- Relationship and involvement to be continued during **implementation** stage and stage of usage

What is the most important aspect for appropriate technology being successful?

- ○ Simple design
- ○ Small sc
- ○ Low cap
- ◉ Bottom

Correct

That's right! There are common attributes to appropriate technology. However, technological requirements vary from case to case. The most important aspect is the community involvement - i.e. designing with and for the community.

Continue

What makes 'inappropriate' technology fail in rural areas or in developing countries?

- ○ People do not know how to use the technology
- ○ The tech
- ◉ The tech … nt it is impleme

Correct

That's right! The technology is not designed for the needs of the user and/or the environment it is implemented in. Otherwise, the chance of long term success is low.

Continue

What can be used as an indicator for the problems related to the supply of high quality, safe drinking water in small, rural communities in Canada?

- ◉ Frequent boil water advisories
- ○ Addition
- ○ No filtra
- ○ Water re

Correct

That's right! Frequent boil water advisories indicate that the treatment is insufficient to supply safe drinking water on a regular basis.

Continue

During which project stage is community involvement of great relevance?

- ○ Design stage
- ○ Impleme
- ○ Impleme
- ◉ Design s

Correct

That's right! Community involvement is crucial during all stages – design stage, implementation stage & stage of usage.

Continue

Learning Objectives

At the end of this class you should be able to:

- Describe what sustainability means in your own words
- Explain RES'EAU's structure for transforming ideas into impact
- Explain the community circle approach and how it is connected to stakeholder engagement
- List 2 criteria that you want to consider in your M7 design project

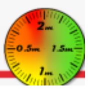
UBC Engineering APSC 100 / 101

Q2. Appropriate technology is often designed in a way that ensures that community members can maintain and repair the technology. This most likely increases… (choose the best answer)

A. Cost
B. Resiliency
C. Stakeholder engagement
D. Energy usage

Q1. Related to their water treatment, community members talked about the lake where water is withdrawn, alternative water sources and the communities needs? Which of the concepts taught in M6 did they apply when doing so?

A. Drivers of sustainability
B. Systems approach
C. Life cycle approach
D. Waves of innovation



UBC Engineering APSC 100 / 101

Q3. How can you best study the behaviour of a complex system?

A. Study the behaviour of each object of the system - the system behaves like the sum of its parts
B. Look for changes in behaviour of a large amount of objects – changes in behaviour of the majority of the objects will cause the system to change
C. Look for patterns/rules that are responsible for the interactions between objects
D. Study in detail the characteristics of one object – detail matters

Module 6

Week 1- ***Engineering Achievements and Sustainability***
Sustainability defined, drivers for sustainability, engineering innovations and achievements

Week 2- ***The Systems Approach to Engineering Sustainability***
Sustainability and the engineering design model, systems thinking, resiliency

Week 3- ***Life-Cycle Thinking in Engineering***
Assessing for sustainability, Life cycle assessment (LCA)

Week 4- ***Appropriate Technology***
Appropriate technology, stakeholder engagement

Module 7

Week 1- ***Stakeholder Needs to Design Criteria***
From the needs of stakeholder to design tools.

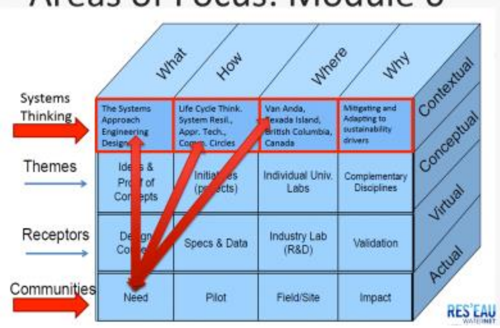
Week 2- ***Virtual Prototyping and Modeling***
Using virtual prototypes and data to make design decisions and model system level performance.

Week 3- ***Physical Prototyping and Modelling***
Conducting experiments to understand the effects of design parameters and help with system design.

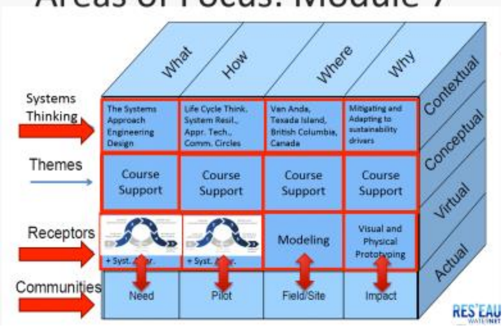
Week 4- ***Acting like an Engineer***
Justifying and supporting decisions and making assumptions.

Week 5- ***An Engineer's Role in Society***
Making engineering decisions and the Engineer's position in society. Competition and Course Wrap up.

Areas of Focus: Module 6

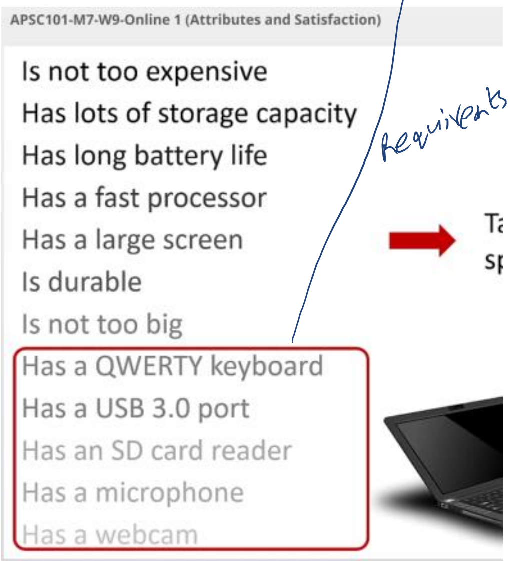


Areas of Focus: Module 7

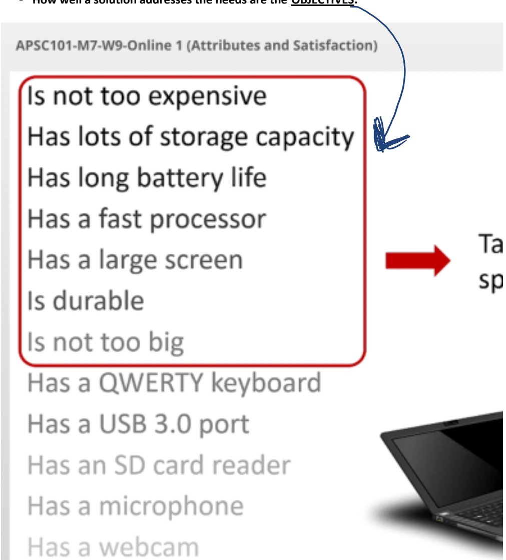


Week 9:

- **Stakeholder (WANTS AND WISHES) are *Needs***
- **Job of an engineer is to translate these stakeholder needs into target design specifications**
- **Looking at the list, some of the items are features that are either present or not, such as whether the laptop has a standard keyboard. These will become the requirements.**



- **How well a solution addresses the needs are the <u>OBJECTIVES</u>.**



<u>Requirements</u>:
- **are the much have features or parameter values for a design to be considered acceptable.**

<u>Objectives</u>:
- **Stakeholder preference is quantified using the *objectives*.**
- **are used to differentiate between performance that is barely acceptable, that is only just meeting any associated requirements - and performance that is outstanding.**

APSC101-M7-W9-Online 1 (Attributes and Satisfaction)

What is the name for the necessary features or performance thresholds that must be met for a design to be considered acceptable?

- Attributes
- Criteria
- Needs
- Objectiv
- Paramet
- (selected) Requirements
- Target design specifications

Correct

That's right! The necessary features or performance thresholds are the "requirements".

Continue

What is the name for the statements that characterize the wants and wishes of stakeholders?

- Attributes
- Crit
- (selected) Nee
- Obj
- Par
- Requirements
- Target design specifications

Correct

That's right! Stakeholder wants and wishes are the needs.

Continue

Which of the following is the most vague or subjective?

- (selected) Requirements
- Obj
- Nee
- Tar

Incorrect

You did not select the correct response. The "needs" are expressed in stakeholder language and are generally vague.

Continue

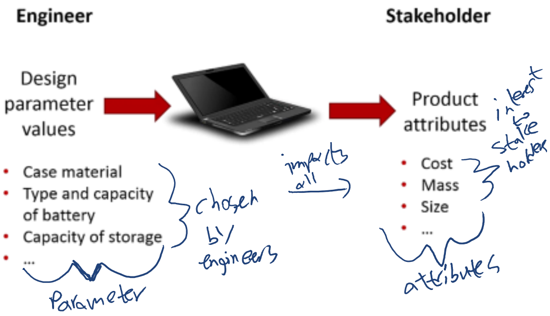
What is the name for the collection of requirements and objectives?

- Attributes
- Crit
- Nee
- Par
- (selected) Tar

Correct

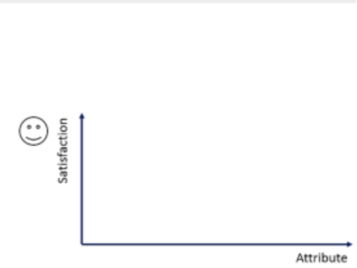
That's right! Requirements and objectives together form the target design specifications.

Continue



Satisfaction Curves

We use satisfaction curves to represent the design objectives in general. On the x-axis is the attribute. This is something important to the stakeholder. On the y-axis is satisfaction, sometimes depicted with a smiley face. It is something we are trying to maximize, all other things being equal. It ranges from 0 to 1, or 0% to 100%. The satisfaction curve provides a means by which to quantify performance in an objective from the target design specifications.

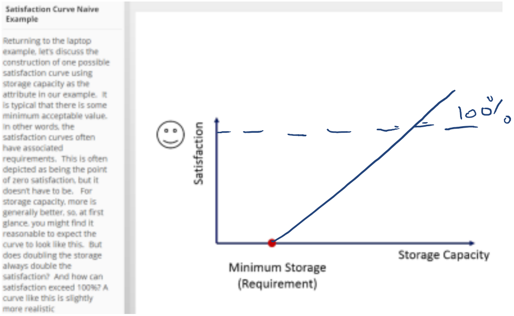


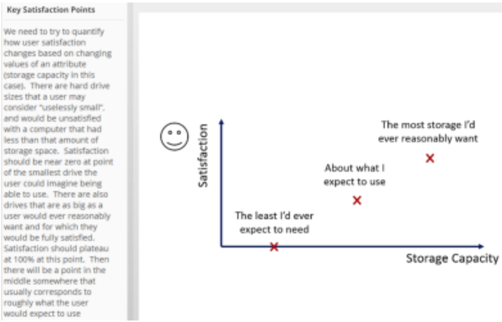
<u>Satisfaction Curves</u>:

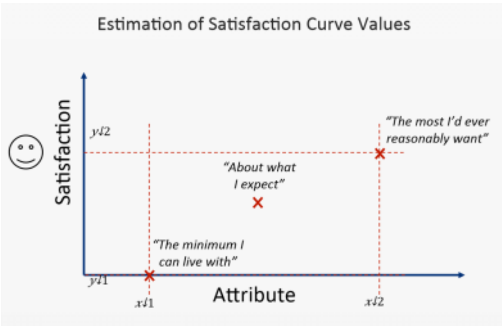
- **They represent Design Objectives**
- **x - axis is the attribute (THIS IS SOMETHING IMPORTANT TO THE STAKEHOLDER)**

- **y - axis is satisfaction sometimes depicted with a smiley face. It is something we are trying to maximize, all other things being equal. It ranges from 0 to 1 or 0% to 100%**

- **The satisfaction curve provides a means by which to quantify performance in *<u>an Objective</u>* from the target design specifications.**







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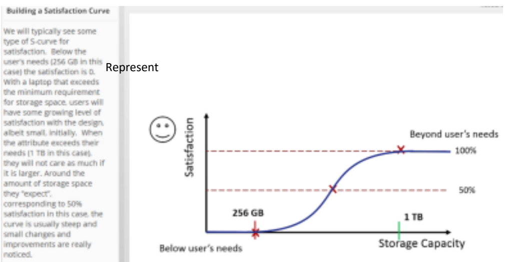
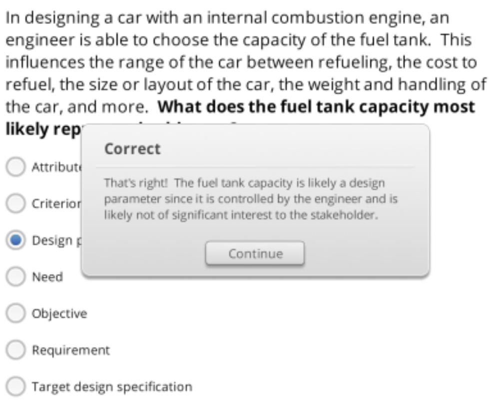




Continuing with the car example, what does "*cost to refuel*" most likely represent in this case?

- (selected) Attribut
- Criterion
- Design p
- Need
- Objective
- Requirement
- Target design specification

Correct

That's right! "Cost to refuel" is likely an attribute – something of interest to the stakeholders.

Continue

Continuing with the car example, what does *maximum acceptable cost to refuel* most likely represent in this case?

- Attribut
- Criterior
- (selected) Design p
- Need
- Objective
- Requirement
- Target design specification

Incorrect

You did not select the correct response. Maximum acceptable cost is expressing a pass/fail threshold. This is a requirement.

Continue

The value where satisfaction reaches zero on a satisfaction curve is often associated with which of the following?

- Attribut
- Criterior
- Design p
- (selected) Need
- Objective
- Requirement
- Target design specification

Incorrect

You did not select the correct response. Minimum/maximum acceptable performance is a pass/fail threshold. This is a requirement.

Continue

Which of the following best describes what satisfaction curves are used to quantify?

- Attribut
- Criteria
- Design p
- Needs
- (selected) Objectives
- Requirements
- Target design specifications

Correct

That's right! Satisfaction curves are used to quantify the objectives.

Continue

APSC101-M7-W1-Online 2B (Spreadsheet Simulation)

Learning Goals

- ***Describe*** the relationship between exit flowrate and water height for a tank with a submerged nozzle
- ***Describe*** how to use a spreadsheet to model a simple, time-varying physical system
- ***Use*** absolute and relative cell references in spreadsheet and perform calculations with constants

Which of the following would be appropriate for the units of Q?

- ◯ L
- ◉ L/s
- ◯ m/s
- ◯ m
- ◯ s

Correct

That's right! Q represents a volume flow rate (volume per unit time)

Continue

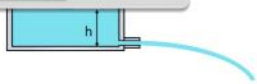
For a tank with an outlet on the bottom, as shown, how will the exit flow rate change if the height of water, *h*, inside the tank increases?

- ◉ It will inc
- ◯ It will sta
- ◯ It will de

Correct

That's right! Exit flow rate increases with the square root of height, h.

Continue



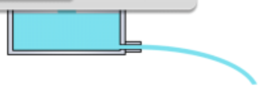
For a tank with an outlet on the bottom, as shown, how will the exit flow rate change if tank diameter is increased? Assume Qin is adjusted to maintain constant height.

- ◯ It will inc
- ◉ It will sta
- ◯ It will de

Correct

That's right! The flow rate out for a given height does not depend on diameter. Qout = A_nozzle*(2*g*h)^0.5

Continue



The following tanks all start with the same initial volume of water. Which one will take the longest to drain?

- ◉ Large tank diameter and small nozzle diameter
- ◯ Large ta
- ◯ Small ta
- ◯ Small ta
- ◯ Two or r

Correct

That's right! The large tank diameter will have a lower water height for the same volume, which leads to smaller Qout. Smaller nozzle diameter leads to smaller Qout. Qout = A_nozzle*(2*g*h)^0.5

Continue

APSC101-M7-W1-Online 2B (Spreadsheet Simulation)

Which of the following spreadsheet formulas correctly implements the following:

- Return a value of 1 when cell A1 is greater than cell A2
- Return a value of -1 when cell A2 is greater than or equal t

Correct

That's right! =if(A2<A1,1,-1) gives 1 when A1>A2 and -1 otherwise.

Continue

- ◯ =if(A2<=
- ◯ =if(A1>A
- ◯ =if(A1<A2,1,-1)
- ◉ =if(A2<A1,1,-1)

Which best describes, in words, the calculation being implemented in cell B14 below?

	A	B	C	D	E	F
3						
4	Parameters					
5	D	0.1	m			
6	A_tank	0.00785	m^2			
7	d_nozzle	0.002	m			
8	A_nozzle	3.1E-06	m^2			
9	dt	1	s			
10						
11	Time	Volume	Height	Qin	Qout	Qnet
12	[s]	[L]	[mm]	[L/s]	[L/s]	[L/s]
13	0	0.0	0.0	0.1	0.0	0.1
14		=B13+F13*B9		0.1	0.0	0.0
15	2	0.1	12.6	0.1	0.0	0.0

- ◯ The current volume will be equal to the net flow rate multiplied by a small time step
- ◯ The rate of change of volume will be the flow rate in minus the flow rate out
- ◯ The volume in the tank is a constant value
- ◯ The change of volume will be the current volume plus the flow rate

Which best describes, in words, the calculation being implemented in cell B14 below?

	A	B	C	D	E	F
3						
4	Parameters					
5	D	0.1	m			
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9	dt	1	s			
10						
11	Time	Volume	Height	Qin	Qout	Qnet
12	[s]	[L]	[mm]	[L/s]	[L/s]	[L/s]
13	0	0.0	0.0	0.1	0.0	0.1
14		=B13+F13*B9		0.1	0.0	0.0
15	2	0.1	12.6	0.1	0.0	0.0

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Which best describes, in words, the calculation being implemented in cell B14 below?

	A	B	C	D	E	F
3						
4	Parameters					
5	D					
6	A_tank	0.0				
7	d_nozzle					
8	A_nozzle	3.				
9	dt					
10						
11	Time	Vol				
12	[s]					
13	0	0.0	0.0	0.1	0.0	0.1
14		=B13+F13*B9		0.1	0.0	0.0
15	2	0.1	12.6	0.1	0.0	0.0

- (•) The current volume will be equal to the net flow rate multiplied by a small
- ( ) ...change of ... be the flow ... is the flow
- ( ) ... in the tank is ... value
- ( ) The change of volume will be the current volume plus the flow rate in

Correct

That's right! This equation is saying the volume a short time later is the volume at the current time plus the rate of change of volume times the time interval (delta t).

Continue

Which of the following expressions require additional constants to be included in order to make the units consistent? (select all that apply)

- [ ] V [L] = Q [L/s] * t [s]
- [ ] h [m] = V
- [x] V [L] = Q
- [ ] h [mm] =

Correct

That's right! V [L] = Q [m^3/s] * t [s] should actually be V[L] = 1000*Q[m^3/s] * t[s]

Continue

When does the water height in this scenario reach a steady state value (constant)?

- ( ) When th
- ( ) When th
- ( ) When th
- (•) When the flow rate out equals the flow rate in

Correct

That's right! When flow rate out equals flow rate in, there is no change in volume.

Continue

What best describes, in words, Step 3 of the algorithm?

Note: in Step 1 the water height was determined from volume; in Step 2 the net flow rate was determined; and step four involved iterating back to Step 1

- ( ) The change of height is equal to the difference of flow rates
- ( ) The volume is equal to the difference of flow rates
- (•) The volume at the next time is the volume at the current time plus the change in volume
- ( ) The volume at the next time is the volume at the current time plus the height

What best describes, in words, Step 3 of the algorithm?

Note: in Step 1 the water height was determined from volume; in Step 2 the net flow rate was determined; and step four involved i

- ( ) The cha
- ( ) The volu
- (•) The volu ... the change in volume
- ( ) The volume at the next time is the volume at the current time plus the height

Correct

That's right! The third step involved adding the change in volume (Qnet * dt) to the current volume to estimate the volume a short time later.

Continue

If the flow rate into the tank is reduced, what happens to the to the ***rate*** of change of height, assuming all other parameters remain unchanged?

- (selected) It becomes smaller (or more negative)
- There is
- It does n
- It becom

Correct

That's right! If the flow rate in decreases, the rate of change of volume decreases. Since the tank area does not change, the rate of change of height must become smaller (or more negative).

Continue

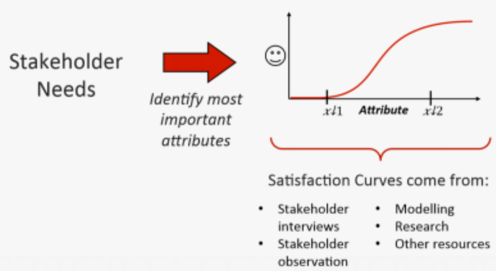
Learning Goals

By the end of this section, you should be able to:

- ***Describe*** what design satisfaction metrics (objectives) are and how they differ from stakeholders needs
- ***Convert*** needs into satisfaction curves to evaluate different designs
- ***Estimate*** numerical values to use with satisfaction curves, with *defensible decision* making

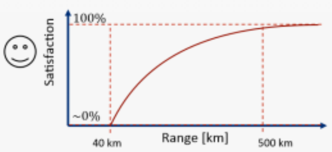
Engineering APSC 100 / 101

Process of Generating Satisfaction Curves



Estimation of Satisfaction Curve Values

Explanation and Assumptions:



- Based on common trips around Greater Vancouver Area
- Data Source: Google Maps
- Minimum satisfaction:
  - Refuel after a single short return trip
- Full Satisfaction:
  - Range that allows for long trips in the area without refuelling

Week 10:

Learning Goals

- ***Describe*** the relationship catchment area, rainfall, and flowrate into the storage tank
- ***Describe*** how to use a spreadsheet to model water collection in the rainwater harvesting system

Rainfall is often described in terms of height. How should the dimensions of rainfall actually be measured?

- (●) Volume per unit time, per unit area
- ( ) Volume
- ( ) Area
- ( ) Area per
- ( ) Volume

Correct

That's right! Rainfall measures the volume flow rate for a unit area

Continue

If the catchment area is doubled, how does the inflow to the tank, Qin, change?

- ( ) It more than doubles
- (●) It double
- ( ) No chan
- ( ) It halves
- ( ) It more t

Correct

That's right! Double the catchment area doubles the volume captured.

Continue

If the following glasses are left in the rain, and if all have equal volume, which glass would fill to the top with rainwater ***first***?

Note: if the volumes are equal, the glass sizes are not shown to scale.

Correct

That's right! The glass to fill first is the one with the largest ratio of top diameter to height.

Continue

For the same scenario, which glass would fill to the top with rainwater ***last***?

Note: the volumes are equal - the glass sizes are not shown to scale.

Incorrect

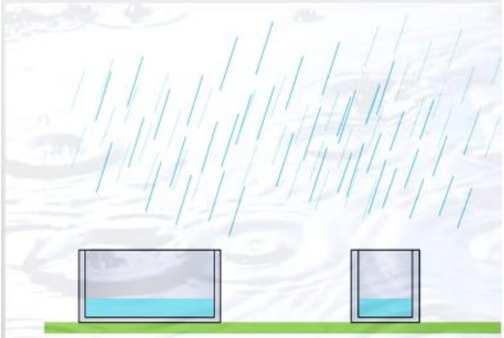
You did not select the correct response. The glass to fill last is the one with the smallest ratio of top diameter to height.

Continue

- **Rainfall is usually measured in units of height per time**
- **They say "10mm of rain are expected overnight" but what is really meant here is that there is a *<u>Volume flow rate of rain per unit area</u>*. ---> Volume flow rate of rain/ Unit Area**
- **Analogy :**

  If we put out 2 open containers into the rain, one container that is wide another that is narrow, they will both fill with rainwater to the same height for a given amount of time. The difference is the wider container will have more total volume.

APSC101-M7-W10-Online 1



The Module 7 simulation will be based on what unit of time? (i.e. what is the temporal resolution of the simulation?)

- ○ Minutes
- ○ Hours
- ○ Days
- ○ Weeks
- ○ Months
- ◉ Years

Incorrect

You did not select the correct response. You will model rainfall, inflow, and outflow on a per day basis.

Continue

In the simulation, when computing the volume based on Q_{in}, the formula was modified from "=D13+C14" to "=D13+C14*1". What was the "*1" for?

- ○ It indicates in Excel that the formula is going to be copied
- ◉ It represented "1 day" as a reminder that C14 was in m^3/day not in m^3
- ○ It converted the data in C14 from text to a number
- ○ It forces C14 to be a relative reference

	A	B	C	D
6	Roof width	W	8	m
7	Roof length	B	12	m
8	Catchment area	Ac	96	m^2
9	Initial volume	Vin	0	m^3
10				
11	**Date**	**Daily Rainfall**	**Qin**	**Volume**
12	[-]	[mm]	[m^3/day]	[m^3]
13	Mar 1	1.2	0.115	0.115
14	Mar 2	5.2	0.499	
15	Mar 3	1.8	0.173	

APSC101-M7-W10-Online 1 Resources

What formula should be entered in cell D14 to compute the volume for Mar 2?

- ◉ =D13+C14
- ○ =D$13+(
- ○ =C9+D1
- ○ =C$9+C1
- ○ =C9+C14
- ○ =C$9+D13+C14

Correct

That's right! The volume on May 2 is the volume on May 1 (D13) plus the volume flow rate on May 2 (C14) times the duration (1 day, not shown since C14 is in units of volume per day)

Continue

	A	B	C	D
				n
				n
				n^2
				n^3
				Volume
				[m^3]
				0.115
14	Mar 2	5.2	0.499	
15	Mar 3	1.8	0.173	
16	Mar 4	8.0	0.768	
17	Mar 5	1.6	0.154	
18	Mar 6	10.6	1.018	

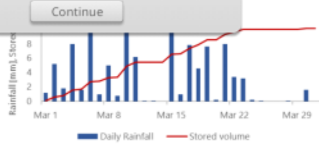
In the simulation output, why did the stored volume only increase?

- ○ The tank had infinite volume
- ○ Daily rai
- ◉ There w

Correct

That's right! We did not model the flow out of the tank.

Continue



What factors were identified in the video as things that were not considered in this simulation but will be important for your simulation? (Select all that apply)

- [ ] Need to
- [ ] Need to
- [ ] Need to
- [x] Need to
- [x] Need to consider the maximum tank volume to determine when it is full

Correct

That's right! The two main parameters are how much water can we store in our tank (when is it full) and how much water is consumed (what is the outflow)

Continue

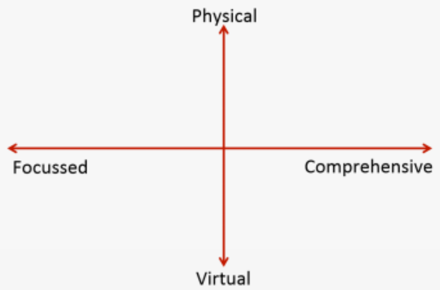
$$\frac{\text{Volume}}{\text{Area}} = \frac{\text{area} \times h}{\text{area}} \rightarrow \text{height}$$

Learning Goals

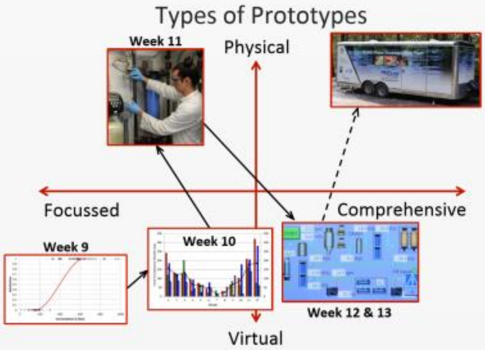
By the end of this section, you should be able to:

- ***Describe*** what a model is and how it can be used to make defensible design decisions
- ***List*** some advantages and disadvantages of virtual prototypes
- ***Prepare*** to design and implement a system level model for your RWH project

Types of Prototypes



Types of Prototypes



Virtual Prototypes

Advantages of Virtual Prototypes

- Inexpensive
- Often faster to develop than physical

Cheaper and quicker than Physical

Disadvantages of Virtual Prototypes:

- Rely on approximations – need to understand limitations
- Need to interpret the results to apply them to physical systems

Computer models are one common method of virtual prototyping

Computer Modelling

Why we use computer models:

- Flexible – can easily make changes
- Powerful – modern computing power
- Numerical – allow us to approximate some equations that we cannot solve exactly on paper

Learning Goals

By the end of this section, you should be able to:

- ***Describe*** how system parameters affect multiple attributes and user satisfaction
- ***Design*** and ***create*** a computer model to simulate energy in a system
- ***Describe*** how energy is lost in real systems

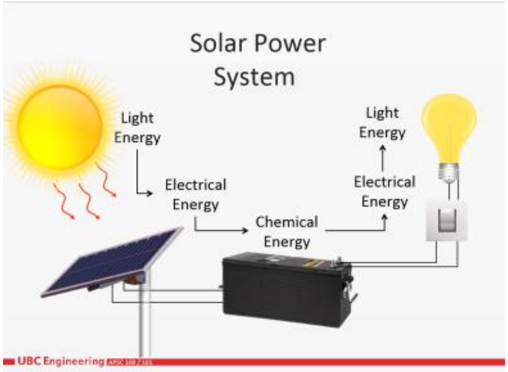
UBC Engineering

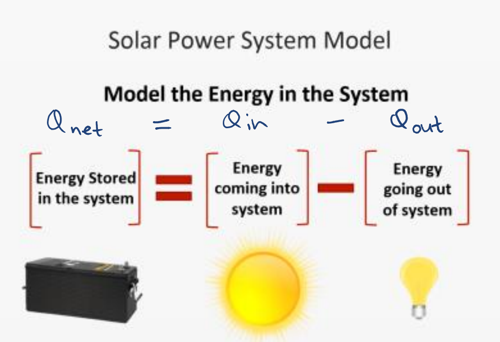
Solar Power System

One possible way to provide electrical power for remote applications.

Advantages:

- No local emissions
- Silent operation
- No fuel to transport during operation





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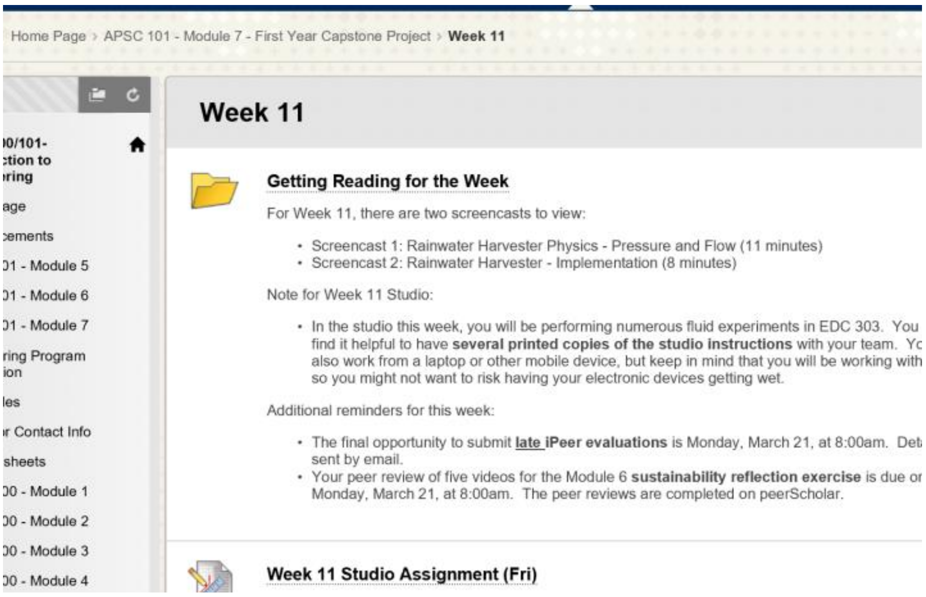
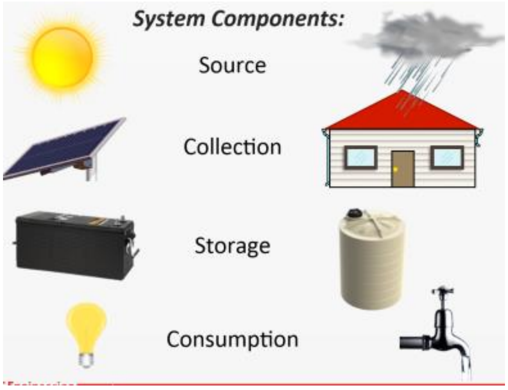
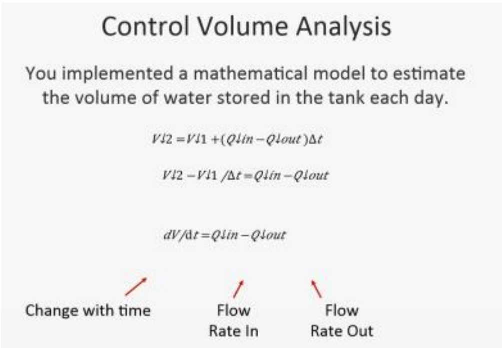
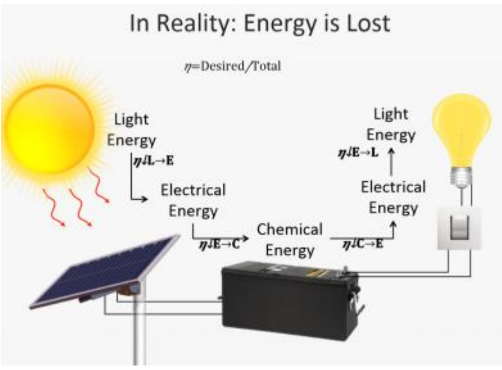
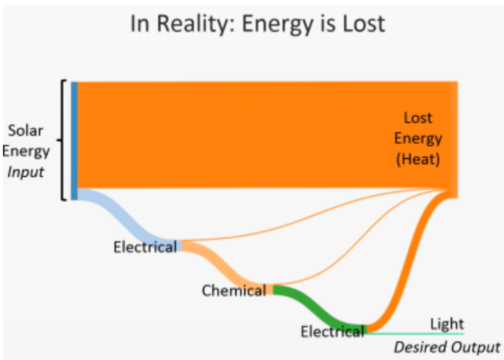
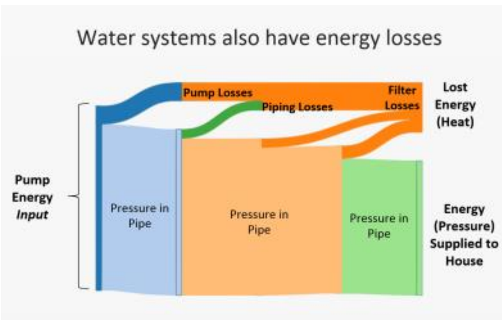


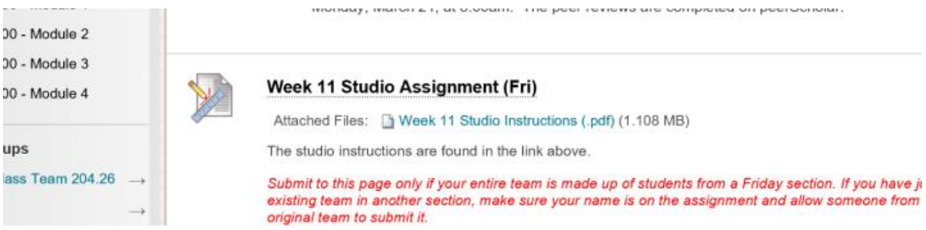

System Components:
Source
Collection
Storage
Consumption


Control Volume Analysis
You implemented a mathematical model to estimate the volume of water stored in the tank each day.
V↓2 = V↓1 + (Q↓in − Q↓out)Δt
V↓2 − V↓1 /Δt = Q↓in − Q↓out
dV/Δt = Q↓in − Q↓out
Change with time
Flow Rate In
Flow Rate Out


In Reality: Energy is Lost
η=Desired/Total
Light Energy
η↓L→E
Electrical Energy
η↓E→C
Chemical Energy
η↓C→E
Electrical Energy
η↓E→L
Light Energy


In Reality: Energy is Lost
Solar Energy Input
Lost Energy (Heat)
Electrical
Chemical
Electrical
Light
Desired Output


Water systems also have energy losses
Pump Losses
Piping Losses
Filter Losses
Lost Energy (Heat)
Pump Energy Input
Pressure in Pipe
Pressure in Pipe
Pressure in Pipe
Energy (Pressure) Supplied to House


00 - Module 2
00 - Module 3
00 - Module 4
ups
lass Team 204.26
Week 11 Studio Assignment (Fri)
Attached Files: Week 11 Studio Instructions (.pdf) (1.108 MB)
The studio instructions are found in the link above.
Submit to this page only if your entire team is made up of students from a Friday section. If you have j existing team in another section, make sure your name is on the assignment and allow someone from original team to submit it.

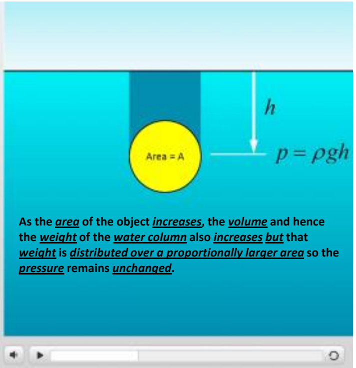
Week 11:

Learning Goals

- ***Describe*** the relationship between pressure and depth in a fluid
- ***Describe*** the relationship between flow rate, flow velocity, and pressure for a discharging tank
- ***Describe*** the effect of piping losses, flow restrictions, and elevation changes have on pressure in a piping system

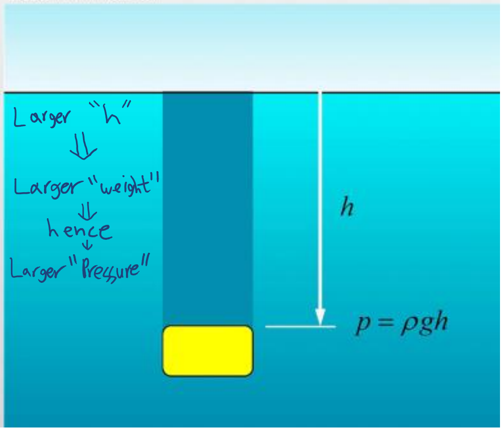
Pressure and depth 3

When we talk about the weight of the water column above our object, it is important to recognize this is based on the projected area of our object, as we look from above. You notice that area does not appear in the equation. As the area of our object gets bigger, the volume and, and hence the weight of the water column also increases; however, that weight is distributed over a proportionally larger area. So the pressure remains unchanged. The units of pressure are force per unit area, or N/m^2. This is, by definition, Pascals. If we now move our object further down, the water column is larger and has larger weight. And the pressure also is larger, again proportional to the new depth, h.



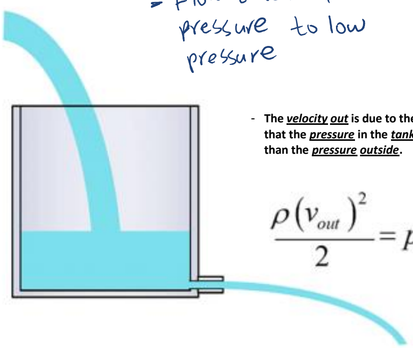
As the *__area__* of the object *__increases__*, the *__volume__* and hence the *__weight__* of the *__water column__* also *__increases__* *__but__* that *__weight__* is *__distributed over a proportionally larger area__* so the *__pressure__* remains *__unchanged__*.

APSC101-M7-W11-Online 1



Pressure and Q_{out}

- Flow travels from high pressure to low pressure



- **The *__velocity out__* is due to the fact that the *__pressure__* in the *__tank__* is *__larger__* than the *__pressure outside__*.**

$$\frac{\rho (v_{out})^2}{2} = p$$

Everyday example

In blowing up a balloon, you need to force area through the opening of the balloon. The pressure inside the balloon is higher than the atmospheric pressure. This is due to the elastic walls of the balloon pushing inward. Your lungs and mouth need to create a pressure greater than the pressure inside the balloon in order to cause air to flow in.

- **As the pressure inside the balloon is higher than the atmospheric pressure hence your lungs and mouth need to create a pressure greater than the pressure inside in order to**

cause air to flow in (balloon to expand)

What dimensions are used to describe pressure?

- ◯ Force
- ◯ Force pe
- ◉ Force pe
- ◯ Force pe
- ◯ Mass pe
- ◯ Mass per unit area
- ◯ Mass per unit volume

Correct

That's right! Pressure is measured in force per unit area (e.g. weight per unit area in the video)

Continue

Object 1 has area A (viewed from above) and is submerged in water to a depth h. Object 2 has area 0.5A and is submerged to a depth 2h. How does the pressure on Object 1 (p_1) compare to Object 2 (p_2)

- ◯ $p_1 > 2p_2$
- ◯ $p_1 = 2p_2$
- ◯ $p_1 = p_2$
- ◉ $2p_1 = p_2$
- ◯ $2p_1 < p_2$

Correct

That's right! The area of the object does not affect the pressure, but doubling the depth doubles the pressure.

Continue

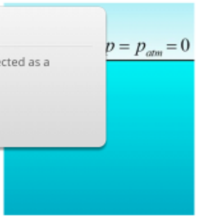
In the video example of the object being submerged under water, why was the atmospheric pressure treated as 0?

- ◯ The den density
- ◯ Atmospl neglecte
- ◉ It was ch were me
- ◯ Pressures are always defined relative to the pressure at sea level

Correct

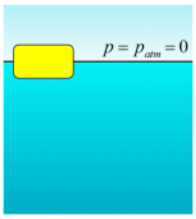
That's right! The pressure was selected as a reference.

Continue



In the video example of the object being submerged under water, why was the atmospheric pressure treated as 0?

- ◯ The density of air is much less than the density of water
- ◯ Atmospheric pressure is small and can be neglected
- ◉ It was chosen as a reference – all pressures were measured relative to this
- ◯ Pressures are always defined relative to the pressure at sea level



Which of the following are explanations of why air exits an inflated balloon, if the opening of the balloon is exposed to the atmosphere? (select all that apply)

- ☐ The pressure of the air in the bottom of the ballc of the ai
- ☑ The wall push inv inflated
- ☑ The pres greater than the pressure outside
- ☐ Gravity pulls the air out of the balloon

Correct

That's right! Pressure is greater inside the balloon. This is due to the walls of the balloon pushing inward.

Continue

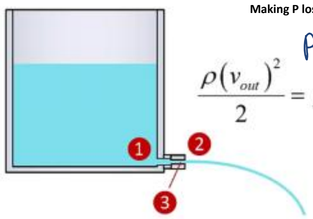
Losses through Restrictions

At P1 the pressure is the highest and it decreases as you go right towards P loss. Making P loss with the least pressure.

p \ p \ p

At P1 the pressure is the highest and it decreases as you go right towards P loss. Making P loss with the least pressure.

$P_1 > P_2 > P_{loss}$



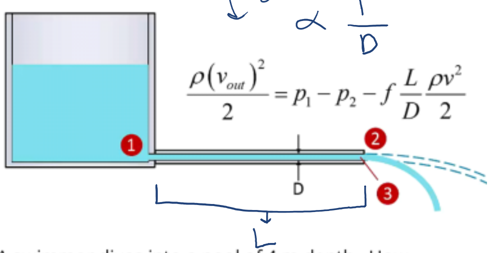
$$\frac{\rho (v_{out})^2}{2} = p_1 - p_2 - p_{loss}$$

Losses through Piping

D - is the diameter of the pipe
L - is the length of the pipe

Friction Losses $\propto L$ and $\propto \frac{1}{D}$

$$\frac{\rho (v_{out})^2}{2} = p_1 - p_2 - f \frac{L}{D} \frac{\rho v^2}{2}$$



A swimmer dives into a pool of 4 m depth. How different is the pressure when they touch the bottom compared to when they are midway between the bottom and surface?

- ( ) Pressur
- ( ) Pressur
- ( ) The two
- (•) Pressur
- ( ) Pressure at the bottom is more than twice as large

Correct

That's right! Pressure varies linearly with depth; twice the depth = twice the pressure.

Continue

In the expression for the losses in a pipe component, what does the parameter "K" represent?

$$p_1 - p_2 - K \frac{\rho v^2}{2}$$

- ( ) The velo
- ( ) The pres
- ( ) The flow
- ( ) The ratio
- (•) A loss coefficient that is tabulated for common components

Correct

That's right! K is the "loss coefficient" and tabulated values are available for common components (e.g. valves, elbows, and contractions)

Continue

Which of the following parameters, if increased, will increase the pressure losses in a pipe? (Select all that apply)

- [ ] Pipe dia
- [x] Flow velo
- [x] Fluid den
- [x] Pipe leng
- [x] Friction factor, f

Correct

That's right! All of the parameters increase losses, except for pipe diameter (increasing D will decrease losses)

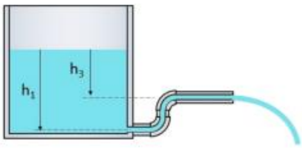
Continue

Which of the following are elements of the rainwater harvesting system that you will be considering as you design your system? (Select all that apply)

- [x] Piping to and from storage
- [x] A pump
- [x] A filtration system
- [x] A storage tank
- [ ] Connections to a community distribution network
- [x] A catchment area
- [x] A collection tank

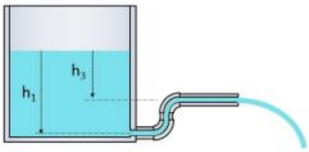
Which of the following best describes the outlet height, h_3, for this tank such that there is no flow out?

- ( ) $h_3 \leq 0$ ✓
- ( ) $h_3 = 0$ ✗
- ( ) $h_3 \geq 0$ ✗
- (•) $h_3 = h_1$ ✗
- ( ) $h_3 \geq h_1$ ✗



If the outlet for this tank is modified such that $h_3 > h_1$, what will happen to the flow rate out compared to if $h_3 = h_1$?

- ( ) There will be no flow ✗
- ( ) It will be slower ✗
- ( ) It will be the same ✗
- ( ) It will be faster ✓

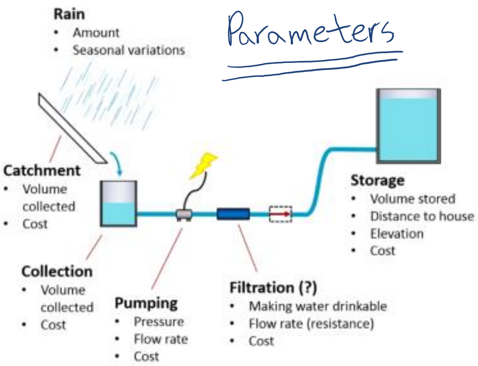


Week 11 Part 2:

APSC101-M7-W11-Online 2

Learning Goals

- ***Describe*** the arrangement and role of components in the rainwater harvesting system
- ***Explain*** how flow rate depends on the selection and sizing of the pump, filtration, and piping, and on the location of the storage tank



What dictates the minimum acceptable flow rate for the rainwater harvester system?

- ( ) Peak and average rainfall rate
- ( ) Catchme
- ( ) Storage
- (•) Require
- ( ) Pump fl
- ( ) Distance to storage tank and storage tank elevation

Correct

That's right! The minimum ***acceptable*** flow rate is dictated by the stakeholder consumption requirements.

Continue

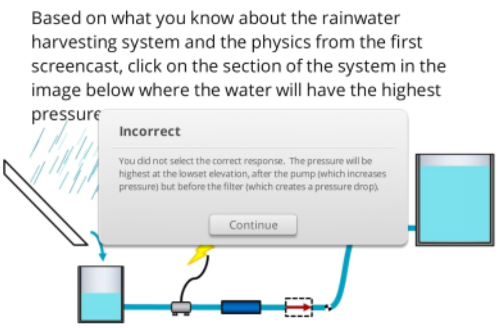
Where should the filtration system be placed?

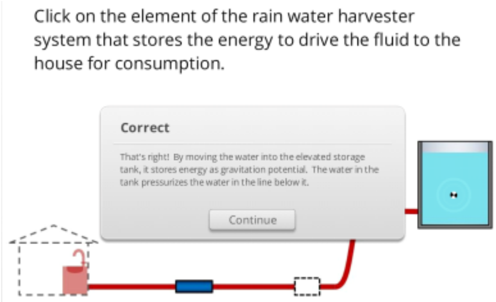
- ( ) On the li
- (•) It can be
- ( ) On the li

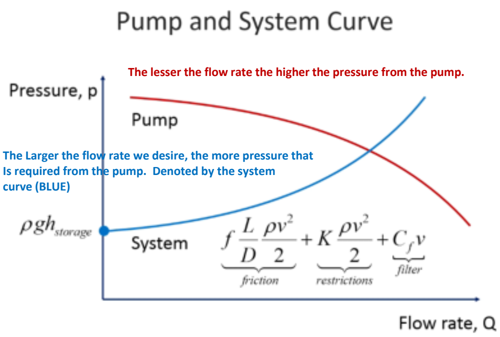
Correct

That's right! The filter can be placed on either line. This is an important decision though, as it will have significant impacts for flow rate, size, cost, and so on.

Continue

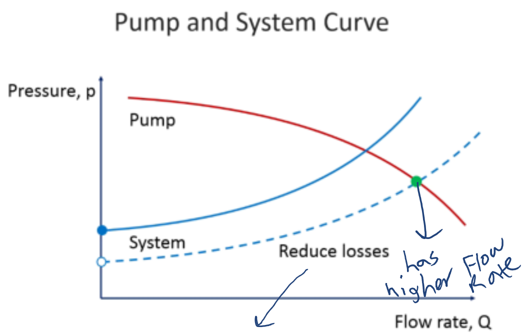




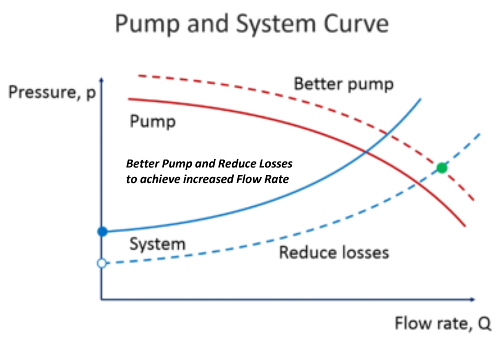


The lesser the flow rate the higher the pressure from the pump.

The Larger the flow rate we desire, the more pressure that Is required from the pump. Denoted by the system curve (BLUE)



- **To increase flow rate we can decrease the losses:**
  - **Reducing the elevation of the storage tank**
  - **shortening the distance to the storage tank (decrease length of the pipe)**



Which of the following describes the pressure to flow rate relationship for a typical pump?

- (●) Highest
- ( ) Highest
- ( ) Pressur
- ( ) Highest
- ( ) Lowest pressure at intermediate flow rates

Correct

That's right! Pressure tends to be highest at low flow rates, and lowest at high flow rates.

Continue

In the equation below, select the term that represents the pressure lost to the elevation change from the pump to the storage tank.

p_{pump} (... $+C_f v\Big)$

Correct

That's right! The elevation difference is represented by rho g h.

$\rho g h_{storage}$

Continue

In the equation below, select the term the represents the pressure lost to friction in the pipe between collection tank and the storage tank.

p_{pump} (... $+C_f v\Big)$

Correct

That's right! The pressure lost in the pipe depends on the friction factor, f, pipe length L, pipe diameter D, water density, rho, and flow velocity v. You didn't need to memorize this, but hopefully you remembered that pressure lost in a pipe increases with L, and this is the only term that includes an L.

Continue

What do the three terms in parentheses in the equation below mean when taken together?

$$p_{pump}(v) = \rho g h + \left(f \frac{L}{D}\frac{\rho v^2}{2} + K\frac{\rho v^2}{2} + C_f v \right)$$

- (●) Pressure losses
- ( ) Kinetic energy
- ( ) Elevation gain
- ( ) Pump power

What do the three terms in parentheses in the equation below mean when taken together?

$$p_{pump}(v) = \rho g h + \left(f \frac{L}{D}\frac{\rho v^2}{2} + K\frac{\rho v^2}{2} + C_f v \right)$$

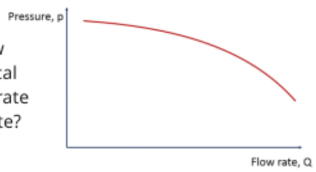
- (●) Pressur
- ( ) Kinetic e
- ( ) Elevatio
- ( ) Pump power

Correct

That's right! The three terms represent piping losses, losses through components, and friction through the filter.

Continue

Considering the pressure versus flow rate curve for a typical pump, at what flow rate will the pump operate?



- ( ) What ever flow rate we set
- (●) Where the system curve crosses the pump curve in the figure
- ( ) At the flow rate corresponding to pressure "pgh"
- ( ) At steady state, it will operate at the point with maximum flow rate
- ( ) At steady state, it will operate at the point with minimum flow rate

If we collect enough rainfall but our pump does not transport a sufficient volume of water to the storage tank, what are some options? (Select all that apply)

- [ ] Increase the loss coefficient, K
- [x] Increase pipe diameter ✓
- [x] Increase the pump size or capacity ✓
- [x] Reduce storage tank elevation ✓
- [x] Decrease pipe length ✓

Shaheer Khan

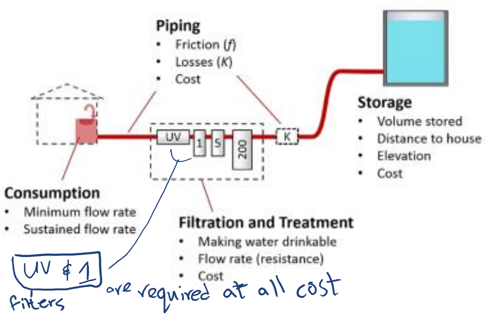
Week 12:

APSC101-M7-W12-Online 1

Learning Goals

- ***Describe*** the arrangement and role of the filter components in the rainwater harvesting system
- ***Describe*** how the satisfaction curves are used and combined to determine overall system satisfaction
- ***Explain*** how a spreadsheet can be used to develop a numerical model of the rainwater harvester water consumption line subsystem

APSC101-M7-W12-Online 1



Select the correct order of the water treatment elements.

- ( ) 1 micron filter -> 5 micron filter -> 200 micron filter -> UV purifier
- (•) 200 micron filter -> 5 micron filter -> 1 micron filter -> UV purifier
- ( ) UV purifier -> 1 micron filter -> 5 micron filter -> 200 micron filter
- ( ) UV purifier -> 200 micron filter -> 5 micron filter -> 1 micron filter
- ( ) The order of elements does not matter.

Which of the following components are required to be on your system?

- [x] 1 micron filter
- [ ] 5 micron filter
- [ ] 200 micron filter
- [x] UV purifier

Why is it important that the UV purifier come after the filters?

- ( ) The UV purifier can become clogged with sediment
- (•) The UV purifier may not work if the water is cloudy
- ( ) The UV purifier requires the filters to remove pathogens first

If the life in litres of the 1 micron filter depends on whether or not the 5 micron filter is used as a pre-filter, which *function* in a spreadsheet could be used to insert the appropriate value for the 1 micron filter life?

- ( ) =Sum()
- ( ) Absolute reference ($)
- (•) =If()

What happens if your system cannot deliver the consumption value you specify?

- ( ) Your solution is disqualified
- ( ) You incur a cost penalty
- ( ) You incur a reliability penalty
- (•) You incur a cost and reliability penalty

How are design trade-offs resolved in determining the project scoring?

- ( ) By determining the overall highest satisfaction
- (•) By deter... requirem... ...all
- ( ) By deter...

Incorrect

You did not select the correct response. Designs must meet requirements; trade-offs are resolved by looking at highest overall satisfaction.

Continue

How is the overall satisfaction determined?

- ( ) By averaging satisfaction scores ✗
- ( ) Using the sum of satisfaction scores ✗
- (•) Using a weighted sum of satisfaction scores ✓
- ( ) Using the product of satisfaction scores ✗
- ( ) By counting the number of requirement violations ✗

Which of the following are potential reasons for ***NOT*** including a 5 micron filter in your system (assuming the filters are on the line from storage to the house)?

- [ ] Increase in on demand flow rate
- [x] Reductio...
- [ ] Increase...

Incorrect

You did not select the correct response. Removing the filter might reduce initial cost and increase on demand flow. Consumption is dictated by the subsystem from catchment to storage.

Continue

Which of the following are potential ***negative consequences*** of not including a 5 micron filter in your system for this project (assuming the filters are on the line from storage to the house)?

- [x] Increase...
- [ ] Increase...
- [x] Increase...
- [ ] Decreas...

Correct

That's right! Removing the filter might increase fouling of the 1 micron filter, which might require additional maintenance.

Continue

Which of the following are potential ***negative consequences*** of not including a 5 micron filter in your system for this project (assuming the filters are on the line from storage to the house)?

- [x] Increase in the rate of fouling of the 1 micron filter *consequences* of not including a 5 micron filter in your system for this project (assuming the filters are on the line from storage to the house)?

- [x] Increase in the rate of fouling of the 1 micron filter
- [ ] Increase in the rate of fouling of the 200 micron filter
- [x] Increase in maintenance costs
- [ ] Decrease in on demand flow rate

Which constant in this equation will change if a 10 micron filter is added to the system?

$\rho g h_{stor}$ … $+ C_f v$

Correct

That's right! Cf describes the friction due to the filters.

Continue

Imagine the 1, 5, and 200 micron filters are all used and their respective C_f values are 10,000, 1,000, and 100. What value of C_f for the system should be used?

- ( ) 100 (the minimum)
- ( ) 1,000 (th
- ( ) 3,700 (th
- ( ) 10,000 (t
- (•) 11,100 (t

Correct

That's right! The final Cf value is the sum of the values from each filter.

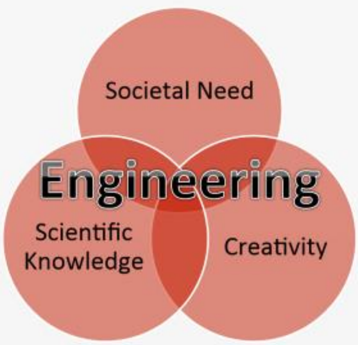
Continue

As an engineer, you need to ***make***, ***communicate***, and ***defend*** decisions that are based on incomplete and sometimes contradictory information.

Week 12 and 13:

Acting Like an Engineer

Role in Society



Learning Goals

By the end of this section, you should be able to:

- ***Describe*** effective practices in teamwork
- ***Demonstrate*** ethical behavior and describe the importance of engineering codes of ethics, both at the student and professional level
- ***Describe*** the contributions that an engineer can make to society as well as the impact (both positive and negative) that an engineering project can have on society

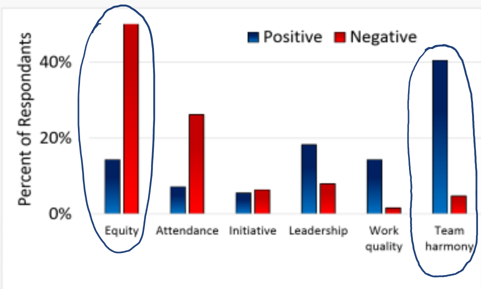
UBC Engineering

Engineering problems have societal impact.

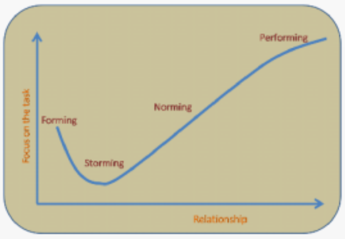
As an engineer, you need consider all stakeholders, including you're the profession of engineering, in your decision-making

How Significant Has Each Issue Been

Most Positive & Negative Team Experiences



Tuckman Stages of Team Development



Can you relate crucial periods of your own team's development to these stages?

What makes Engineering a "Profession"?

- A profession is a learned calling with specialized skills, distinctive functions and recognized social obligations and has unique characteristics.
  - services based upon advanced knowledge/skill/ judgment.
  - charged with substantial degree of public obligation; services rendered largely in the general public interest.
  - bound by distinctive ethical code in its relationships with clients, employees, colleagues and the public.
  - assumes responsibility for actions related to professional services provided in a personal or supervisory capacity.

These are the 12 Graduate Attributes expected of every engineering graduate across Canada.

1. Apply knowledge	7. Communicate effectively
2. Analyze problems	8. Embrace professionalism
3. Conduct investigations	9. Consider impact of actions
4. Design	10. Act ethically
5. Use engineering tools	11. Manage projects
6. Work in teams	12. Commit to learning

Question: how can you develop these attributes during your time at UBC?

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Shaheer Khan :)

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