Mechanical Engineering (Exploring Engineering, pgs 293-311)

- **Fluid mechanics** are used with the water flowing through the machine
    - **Density** is mass per unit volume (kg/m^3)
    - **Pressure** is the force per unit area, measured in pascals (1 Pa = a N/m^2)
    - **Viscosity** is the fluid's resistance to flow (N x s/m^2)
    - **Laminar flow** is at low speeds (regular), **turbulent flow** is at high speeds (chaotic)
        - Determined by **Reynolds number** (*Re*) Re= *p*VD/*u*
        - Up to 2000: laminar, over 4000: turbulent, between: in transition
- **First Law of Thermodynamics:** energy cannot be created or destroyed
- Criteria to be optimized when choosing materials:
    - Elastic modulus (stiffness), elastic limit, yield strength, toughness
    - **Stress-strain diagrams** express materials' properties

Green Energy Engineering (Exploring Engineering, pgs 375-392)

- Photons from sunlight are measured in **wavelengths**
- High frequency (short wavelength) light works better
- **Planck's equation**
    - ***E=hv***
    - E is the photon's energy
    - V is frequency (cycles/s)
    - H is planck's constant
- **Wave motion** can be mechanically tapped for power

Electrochemical Engineering (Exploring Engineering, pgs 355-371)

- Solar energy is low when demand is high (morning and evening)
    - **Load leveling**
        - Store energy in batteries
        - Inverter converts direct current (DC) to alternating current (AC)
- **Fuel cells**
    - Continuously refueled
    - Hydrogen fuel cell converts H2 to H2O
        - Waste not a concern

Environmental Engineering (Environmental Engineering, pgs 5-11, 22, 298-363)

- Three **pillars of sustainability**
    - Links between society, the economy, and the environment
- **Life Cycle Thinking**- taking into account all the stages of a product, from development to disposal
- **Green Chemistry**- eliminating use and generation of hazardous materials
- Oil is an example of **point source** pollution (from one specific place)
- Seawater is not useful for water supply b/c desalination is expensive
    - Still must keep clean for ecosystem

T (°C)	ρ (kg/m^3)	c_p (kJ/kg-°C)	ν (m^2/s) $\times 10^{-6}$	k (W/m-°C)	α (m^2/s) $\times 10^{-7}$	Pr	β (K^{-1}) $\times 10^{-3}$
0	1002.28	4.2178	1.788	0.552	1.308	13.6	
20	1000.52	4.1818	1.006	0.597	1.430	7.02	0.18
40	994.59	4.1784	0.658	0.628	1.512	4.34	
60	985.46	4.1843	0.478	0.651	1.554	3.02	
80	974.08	4.1964	0.364	0.668	1.636	2.22	
100	960.63	4.2161	0.294	0.680	1.680	1.74	
120	945.25	4.250	0.247	0.685	1.708	1.446	
140	928.27	4.283	0.214	0.684	1.724	1.241	
160	909.69	4.342	0.190	0.680	1.729	1.099	
180	889.03	4.417	0.173	0.675	1.724	1.004	
200	866.76	4.505	0.160	0.665	1.706	0.937	
220	842.41	4.610	0.150	0.652	1.680	0.891	
240	815.66	4.756	0.143	0.635	1.639	0.871	
260	785.87	4.949	0.137	0.611	1.577	0.874	
280	752.55	5.208	0.135	0.580	1.481	0.910	
300	714.26	5.728	0.135	0.540	1.324	1.019	

Notes: T = temperature, ρ = density, c_p = specific heat capacity, $\nu = \mu/\rho$ = kinetic viscosity, k = thermal conductivity, $\alpha = c_p\rho/k$ = heat (thermal) diffusivity, Pr = Prandtl number, β = coefficient of volumetric expansion of fluid

https://www.oreilly.com/library/view/solar-energy-engineering/9780123745019/xhtml/APP005.html

Links for further exploration:

Project from sophomore year: http://marilynnhuntsanmarin.weebly.com/solve-a-world-issue.html

BP Macondo well (used for oil spill cleanup): https://www.scientificamerican.com/article/how-microbes-helped-clean-bp-s-oil-spill/

Video about microbes: https://www.youtube.com/watch?v=a_HWlFzgQiM&feature=youtu.be

About the bacteria: http://www.inrs.ca/english/actualites/oil-eating-bacterium-can-help-clean-pollution-and-spills

How to get bacteria for cheap: https://www.sciencebuddies.org/science-fair-projects/ask-an-expert/viewtopic.php?t=12159#p43078