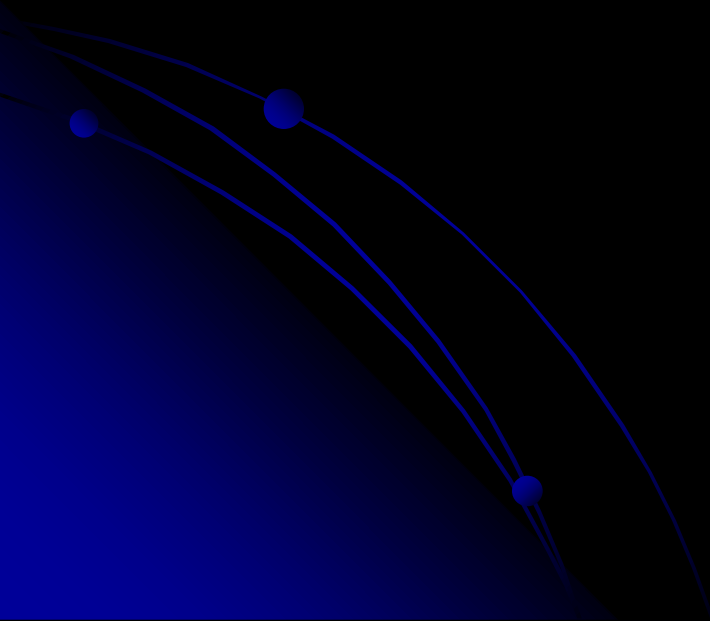


# Pharmaceutical Research

Exploring Biomedical Engineering

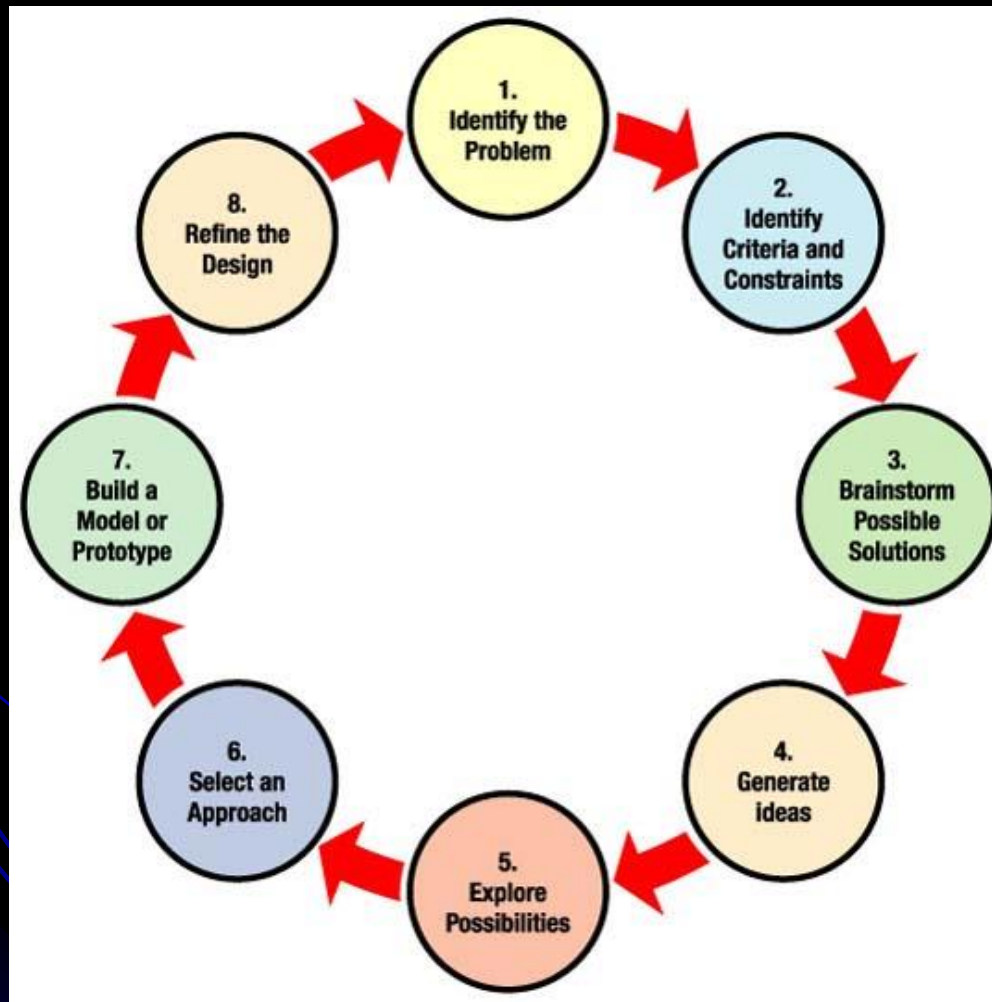


# Biomedical Engineering - BME

- Applying the engineering design process to problems in **medicine and biology**
- Typically requires master's degree or PhD
- An extremely diverse field, in terms of content
- Includes people from many disciplines



# Engineering Design Process



# Biomedical Research

- Your research team has successfully developed a new prescription medication called “**Outstandix**,” which is designed to slow or stop the process of inflammation that causes pain in patients.
- Animal testing has gone smoothly and seems to provide relief from inflammatory pain.
- So far, no negative side effects have been seen in the test animals, but this drug has been shown to drastically reduce the levels of a protein called **Osteopontin** in the blood, urine and joint (synovial) fluid.

# Research

- Includes reading scholarly articles on the subject
- If the information is not available, design an experiment to learn more
- Begin by researching what others have already learned—saves time and money!

# Biomedical Research

- Although no side effects have been seen in animal testing, it is important to research all effects of **Outstandix** before beginning human testing
- Today, we will research what others have already learned about **Osteopontin**
- Read the following article excerpts and take notes on the effects of **Osteopontin** in the body

# Osteopontin

- Inhibits formation of calcium crystals in the body
- Inhibits cell apoptosis (cancer implications)
- Aids in cell migration and attachment
- Present at sites of inflammation and wound healing
- Very important for bone mineralization

# Osteopontin

- We are going to focus on the effect that **Osteopontin** has on inhibiting the precipitation of calcium salts out of solution in three areas of the body—blood, urine and joint fluid



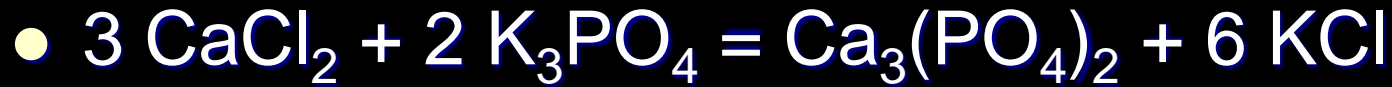
# Osteopontin

- Body chemistry is very important for the maintenance of life
- $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{H}^+$ ,  $\text{Ca}^{+2}$ ,  $\text{Po}^{4-}$ ,  $\text{Cl}^-$
- We get these chemicals from the food we eat
- Most are dissociated into ions, but can re-associate to form different chemicals

# Precipitate



# Forming a Precipitate



- Solid **calcium phosphate** forms and drops to the bottom of the glass

- Similar to crystallization in the body

- Calcium apatite, oxalate, phosphate....  
are all solid forms of calcium salts

# Research Implications

- **Blood** — Calcium phosphate crystals that form in the blood can cause a pulmonary embolism, causing immediate death; smaller crystal formations can lead to vascular calcification that can cause problems later in life
- **Urine** — Calcium phosphate crystals that form in urine often lead to kidney stone formation
- **Synovial (joint) fluid** — Crystals in synovial fluid can lead to joint problems, and severe joint pain

# Vascular Calcification

- Calcification can form in the blood vessels, cardiac tissue or valves of the heart, causing stiffness
- Stiff vessels can fail, causing rupture; in a large artery, this can cause death

# Kidney Stones



# Joint Crystals



# References

- Center for Biomedical Engineering Research. Updated 2012. CBER, College of Engineering, University of Delaware. Accessed July 30, 2012. <http://www.cber.udel.edu/research.html>
- Engineering Design Challenge. Last updated February 22, 2008. NASA Lunar Plant Growth Chamber. Accessed July 10, 2012 (Source of definitions, images and other information.) [http://www.nasa.gov/audience/foreducators/plantgrowth/reference/Eng\\_Design\\_5-12.html](http://www.nasa.gov/audience/foreducators/plantgrowth/reference/Eng_Design_5-12.html)