AIChE/CACHE Mobile Device APP Competition 2014
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The 2014 Mobile device competition was won by Kansas State University. The team was led by a team of Chemical Engineers and Computer Science Students. Presenting at the national meeting were Andrew W. Woolley (ChE), Thaddeus T. Tuck (Computer Science), and Michael R. Whitehead (Computer Science).

The winning App is a game that provides students with the opportunity to learn about pump design. Students are required to use their knowledge of fluid mechanics and chemical engineering process design to design a pump to meet a specific objective (i.e. pumping a liquid to a certain height at a given pressure). This application starts with the easiest levels of the macroscopic mechanical energy balance and gradually becomes more difficult, with the final stages factoring in economics and materials of design. By the last stage of the game, students will be able to design pumps for a specific process flow objective by correctly using the mechanical energy balance,

Figure 1: Thaddeus Tuck explaining the game to Michael Cutlip.

incorporating pressure drop in pipes, fittings, and process equipment, by considering the actual net positive suction head (NPSH), by considering materials of construction, and by calculating the cost of the pump. This game could be incorporated into courses on fluid dynamics and/or process design to enhance student learning.
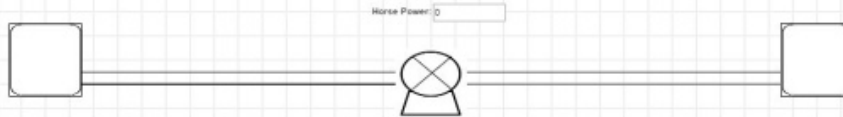
The following are some screen shots from the game. They start with the simple pump design, level 1, and end with the most complicated design of the game, level 9.

Level 1

Time to Move All Liquid: 1.94 Hours

Diameter of Pipes: 1 inches

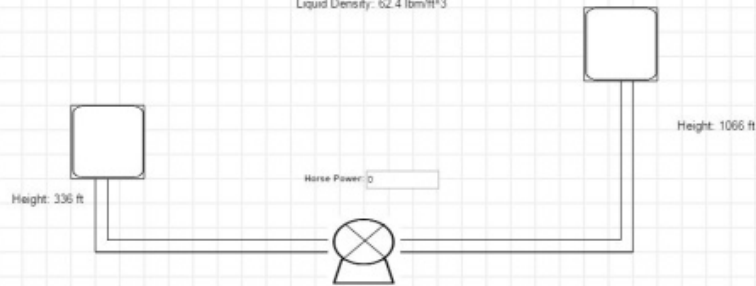Volume of Containers: 3574 ft^3

Liquid Density: 62.4 lbm/ft^3

Horse Power: 0

Level 2

Time to Move All Liquid: 1.76 Hours

Diameter of Pipes: 1.5 inches

Volume of Containers: 2815 ft^3

Liquid Density: 62.4 lbm/ft^3

Height: 1066 ft

Horse Power: 0

Height: 336 ft

Level 3

Time to Move All Liquid: 0.81 Hours

Diameter of Pipes: 0.75 inches

Volume of Containers: 2951 ft^3

Liquid Density: 62.4 lbm/ft^3
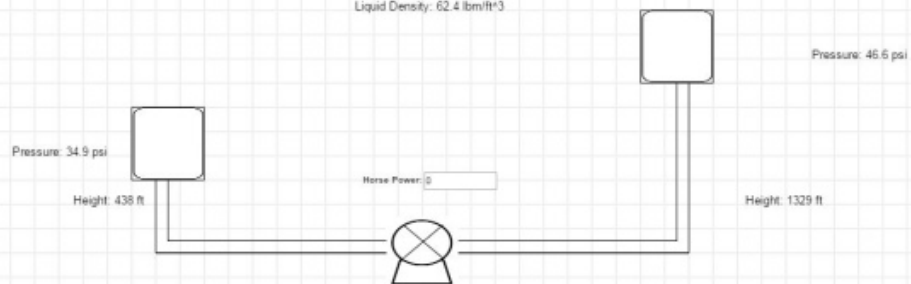
Pressure: 46.6 psi

Pressure: 34.9 psi

Horse Power: 0

Height: 438 ft

Height: 1329 ft

Level 4

Time to Move All Liquid: 1.74 Hours

Diameter of Pipes: 2.5 inches

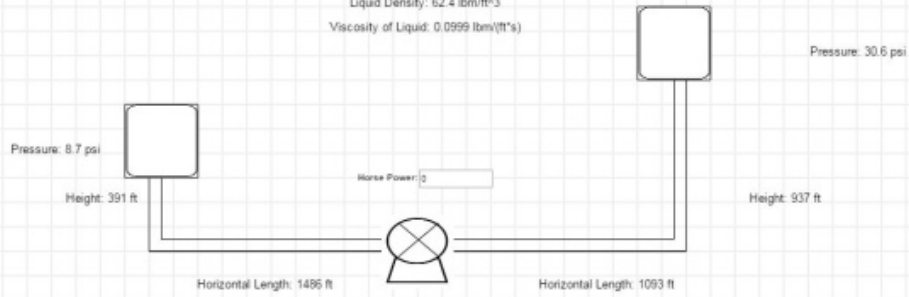Volume of Containers: 2779 ft^3

Liquid Density: 62.4 lbm/ft^3
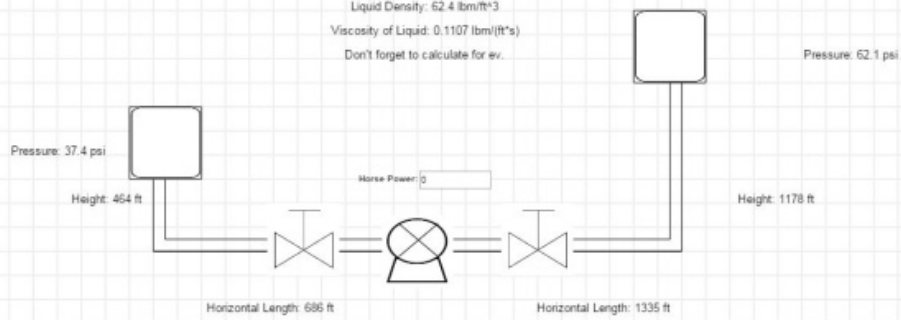
Viscosity of Liquid: 0.0999 lbm/(ft*s)

Pressure: 30.6 psi

Pressure: 8.7 psi

Horse Power: 0

Height: 391 ft

Height: 937 ft

Horizontal Length: 1486 ft

Horizontal Length: 1093 ft

Level 5

Time to Move All Liquid: 1.6 Hours

Diameter of Pipes: 2.5 inches

Volume of Containers: 2466 ft^3

Liquid Density: 62.4 lbm/ft^3

Viscosity of Liquid: 0.1107 lbm/(ft*s)

Don't forget to calculate for ev.

Pressure: 62.1 psi

Pressure: 37.4 psi

Horse Power: 0

Height: 464 ft

Height: 1178 ft

Horizontal Length: 686 ft

Horizontal Length: 1335 ft

Level 6

Time to Move All Liquid: 1.1 Hours

Diameter of Pipes: 3 inches

Volume of Containers: 3508 ft^3

Liquid Density: 62.4 lbm/ft^3

Viscosity of Liquid: 0.1198 lbm/(ft*s)

Don't forget to calculate for ev.

Efficiency Factor: 75 %

Pressure: 41.5 psi

Pressure: 26 psi

Height: 302 ft

Horse Power: 0

Height: 920 ft

Horizontal Length: 944 ft

Horizontal Length: 1441 ft

Level 7

Time to Move All Liquid: 1.48 Hours

Diameter of Pipes: 5 inches

Volume of Containers: 3426 ft^3

Liquid Density: 62.4 lbm/ft^3

Viscosity of Liquid: 0.0795 lbm/(ft*s)
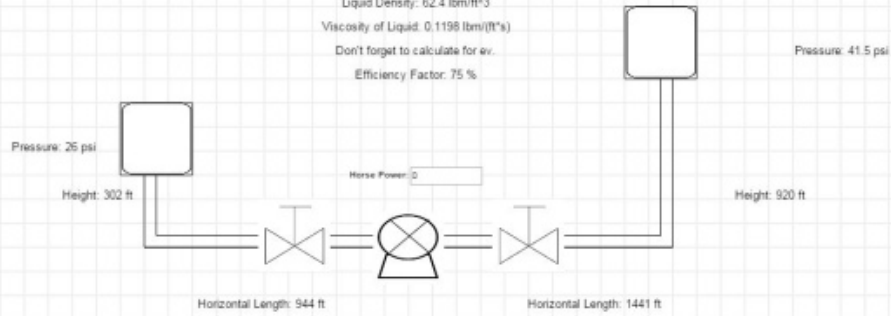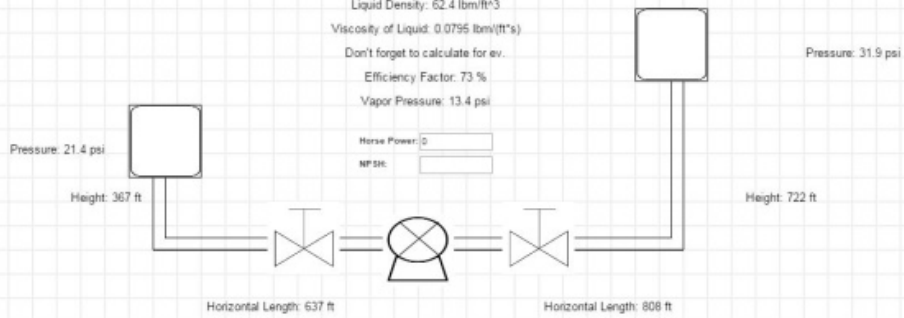
Don't forget to calculate for ev.

Efficiency Factor: 73 %

Vapor Pressure: 13.4 psi

Pressure: 31.9 psi

Pressure: 21.4 psi

Horse Power: 0

NPSH:

Height: 367 ft

Height: 722 ft

Horizontal Length: 637 ft

Horizontal Length: 808 ft

Level 8

Time to Move All Liquid: 0.31 Hours
Diameter of Pipes: 3 inches
Volume of Containers: 9513 ft^3
Liquid Density: 62.4 lbm/ft^3
Viscosity of Liquid: 0.1044 lbm/(ft*s)
Don't forget to calculate for ev.
Efficiency Factor: 80 %
Vapor Pressure: 34.1 psi

Horse Power: 0
NPSH:
Pump Type:

Pressure: 68.4 psi

Pressure: 47.1 psi

Height: 393 ft

Height: 659 ft

Horizontal Length: 1236 ft

Horizontal Length: 676 ft

Level 9

Time to Move All Liquid: 0.87 Hours
Diameter of Pipes: 4 inches
Volume of Containers: 5676 ft^3
Liquid Density: 62.4 lbm/ft^3
Viscosity of Liquid: 0.0853 lbm/(ft*s)
Don't forget to calculate for ev.
Efficiency Factor: 85 %
Vapor Pressure: 34.8 psi

Horse Power: 0
NPSH:
Pump Type:
Cost:

Pressure: 65.7 psi

Pressure: 44.8 psi

Height: 260 ft

Height: 670 ft

Horizontal Length: 640 ft

Horizontal Length: 648 ft

Figure 2: Michael R. Whitehead on the left with Andrew W. Woolley (not facing camera) explaining their winning game to another ChE.