

Name _____ Date _____

Staying Warm in Frigid Waters

Objectives

Students will demonstrate the principle of counter-current heat exchange and illustrate their experimental data in chart form.

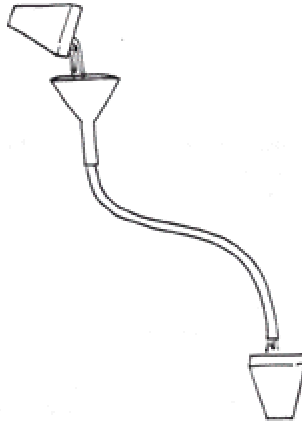
Materials (for each group of 3/4 students)

- 1/2 inch plastic tubes one meter long
- 1/4 inch copper tubes a meter and a half long
- short sections of flexible tubing to fit on ends of copper
- 4 funnels
- 4 foam cups
- 4 thermometers
- towels
- lab stands or pegboard walls
- safety goggles

Procedure

Part A

1. Fill a foam cup with body temperature water (approximately 40 C).
2. Pour water through a funnel attached to an end of a 1/2 in. plastic tube and catch it in a foam cup at the other end.



3. Take the temperature of the water you caught.
Water Temp:
4. Repeat the process but start with cold tap water (approximately 10 C).
Water Temp:

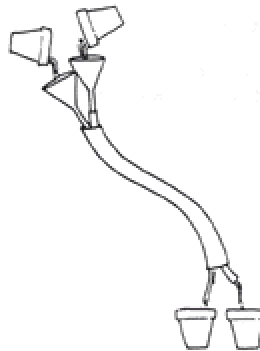
Make a data table showing results from every team in the room. Graph your results.

	single tube cold	single tube warm	same direction warm inside; cold outside	same direction warm inside; cold outside	counter flow warm inside; cold outside
your data					
Team 2					
Team 3					
Team 4					
Team 5					
Team 6					

Part B

In the human body we have both arteries and veins. They often are found alongside each other. Both carry flowing liquid at the same time---arteries move blood away from the heart, veins return blood flow to the heart. In order to model tubes in close contact without air we will nest one tube inside the other tube.

1. Insert the copper feeder tube into the larger 1/2 in. plastic tube opening. Attach funnels to the upper ends of both the inside and outside tubes.

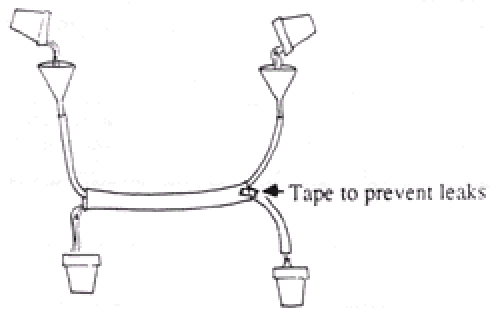


2. Pour approximately 40 C water into the outer tube and 10 C water into the inner tube at the same time. Take the temperature of the water on exit from each tube.
Water Temp:
3. Repeat the process with the warm water in the inner tube and the cooler water in the outer tube.
Water Temp:

Make a data table showing results from every team in the room. Did the two temperatures of water both end up at the same temperature?

	40° C outer tube 10° C inner tube	10° C outer tube 40° C inner tube
your data		
Team 2		
Team 3		
Team 4		
Team 5		
Team 6		

1. Repeat the procedure with the funnel at one end of the copper tube and the opposite end of the outside plastic tube. To do this you may have to make short extension tubes so each funnel can be held above the tube to create a flow.



2. Collect and record data flowing warm on the inside and cool on the outside.
Water Temp:
3. Collect and record data flowing cool on the outside and warm on the inside.
Water Temp: