TEACHER INFORMATION

Mix it Up: Combining Liquids of Different Temperature

1. There are currently 3 different combinations of equipment that will work for collecting temperature data. The most common method, which works for both the TI-83 Plus and TI-84 Plus families of calculators, is to use a Temperature Probe attached to a CBL 2 or LabPro.

   The TI-84 Plus calculator has a USB port located at the top right corner. Using the USB port, either an EasyTemp or an EasyLink with a Temperature Probe can be connected to collect temperature data. For more information on EasyTemp and EasyLink refer to Page *ix* at the front section of this book.

2. When connecting an EasyTemp or an EasyLink to a TI-84 Plus calculator using USB, the EasyData application automatically launches when the calculator is turned on and at the home screen.

3. There should be a significant temperature difference between the water in the two cups. For best results, one cup should contain water that is above room temperature and the other should contain water that is below room temperature. This will minimize errors due to heat transfer between the room and the water.

4. Cold and hot tap water will work well for this activity. It is important that there be no ice in the cold water, as the phase change makes the formula given inapplicable.

5. You may wish to use different amounts of water than those specified in the instruction section. Be sure that the cups you are using are large enough to hold the combined mixture volume.

6. Have the students work quickly as soon as they begin to collect data to minimize heat transfer errors.

DATA TABLE

Volumes used (in mL)		Temperatures measured (in ºC)	
Cup 1 (V_1)	100	**Cup 1 (T_1)**	16.7
Cup 2 (V_2)	150	**Cup 2 (T_2)**	64.8
		Mixture (T_m)	45.2

ANSWERS TO QUESTIONS

1. $T_m = \dfrac{T_1V_1 + T_2V_2}{V_1 + V_2}$

2. From the expression above, we get T_m = 45.6 ºC.

3. The measured value is a little lower than the predicted value. Perhaps this is due to the warm water cooling as we worked.

4. The average is 40.75 ºC.

5. If the goal is to get a sample of water of this temperature, we'd need to add less warm water than before since the mixture we created was warmer than this average.

6. Solving the expression for V_2 we get $V_2 = \frac{V_1(T_1 - T_m)}{T_m - T_2}$. If $T_m = (T_1 + T_2)/2$, then a little algebra shows that $V_2 = V_1$.

7. Going back to the original expression of $T_1V_1 + T_2V_2 = T_m(V_1 + V_2)$, if we let $V_2 = V_1$, then a little more algebra shows that $T_m = (T_1 + T_2)/2$.