

Title of Lesson Plan	Warming by Freezing!
Prepared By (first and last name)	Marcie Charters
City and State	Bothell, WA
Grade Level(s)	9
Keywords (subjects covered)	Phase change, heat transfer
Brief Description	Two experiences that allow students to observe that heat is released when water goes from a liquid phase to a solid phase. Heat released from a slow phase change is difficult to measure (water freezing on a fir seedling), therefore, we will start with a measurable example by using heat-releasing hand warmers.
Total Time Required	Approx 2-3 class periods
Setting	Science lab classroom
Lesson Objectives/Goals	Students will observe that heat is released during the freezing of a supercooled liquid. They will then apply this knowledge to a practical application in the forestry industry.
Materials Needed	Part I: "hand warmer" pouches (found at REI and other sporting goods stores), thermometer, a small bowl of water Part II: young fir tree seedlings, a freezer, a spray bottle of water
Standards Addressed	Conservation of Energy, Properties of Matter
Procedure Procedure, cont	PART 1: Students, in groups of 2-4, will be provided with a hand warmer containing supercooled sodium thiosulfate. They will activate the hand warmer by releasing a seed crystal, observing it quickly change from a liquid to a solid. The hand warmer is then immersed in a room temp bowl of water (T_{start}) and when the temp no longer increases, measure the T_{final} . They then calculate ΔT . PART 2: Apply the concept from part 1 to a method used in raising seedlings (or protecting tree fruit from frost). Using two seedlings of roughly the same size, place both in a freezer, spraying one thoroughly with water, leaving the other one dry. Experiment with how long to leave them in the freezer. Check the health of the seedlings after several hours.....which seedling survived the low temperatures?
Assessment	Phase Change & Heat Transfer Exam (this activity is part of a larger unit where we study many types and examples of phase changes)
Literature Cited/References	Conceptual Physics, Hewitt
Forestry Tour Attended	Pacific Northwest 2008

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