

Learning Objectives	1) Students will evaluate the quality of chocolate processing for different brands and types based on taste, texture, and fracture properties
Time	20-30 minutes
Topics	<ol style="list-style-type: none"> 1) Heat treatments and their effects on properties 2) Fracture properties 3) How characterization can determine if processes were done properly

Before the Lab:

Supplies to buy every time you run the activity:

- 1) Chocolate. Type, brand, and hyperlinks found below

Chocolate Type	Brand
White Chocolate	Lindt
Milk Chocolate	Hershey
	Ghirardelli
	Scharffen Berger
Dark Chocolate	Hershey
	Ghirardelli
	Scharffen Berger

Supplies to buy as needed:

- 1) Paper plates for the chocolate
- 2) Gloves for those who want to keep their hands clean
- 3) Sandwich size ziplock bags

Prior Knowledge

Recommended for Instructor:

- 1) Familiarity with heat treatments of chocolate
 - Polymorph behavior
 - Relationship between chocolate tempering and final melting temperature/"snap" of chocolate
- 2) Basic understanding of material fracture
 - Ductile vs. Brittle fracture
 - Which is expected out of chocolate

Prior Knowledge

Recommended for Students:

- 1) Be able to distinguish white, milk, and dark chocolate by sight (and taste if able to eat)



Materials Science of Chocolate

Lab Set-up:

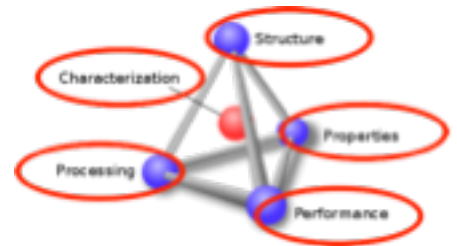
- 1) Separate one of each chocolate into small ziplock bags
- 2) Before the students arrive, make sure each group has:
 - One plate
 - Gloves (if requested by the participant)
 - Ziplock bag with one piece of each type of chocolate

Pre-lab Questions:

The lecture before this lab should explain the basics of solidification, heat treatments, and the similarities between chocolate and steel manufacturing.

1. The process of making chocolate fits into all categories of the tetrahedron. Explain why this activity fits into those categories.

Chocolate fits in all five because the structure is influenced by the heat treatment process. This effects the properties (melting temperature and fracture characteristics), which effects the final performance. The students are doing characterization right now to determine if the processing was done correctly.



- 2) How does the cooling rate affect the texture of the chocolate?

Properly tempered chocolate will “snap” or fracture in a brittle manner. It should not melt in your hand but melt smoothly in your mouth.



Materials Science of Chocolate

Running the Lab:

- 1) Each student has their own selection of chocolate.
- 2) They should have already answered the pre-lab questions. Ask the students if they had any unresolved questions about the pre-lab questions.
- 3) Instruct the students to read all of the directions.
- 4) Details for how to conduct each test can be found on a slide in the accompanying lecture. Ask if students have any questions about each test. Remind students that eating the chocolate is not necessary.

Expected Results from Tests:

Chocolate	Snap Test	Taste Test	Texture Test
Lindt White	snaps lightly	Individual	Smooth
H. Milk	Rips rather than snaps		Melts in their hand
G. Milk	Snaps lightly		smooth, might melt in their hand
SB. Milk	Snaps lightly		doesn't melt in their hand
H. Dark	Might snap, might not		might melt in their hand
G. Dark	Snaps cleanly		smooth
SB. Dark	Snaps cleanly		Smooth, doesn't melt in their hand

Discussion Points:

- 1) Which chocolate was correctly tempered? How can you tell?
Didn't melt in their hand, snapped, was smooth texture in both hand and mouth
- 2) Which one was your favorite? Why?