Name _____ Date _____ Period _____

ZornScience
zornscience.org

The Cold-Water Detergent Challenge

Biology

Work with your group. Record every measurement with its unit. Answer questions in complete sentences.

Draft lab. This lab has not been tested in a classroom yet. Your teacher may change some steps, times or amounts.

The Puzzle

Many laundry detergents say they remove tough stains even in cold water. Their labels list **enzymes**, such as **protease**, which breaks down protein. Grass, blood, and egg stains are mostly protein. In this lab, the "stain" is gelatin, a protein, set inside a drinking straw. As the enzyme digests the gelatin, the solid column gets shorter.

Question

How do temperature and heat treatment affect how much gelatin a detergent's enzymes can digest?

Safety

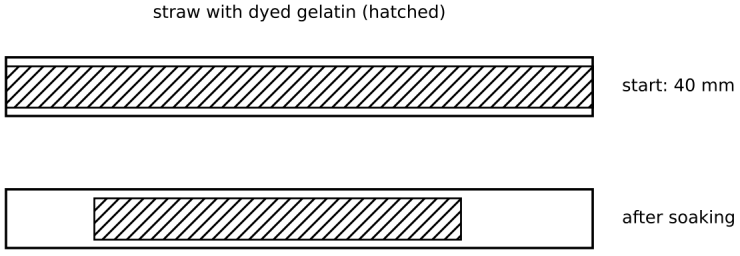
- Wear goggles and gloves. Detergent irritates eyes and skin.
- If detergent gets in your eyes, use the eyewash for 15 minutes and tell your teacher.
- Handle the warm water bath with care.

Materials (per group)

- 6 cups labeled 1 to 6, each with 50 mL of liquid
- 12 gelatin straw segments, each 40 mm long (2 per cup)
- Ice-water bath and warm water bath (about 30 °C), thermometer
- Ruler (mm), tweezers, paper towels, timer

The six conditions

Cup	Liquid	Temperature
1	Water (control)	Room, about 22 °C
2	Detergent solution	Room, about 22 °C
3	Detergent solution	Ice bath, about 5 °C
4	Detergent solution	Warm bath, about 30 °C
5	Heat-treated detergent (heated, then cooled)	Room, about 22 °C
6	Water (control)	Warm bath, about 30 °C



Each straw segment starts at 40 mm. Enzymes digest it from both open ends.

CC BY-NC-SA 4.0 | zornscience.org

Before the Lab

1. Predict which cup will digest the most gelatin and which will digest the least. Explain using the word **enzyme**.

Procedure

1. Put cups 3 and 4 into the ice bath and warm bath. Wait 5 minutes and check their temperatures.

2. Check that each straw segment is 40 mm long. Drop 2 segments into each cup and start the timer.

3. Soak for 30 minutes. Swirl each cup gently every 5 minutes.

4. Use tweezers to remove the segments. Rinse them in plain water and blot gently.

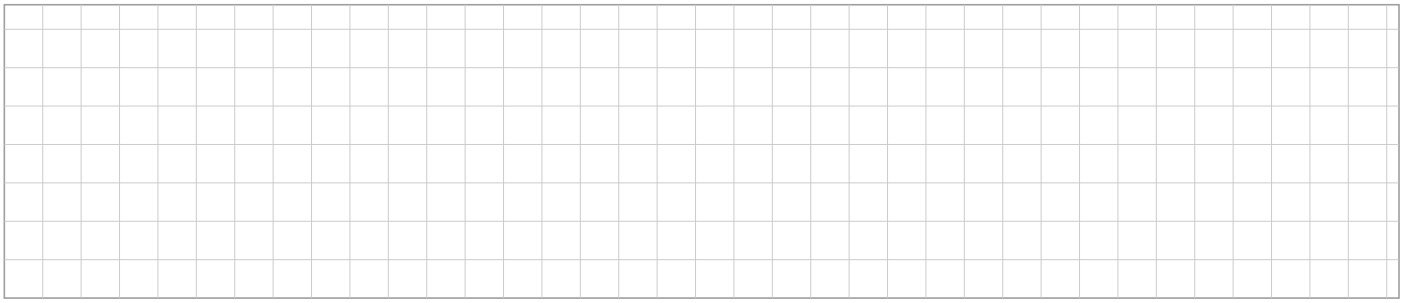
5. Measure the solid gelatin left in each straw, in mm. Find digested length = 40 mm - length left. Average the two segments.

Data

Table 1. Gelatin digested

Cup	Condition	Segment A digested (mm)	Segment B digested (mm)	Average digested (mm)
1	Water, room			
2	Detergent, room			
3	Detergent, ice			
4	Detergent, warm			
5	Heat-treated, room			
6	Water, warm			

2. Make a bar graph of average digested length for all six cups.



Analysis

3. Why do we need cups 1 and 6? What does cup 6 tell you about the warm bath?

CC BY-NC-SA 4.0 | zornscience.org

4. Compare cups 2, 3, and 4. How did temperature affect the enzyme? Explain using particle motion.

5. Cup 5's detergent was heated, then cooled back to room temperature. Why did it digest so little, even though it was at the same temperature as cup 2?

6. Was the enzyme in cup 3 (ice) denatured? How could you test this?

7. Claim, evidence, reasoning: Should a detergent label tell people to wash protein stains in cold water, warm water, or very hot water?

Claim

Evidence

Reasoning

CC BY-NC-SA 4.0 | zornscience.org