

Nurdle Polymer Identification

DESCRIPTION	In this investigation, students will perform a series of laboratory tests to identify the type of plastic polymer that nurdles are made from. By following a step-by-step flow chart and conducting density, solubility, and heat-based tests, students will classify their samples and evaluate the significance of knowing polymer types in environmental science. After testing, students will discuss how polymer identification contributes to understanding nurdle pollution and its spread through aquatic ecosystems.	
AUDIENCE	High School Grade levels	
STUDENT OUTCOMES	<ul style="list-style-type: none"> Students will ask questions and define problems based on their investigation. Students will use data and models to develop explanations and propose solutions consistent with scientific ideas, principles, and theories. Students will follow a flow chart and conduct a series of tests to determine the polymer composition of nurdle samples. Students will explain why identifying plastic polymers is important for environmental monitoring and pollution mitigation. 	
TEACHER BACKGROUND RESOURCES	<ul style="list-style-type: none"> Nurdle Patrol Home Yes Nurdle, No Nurdle – Nurdle Patrol The Great Nurdle Hunt – global nurdle pollution campaign Nurdle Fact Sheet (included in teacher kit) 	
MATERIALS	<ul style="list-style-type: none"> 6 nurdle samples per group Plastic Identification Flow Chart Recording sheet Isopropyl alcohol solution, 45.5% by volume Mazola corn oil Copper wire (5 cm lengths) Corks (to fit 18 mm test tubes) 	<ul style="list-style-type: none"> Acetone Test tubes, 18 x 150 mm Glass stirring rod Bunsen burner Beakers (50 mL and 250 mL) Tongs or forceps Ring stand and wire gauze
TEACHER PREPARATIONS	<ul style="list-style-type: none"> Set up lab stations with: 6 nurdle samples per group Test solutions (water, isopropyl alcohol, corn oil, acetone) Glassware, burners, and safety equipment Fume hood available for acetone and heating steps 	
SAFETY PRECAUTIONS	<ul style="list-style-type: none"> Isopropyl alcohol – flammable, toxic vapors. Keep covered; avoid open flames. Acetone – flammable, toxic vapors. Use under fume hood; keep covered. Copper wire – becomes extremely hot when heated; handle with tongs/forceps. General – Use fume hood when possible. Always wear goggles, gloves, and lab coats. 	

INTRODUCTION	Begin by introducing nurdles using the vials provided in the teacher kit. Show students the Hurdles with Nurdles video to provide context: what nurdles are, how they are used, and the environmental issues they cause.
PROCEDURES	<p>Students will follow the Plastic Identification Flow Chart and record their results.</p> <ol style="list-style-type: none"> 1. Water Test <ul style="list-style-type: none"> ◦ Place 5 mL of water in a test tube. ◦ Submerge a nurdle with a stirring rod. ◦ Record whether it sinks or floats. 2. Isopropyl Alcohol Test <ul style="list-style-type: none"> ◦ Repeat procedure using 5 mL of isopropyl alcohol solution. ◦ Record whether it sinks or floats. 3. Oil Test <ul style="list-style-type: none"> ◦ Repeat procedure using 5 mL of corn oil. ◦ Record results and refer to flow chart. <p>Reference Densities (g/mL):</p> <ul style="list-style-type: none"> ◦ Water: 1.0 ◦ PETE: 1.38–1.39 ◦ HDPE: 0.95–0.97 ◦ PVC: 1.16–1.35 ◦ LDPE: 0.92–0.94 ◦ PP: 0.90–0.91 ◦ PS: 1.05–1.07 4. Copper Wire Test (for plastics that sank in water) <ul style="list-style-type: none"> ◦ Heat copper wire in Bunsen burner until red hot. ◦ Touch to nurdle sample, then reintroduce to flame. ◦ A green flame indicates presence of chlorine (PVC). 5. Acetone Test <ul style="list-style-type: none"> ◦ Place sample in acetone for 20 seconds under fume hood. ◦ Remove and test for stickiness/softening. 6. Heat Test (boiling water) <ul style="list-style-type: none"> ◦ Place nurdle in boiling water for 30 seconds. ◦ Test for softening to further narrow polymer type.
DISCUSSION QUESTIONS	<p>What are the benefits of knowing the polymer composition of nurdles?</p> <p>Were all samples the same type of plastic?</p> <p>What do differences in polymer type suggest about nurdle sources and spread?</p>
EXTENSION	Conduct a local nurdle survey (river, creek, or beach). If nurdles are found, repeat the polymer identification tests and compare with classroom results.
WASTE DISPOSAL	<ul style="list-style-type: none"> • Collect alcohol and acetone waste in labeled containers; dispose of according to local regulations. • Corn oil can be reused if uncontaminated. Dispose of used oil properly. • Plastic samples should be collected in a glass jar, not discarded in trash. • Copper wire can be reused.
	<p>♥ Adapted from <i>Identification of Polymers</i> by David Katz and Plastics Analysis Lab, <i>Hands On Plastics: A Scientific Investigation Kit</i>, American Plastics Council & National Middle Level Science Teachers Association.</p>

Nurdle Polymer Identification - Student Worksheet

OBJECTIVE	Use a series of tests and a flow chart to determine the type of plastic polymer your nurdle samples are made of. Record your results and use evidence to support your conclusions.
SAFETY FIRST	<ul style="list-style-type: none"> • Wear goggles, gloves, and a lab coat at all times. • Work under a fume hood when using acetone or heating samples. • Keep flammable materials away from open flames. • Handle hot equipment with tongs or forceps.
DENSITY REFERENCE (G/ML)	<ul style="list-style-type: none"> • Water = 1.0 • PETE: 1.38–1.39 • HDPE: 0.95–0.97 • PVC: 1.16–1.35 • LDPE: 0.92–0.94 • PP: 0.90–0.91 • PS: 1.05–1.07
PROCEDURES	<p>Follow the flow chart and complete tests in order. Record all observations.</p> <p>Test 1: Water Test</p> <ul style="list-style-type: none"> • Place nurdle in 5 mL of water. • Push down with stirring rod. • Does it sink or float? <p>Test 2: Isopropyl Alcohol Test</p> <ul style="list-style-type: none"> • Place nurdle in 5 mL isopropyl alcohol. • Record sink/float. <p>Test 3: Oil Test</p> <ul style="list-style-type: none"> • Place nurdle in 5 mL corn oil. • Record sink/float. <p>Test 4: Copper Wire Test (for nurdles that sank in water)</p> <ul style="list-style-type: none"> • Heat copper wire until red hot. • Touch nurdle, then place back in flame. • Green flame = chlorine (PVC). <p>Test 5: Acetone Test</p> <ul style="list-style-type: none"> • Place nurdle in acetone for 20 seconds under fume hood. • Does it soften or become sticky? <p>Test 6: Heat Test</p> <ul style="list-style-type: none"> • Place nurdle in boiling water for 30 seconds. • Does it soften?
DISCUSSION QUESTIONS	<p>What type(s) of plastic were your nurdles made of?</p> <p>Were all the nurdles the same polymer? Why or why not?</p> <p>Why is it useful to know the type of polymer in nurdles?</p> <p>How might this information help scientists studying nurdle pollution?</p>

Nurdle Polymer Recording Sheet

Directions: As you test each sample of nurdle, record what happened in the box under the test that was conducted until the polymer type is revealed for that sample. *Note that depending on the results of each nurdle not all test columns will have a recording in it. See example below:

Example

Nurdle Sample	Water test	Alcohol Test	Oil Test	Copper Wire Test	Acetone Test	Heat Test
Sample 1	sink			Orange	No reaction	PETE

Nurdle Sample	Water test	Alcohol Test	Oil Test	Copper Wire Test	Acetone Test	Heat Test
Sample 1						
Sample 2						
Sample 3						
Sample 4						
Sample 5						
Sample 6						

Notes:

Nurdle Polymer Identification Flow Chart

Start → Place nurdle in Water (1.0 g/mL)

- ➡ Floats → Go to Isopropyl Alcohol Test (0.91 g/mL)
 - Floats → Possible LDPE (0.92–0.94) or PP (0.90–0.91) → Confirm with Heat Test.
 - Sinks → Possible HDPE (0.95–0.97) → Confirm with Heat Test.
- ➡ Sinks → Go to Oil Test (0.92 g/mL)
 - Floats → Possible PS (1.05–1.07) → Confirm with Acetone Test.
 - Sinks → Possible PVC (1.16–1.35) or PETE (1.38–1.39)
 - Perform Copper Wire Test →
 - Green Flame → PVC
 - No Green Flame → PETE

