Nurdle Polymer Identification

Description: Students will conduct a series of tests on the nurdles to determine the type of plastic polymer. There will be a series of tests that the students will conduct on the nurdles to determine the type of plastic polymer it is made of. Afterwards students will discuss the benefits of knowing the type of polymer a nurdle is made of and how that information might help in understanding the spread of nurdles in an aquatic environment.

Audience: High School

Student Outcomes:

- Students will ask questions and define problems based on their investigation.
- Students will develop explanations and propose solutions supported by data and models consistent with scientific ideas, principles, and theories.
- Students will be able to perform a series of tests, while using a flow chart, to determine what type of polymer the nurdle samples are made of.
- Students should be able to explain the importance and purpose of knowing what kind of plastic a nurdle is made from.

Teacher Background:

https://nurdlepatrol.org/Forms/Home/
Nurdle Patrol - Home
Yes Nurdle, No Nurdle - Nurdle Patrol
The Great Nurdle Hunt- problem with nurdles
Nurdle Fact Sheet

Materials:

- 6 Nurdle Samples
- Plastic Flow Chart
- Recording Sheet
- Isopropyl alcohol solution, $CH_3CHOHCH_3$, 45.5% by volume. This solution is made by diluting 45.5 mL isopropyl alcohol to 100mL with water. (Also, by diluting 65mL 70% isopropyl rubbing alcohol to 100 mL with water.)
- Mazola Corn Oil
- Copper wire
- Corks to fit 18 mm test tubes
- Acetone
- Test tubes, 18 x 150 mm
- Stirring rod, glass
- Bunsen burner
- Beaker, 50 ml, 250ml

- Tongs or forceps
- Ring stand and ring with wire gauze

Teacher Prep:
Teacher will need to make sure that each testing station is set up with 6 nurdle samples to be tested, Isopropyl alcohol solution, Mazola Corn Oil, Copper wire, Corks to fit 18 mm test tubes, Acetone, Test tubes, 18 x 150 mm, Stirring rod, glass, Bunsen burner, Beaker, 50 ml, 250ml, Tongs or forceps, Ring stand and ring with wire gauze. Be sure there is a fume hood available for students to work under.

Introduction:
The teacher will introduce nurdles to the class using the vials that are provided in the teacher kits. Students will view Hurdles with Nurdles to gain background knowledge of what a nurdle is, what they are used for and the problem that we are seeing with them.

Safety Precautions:
- Isopropyl alcohol is flammable, and the vapors are considered to be toxic. Keep containers closed and cover any open containers, such as a beaker, with a watch glass. Avoid flames.
- Acetone is flammable and the vapors are considered toxic. Keep containers closed and cover any beakers of acetone with a watch glass. Work in a well-ventilated area. Avoid flames.
- The copper wire will get hot when heated in a flame. Hold the wire with tongs or forceps to avoid burns.
- Fume Hood recommended for the safety of students.

Disposal:
- Dispose of alcohol waste and acetone waste according to local regulations.
- Mazola corn oil can be reused if it is not dirty or contaminated. Dispose of any waste oil according to local regulations.
- Waste pieces of plastic can be collected and kept in a glass jar.
- Copper wire can be reused.

Procedures:
Students will be given a copy of the Plastic Flow Chart, recording sheet, vial of Nurdles and be assigned to a lab station that is set up for the following series of tests.

1. Test #1 Water Test
    a. Place approximately 5 mL of water in a test tube.
    b. Start with one of the plastic pellets. Using a stirring rod push the plastic pellet down into the water to remove any surface tension that may be causing it to float.
    c. Observe if it sinks or floats.
    d. Using the flow chart to determine what test needs to be conducted next.

2. Test #2 The Isopropyl Alcohol Test
    a. Place 5 mL of isopropyl alcohol solution in a test tube
    b. Start with one of the plastic pellets. Using a stirring rod push the plastic pellet down into the solution to remove any surface tension that may be causing it to float.
    c. Observe if it sinks or floats.
    d. Using the flow chart to determine what test needs to be conducted next.
3. Test #3 The Oil Test
    a. Place 5 mL of Mazola corn oil in a test tube
    b. Start with one of the plastic pellets. Using a stirring rod push the plastic pellet down into the oil to remove any surface tension that may be causing it to float.
    c. Observe if it sinks or floats.
    d. Using the flow chart to determine what test needs to be conducted next.

Substance	Density g/mL
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. Test #4 Copper Wire Test
    a. This test will be conducted on the plastic samples that sank in the water.
    b. Get a 5cm long copper wire. Put one end of the wire into a cork. Use the cork as a handle.
    c. Have the piece of your plastic sample you will be testing near your Bunsen burner.
    d. Hold the free end of the copper wire over the Bunsen burner until it turns red hot and the flame doesn't have a green color.
    e. Remove wire from the flame and touch the hot wire to the plastic pellet. A small amount of plastic should melt onto the wire. If the wire sticks to the plastic sample, use a pair of tongs to remove it. (You do not want to burn a large piece of plastic)
    f. Place the end of the wire, with the small amount of plastic on it, into the flame. You should see a small flash of a luminous flame (a yellow-orange color). If the flame turns green in color, then the sample contains chlorine.
    g. Repeat this for only the samples that sank in the water.
5. Test #5 The Acetone Test
    a. There should be a beaker of acetone under the hood located in the room. If not, place about 10 mL of acetone in a 50 mL beaker. Work under a fume hood to minimize vapors in the room.

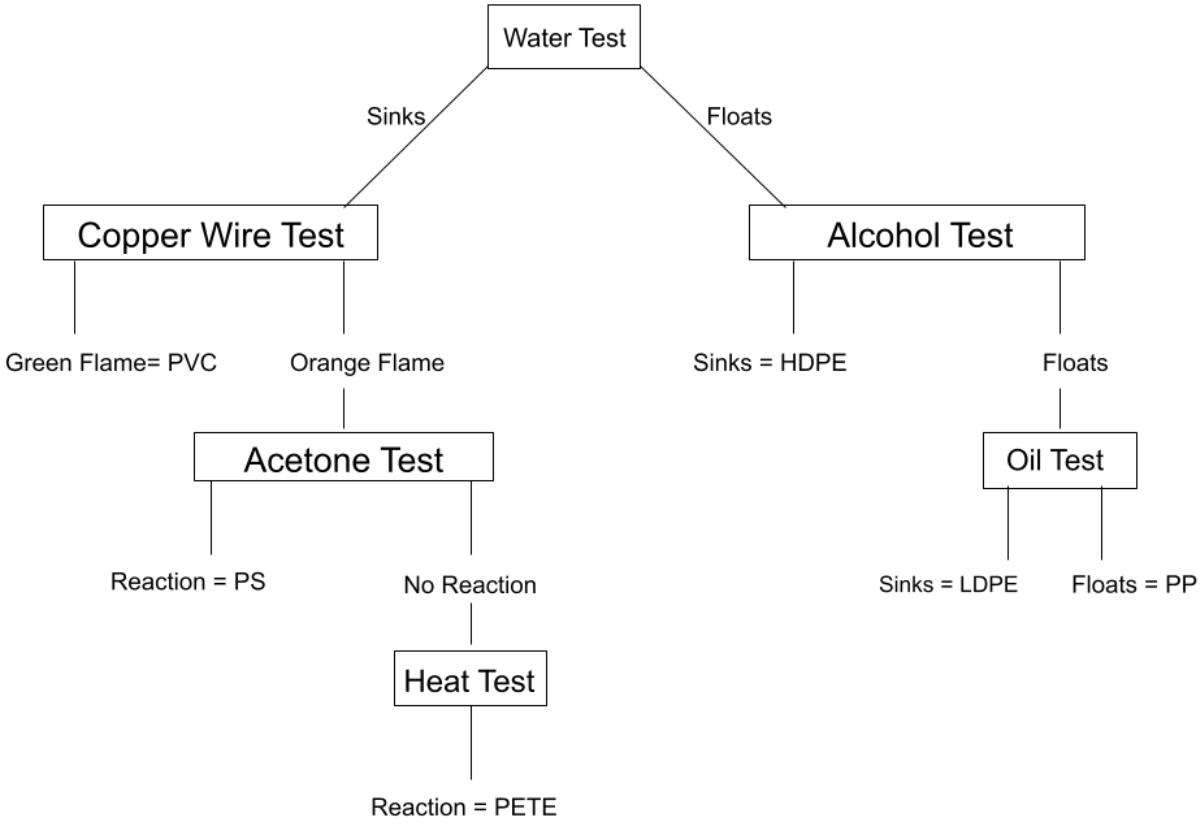
   b. For this test use a sample of plastic that did not give a green colored flame.
   c. Using tongs, place a pellet of the plastic in the acetone for 20 seconds. Remove the pellet and press firmly between your fingers. A positive reaction has occurred if the polymer sample is soft and sticky. Scrape the sample with your fingernail to see if the outer layer has softened.
6. If the sample has a positive reaction, discard it by placing it back in a glass jar. Do not dispose of them in the trash.
   a. Repeat this test for each of the remaining plastic samples that did not give a green colored flame.
7. Test #6 The Heat Test
   a. Place approximately 100 mL of water in a 250-mL beaker and heat to boiling.
   b. Use the sample of plastics that did not have a positive acetone test.
   c. Using tongs, place a pellet of the plastic in the boiling water for 30 seconds. Remove the pellet and press it between your fingers to see if it has softened. A positive reaction has occurred if the polymer sample is softened. **Pellet may be warm to the touch use caution when handling.
   d. If the sample has a positive reaction, discard it by placing it back in a glass jar. Do not dispose of them in the trash.
   e. Repeat this test for each of the remaining plastic samples that did not have a positive acetone test.

Questions/Discussion:
What are the benefits of knowing the type of plastic a nurdle is composed of?

Were all the nurdles made of the same plastic? What conclusions can you draw from this?

Extension:
Using the *All Level Nurdle Survey Lesson,* have students conduct a nurdle survey for their current location. This could be a river, creek, or beach. If nurdles are found, they can perform the same polymer test and compare the results to the nurdles in the previous tests.

Adapted from “Identification of Polymers”, David Katz and Plastics Analysis Lab, Hands On Plastics: A Scientific Investigation Kit, American Plastics Council and National Middle Level Science Teachers Association.


Water Test
Sinks
Floats
Copper Wire Test
Alcohol Test
Green Flame= PVC
Orange Flame
Sinks = HDPE
Floats
Acetone Test
Oil Test
Reaction = PS
No Reaction
Sinks = LDPE
Floats = PP
Heat Test
Reaction = PETE

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:

Ex:

Nurdle Sample	Test #1	Test #2	Test #3	Test #4	Test #5	Test #6
1	sink			Orange	No Reaction	PETE

Nurdle sample	Test #1	Test #2	Test #3	Test #4	Test #5	Test #6
1						
2						
3						
4						
5						
6						