Mud Dauber Nest Tunnel Building Activity Teacher Guide

Prompt: You are a mud dauber that needs to build a nest for your eggs. You will design your nest tunnel to be 10 cm long and 1 cm in diameter (the opening must be at least 7 mm). Your nest will be built around a #2 pencil or plastic straw and when it has hardened we will remove the pencil so you can put your eggs inside. We will then test for the water resistance of each nest.

Brainstorming Rules for your Team:
Rule 1: Postpone and withhold your judgment of ideas
Rule 2: Encourage wild and exaggerated ideas
Rule 3: Quantity of ideas counts at this stage—not quality
Rule 4: Build on the arguments put forward by others
Rule 5: Every person and every idea has equal worth.

Building a mud dauber nest requires a few simple steps. Mud daubers are solitary wasps constructing nests out of mud, so students can mimic this process using mud and water. Here's a step-by-step guide:

TEACHER SETUP:
Make 2 different portions of glue and water. I used 30% glue and 70% water for the 1st protein and for the 2nd protein I used 50% glue and 50% water. Some glue is required but up to you how much. You could let the students choose the amounts.

You could also let the students decide which tools or containers to use.

Gather materials: The primary material you'll need is mud. Grab 2 bowls with damp soil or clay dirt that can be easily formed into a paste-like consistency. You'll also need water to moisten the mud and make it easier to work with. Choose one of the liquids available to start with. You will use the 2nd one to build another tunnel later. Do not use too much water or it will be runny!

Question: Which glue liquid A or B will make them more water-resistant mud tunnel nests?
Write your hypothesis:
_____
_____
_____.

Prepare the mud: Scoop up some mud into a container. Gradually add your chosen liquid while stirring and mixing until the mud becomes a sticky, pliable consistency. You want it to be wet enough to hold together but not too runny.

Shape the nest foundation over a straw or pencil.: Taking one plastic spoonful of mud at a time, shape it into a small, elongated oval or tube-like structure. This will be the base or foundation of the nest. Press and mold the mud firmly to ensure it sticks together. Some mud daubers tap the dirt in place over and over.

Build the nest walls: Use your fingers to add more mud to the foundation and build the walls of the nest. Mud dauber nests are usually cylindrical or tube-like with a small entrance hole. Gradually add more mud in layers, shaping and smoothing it as you go. Carefully slide out the pencil or straw and fix any visible cracks or holes before you allow it to dry.

Allow the nest to dry: Once you've completed the nest structure, let it dry thoroughly. The drying time can vary depending on how much mud you added and the thickness of the mud layers. It may take a few days for the mud to harden completely. Once your first one is complete and starting the drying process, begin the 2nd with the other liquid.

Optional decorations: If you want to add more realism to your mud dauber nest, you can collect small twigs or grass stems and embed them into the mud walls before they dry. This will mimic the organic matter that mud daubers often incorporate into their nests.

Remember that building a mud dauber nest using mud is a simulation, and you should respect the natural habitat of these wasps. If you encounter mud dauber wasps in the wild, it's best to observe their nests from a distance and avoid disturbing them.

Materials List
For each group:

- 2 red solo cups of dirt
- Unsharpened number 2 pencils or straws– your choice!
- 2 different liquids (25 ml of each) simulating 2 proteins (Liquid A and Liquid B) that cause a sticky glue protein and water to harden the tunnels and make them durable
- 2 popsicle sticks
- 2 toothpicks
- Container to hold your nests —-this will be the wall or the ceiling (turn your container on its side if you wish)
- Water resistance test materials (water, dropper, 2 paper towels, Q-tip)

Student Tasks:

1. Build 2 tunnel mud dauber nests: one from each cup of liquid and dirt. Label them liquid A & B.
2. Take pictures of them right away and again when they are dried.
3. Make a data table to collect your data and compare the 2 nests. Here is the things you will need to measure or observe:

a. Mass of nest
b. Length of nest
c. Width of nest
d. Width of opening
e. Record the time it takes for water to enter the nest
f. Count the number of drops until water dampens Qtip

Procedure for water resistance test:
Place your nest on a dry paper towel. Insert a Qtip. Do this gently so it does not break. Lay a damp paper towel over the top of the nest and then slowly begin to drop water on the middle of the nest one drop of water at a time. After 1 minute of dropping drops onto the nest, carefully remove the damp paper towel and make observations about the exterior of the nest and its water resistance. Then gently remove one Q-tip at a time seeing if they feel wet (this means water got into the nest) record your observations of the Q-tip. If it is still dry, repeat the above instructions for another minute and check again. Record data until the Q-tip is damp and/or you can see the water getting inside your nest.

Optional Test: Procedure for earthquake shaker test
Place your nest on the earthquake shaker test. Start with the lowest amount of shake and go up every 30 seconds until it is destroyed or begins to fall apart. Repeat for the second nest. Record your observations and the amount of time until it begins to disintegrate.

Optional Test: Procedure for compression test

Select one nest. Prepare the vice: Ensure the table vice is securely mounted to a stable work surface. Make sure it is clean and in proper working condition
Position the item: Plae the item to be tested between the vice jaws. Ensure it is centered and aligned properly for accurate compression testing.
Apply gradual pressure: slowly turn the vice handle or crank to begin applying pressure to the item. Start with light pressure and gradually increase it while monitoring the behavior of the item. Counting the number of turns until it collapses.
Observe deformation: Continuously observe the item as pressure is applied. Note any visible changes, such as bending, cracking, or flattening. Pay attention to any signs of structural failure.
Record results: Take measurements or photographs at various stages of compression to document the results accurately. Record observations and the number of turns in the data table. Repeat for 2nd nest.

Data Table: Please generate your group’s data table here:

Results:
What did your group decide was the better of the two glue mixtures liquid A or liquid B? Why?
Did that match your hypothesis?

Did you make each tunnel using exactly the same method? If not, what did you change and what made you think it would work better?

What exactly do you think caused the tunnel that was better to have better water resistance?