National Nanotechnology Infrastructure Network
Serving Nanoscale Science, Engineering & Technology

Teacher's Preparatory Guide

Using Modeling to Demonstrate Self-Assembly in Nanotechnology
Take the Water Maze Challenge!

Purpose
This is an extension activity to *Using Modeling to Demonstrate Self-Assembly in Nanotechnology*. The Water Maze is a follow-up activity to give the students a chance to practice and demonstrate what they have learned.

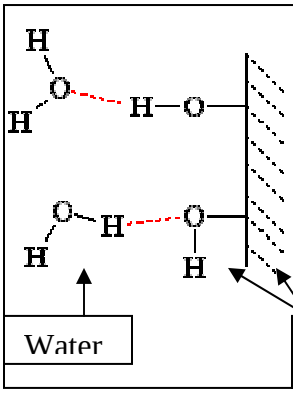
Time required
Two 50 minute class periods or one 90 minute block day for the challenge question.

Level – Middle to high School

Advance Preparation
Below are additional cards to cut out and laminate. These will be used in addition to the ones used in the previous activity.

Additional Tools/Molecules:

Water Water (H_2O) is a polar molecule that has a negatively charged end and a positively charged end.



Capillary Action Capillary action is the physical affect (force) that occurs with water on the walls of a tiny thin tube. Water climbs up the walls of the tube, against gravity, because of the strong attraction of the polar (charged) water molecule and the polar surface of glass (SiO_2).

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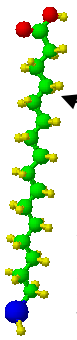
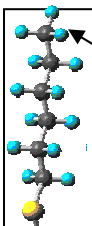
Masks A mask is designed to block out UV light. In this activity, you can design your own pattern of your mask and make as many masks as you would like



Mercaptohexadecaonic Acid (MA) MA molecules are used to make a self-assembled monolayer (SAM) on a wafer. These molecules have a sulfur-hydrogen (SH) on one end that can covalently bond to gold, and a (COOH) group on the top that is negatively charged (hydrophilic).
UV light at 254nm can break the covalent bond between the sulfur and the gold.



Hexadecane Thiol (HT) HT molecules also can be used to make a self-assembled monolayer (SAM) on a wafer. These molecules have a sulfur-hydrogen (SH) on one end that can covalently bond to gold, and a (CH_3) on the other end that is non-polar (hydrophobic). UV light at 254nm can break the covalent bond between the sulfur and the gold.

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Safety Information
There are no safety precautions for this activity.

Directions for the Activity

The water maze activity (challenge question) should be given right after, or the day after, the fly prison modeling activity and the students will need the lesson packet for information. It is recommended to begin the lesson by reviewing how they decided to put together their fly prison to remind them of their first task and why they took each step that they did. Provide students with the cards from the modeling lesson packet and the new cards, student guide, markers, and butcher paper.

The actual activity for the water maze/challenge question is designed for one per group. The grading of this activity is done by the teacher when the group presents. Every student in the group must have a speaking part and below is a very basic grading rubric that can be easily modified to fit your style. Directions for the presentation are found on the student guide.

Once the students have completed the activity, they should make a presentation to the class on their plan. They are asked to follow these directions:

Presentation Preparation:
1. Everyone must have a speaking part.
2. In your presentation, discuss the following:
    - The steps of assembly
    - The reasons for the steps
    - The final maze design
    - How the maze moves the water molecules
    - Some concerns as to how well this will work

Have the butcher paper with the design clearly drawn and labeled. Make your words and drawings big, colorful, and easy to read from the back of the room.

Analyze the Results

1. Was your prediction correct? Why or why not?

_____

2. Why was it important to have a control group?_____

3. Did you use all of the tools? Why or why not? _____

Draw Conclusions

4. Based on your results, do you feel that your steps were the only ones that would work?

Explain your answer.