Name:______________________________Date:______________Class:_______________

Student Worksheet

Small Scale Stenciling: Guided Inquiry

Safety
Chemicals on solar print paper wash off when developed in water. Do not splash water into eyes or onto body. Immediately rinse with water if that should occur.

Introduction

You will be creating images using masks and ultraviolet light. Ultraviolet light causes molecules in the coating of solar print paper to bind together and form a new compound. Photographers use this basic concept to create beautiful pictures. Engineers also use this idea, but they use it to create small-scale stencils that are used to make computer chips. Advancements in technology require more complex and smaller computer chips. Devices on the **nanoscale** are being developed, which are 100–1000 times smaller than the computer chips used presently. Presently there are transistors being manufactured in the size of 45nm, 32nm, and 22nm. The miniaturization of electronic technology at the nanoscale allows for smaller and faster devices.

Question: How can light cause a chemical reaction?

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Question: How can light be used to create patterns that can be used as a stencil?

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Materials
- 1 mask
- 3 solar print papers
- 2 blank transparencies
- 1 Sharpie® marker
- sun
- 1 timer
- towels

Procedure: Using a mask

1. Place the mask on a piece of solar print paper and then place these two items under a source of ultraviolet light.
2. Wait 3–4 minutes or until the exposed areas turn white.
3. Remove the mask and rinse the solar print paper in a pan of tap water for 30 seconds, then use a towel to gently dry the paper. Lay the paper flat on your table to dry. The blue portions of your paper will darken as it dries.

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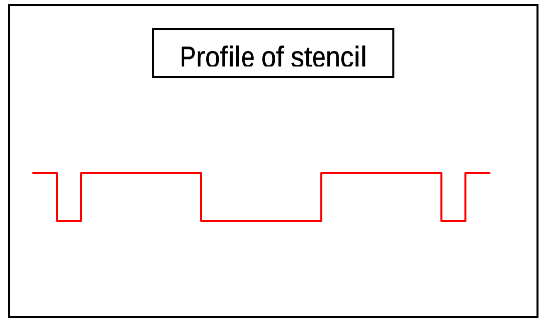
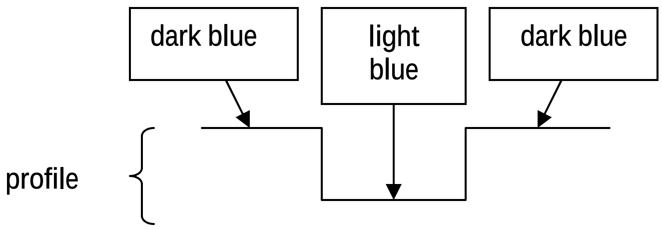
Record Your Observations

In the box to the right, draw a profile of the solar paper as you trace from one horizontal mark to the other. The light blue regions on the exposed solar print represent areas that were masked and protected from the sun and thus washed away with the rinse. The dark blue regions represent regions that were exposed to UV and reacted to form a dark blue dye, which does not wash away with water.



An example of a profile is given below:



Question: Which part of the coating of the solar print paper was rinsed away with the tap water? Why?

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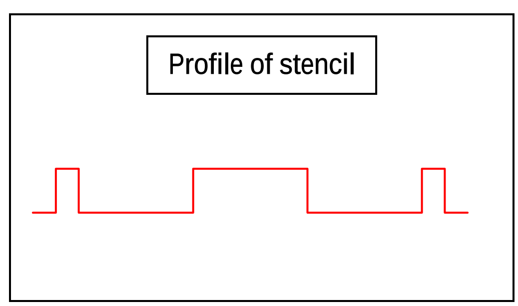
Procedure: Making a mask

4. Using a small piece of blank transparency and a black Sharpie®, draw a mask that would produce a **negative** image of your pattern that you just developed on your solar print paper. Remember to include every feature that is on your first mask.
5. Repeat steps 1–3, but this time expose your new mask and develop on a new piece of solar print paper. Then, check whether you are correct.

Record Your Observations

In the box to the right, draw a profile of the pattern you just created on the solar print paper.



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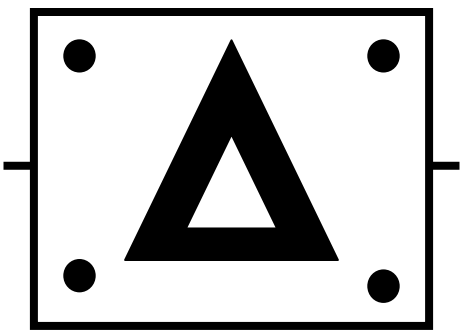
When both your pieces of solar print paper are dry, tape them in the boxes below.

Pattern from original mask	Pattern from new mask



New design

Question: If new features needed to be added to the original mask (as shown at left), can a person take the already exposed solar print paper (the print exposed with the original mask) and re-expose it to add the new features, or would a new piece of solar print paper be needed? Explain.

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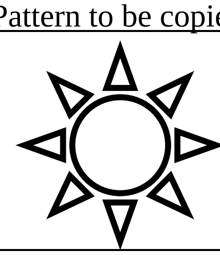
Procedure: Creating multiple images

6. Using a blank piece of transparency and a solar print paper, image as many copies as possible of the pattern shown to the right on a single piece of solar print paper. You may shrink the pattern, but include as many features as possible. **Your goal is to create a print with the most number of perfect copies as possible.** Plan carefully. Remember, you <u>cannot re-expose a section of the solar print paper</u>.

<u>Pattern to be copied</u>



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Prediction: Explain your strategy in making this new mask.

Record Your Observations

Tape your mask and developed image in the box below.

<u>Mask and developed image</u>

Analyze the Results

1. What worked well with your strategy?

2. What didn't work well with your strategy?

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Draw Conclusions

What could you try in the future to improve upon your results?

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