Name:_______________ Date:_______________ Class:_______________

Student Worksheet

Lab-on-a-Slab 2: Build Your Slab

Safety
Wear glasses and gloves. Do not eat or drink iodine or luminol—they are poisonous if ingested. Mild acidic and alkaline solutions can cause skin irritation.

Introduction:
In this lab, you will design a lab-on-a-slab that helps diagnose a mystery patient.

Materials
- various pieces of wire
- wire cutters
- tweezers
- pliers
- styrofoam plate
- permanent marker
- agar gel
- piece of plastic wrap
- sensor pads in containers, 4 of each shape; keep them organized
- 4 pipettes
- distilled water in a small cup as a control
- samples from 3 patients
- 4 hole punch reinforcement rings

Question: How can you use capillary action to do several tests on one small sample?

Make a Prediction

*I think that I can split the sample to go to three different branches and react with three different indicator pads.*_______________

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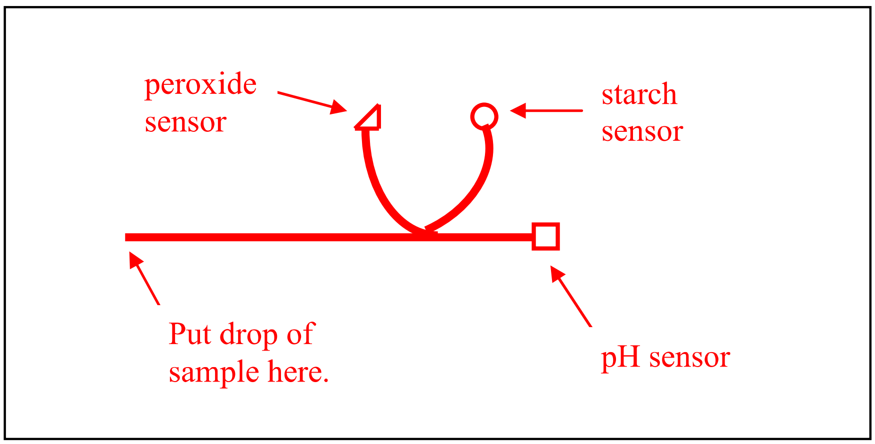
Procedure:



1. In the box above, draw your design that shows where you will place three different sensor pads for testing a sample. The sensor pads are small pieces of filter paper soaked in an indicator chemical. You will need to direct the liquid towards each separate sensor pad. You will use a starch test (circular sensor), a pH test (square sensor), and a peroxide test (triangular sensor). Clearly label it so someone else can understand what it is designed to do.

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2. Shape your wire using wire cutters, tweezers, or pliers. Make 4 copies of the same design to test 4 different samples on the same plate. Label your plate with your name, using a marker.
3. Pour agar gel into the plate. Adjust design with tweezers if necessary. Cover with plastic wrap and let it set overnight.
4. Carefully remove the agar gel. Trim the agar with a knife to separate each of the 4 copies. Remove the wires with tweezers.
5. Place the sensor pads on all four copies of your lab-on-a-slab.
6. Using a pipette, add one or two drops of water as a blank control to the start area of ***one*** of your channels and record the results of the sensor pads.
7. Repeat step 6 with samples from Patient A, Patient B, and Patient C. Be sure to use a fresh pipette for each sample.
8. Assign a diagnosis to each result (e.g., as seen in the chart below, an alkaline sample with starch but no peroxide would have 'alkaline starchosis').

Diagnosis	pH	Starch	Peroxide
acidic oxidosis	Red = acidic	pale brown = NO	Blue glow = YES
acidic starchosis	Red = acidic	blue-black = YES	no glow = NO
alkaline oxidosis	Blue = alkaline	pale brown = NO	Blue glow = YES
alkaline starchosis	Blue = alkaline	blue-black = YES	no glow = NO

Record Your Observations [Label unclear results as "more testing needed" under Diagnosis.]

	Starch	pH	Peroxide	Diagnosis
Control = water	*no*	*neutral*	*no*	*none/normal*
Patient A	*yes*	*acidic*	*no*	*acidic starchosis*
Patient B	*yes*	*alkaline*	*no*	*alkaline starchosis*
Patient C	*no*	*alkaline*	*yes*	*alkaline oxidosis*

Analyze the Results:

Do your results agree with other groups? What should you do about results that don't agree?

Sample answer: Most of the results agreed, except Patient B had starch in our test but not in another group's. We should retest the sample to check that neither of us did something wrong, like pick up the wrong sample or didn't use a fresh pipette but a used one that was contaminated with another sample.

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Draw Conclusion:

1. The group *Doctors Without Borders* often work in war zones, poor nations, or remote areas without electricity. How might a pre-made sensor chip help them? Why might you want to make it smaller?

   They can use the chips without needing a lab and electricity. More can be shipped in a box if they are smaller and they are more portable. More tests can be included on one chip if each test uses a very small amount of liquid.

2. If air is drawn over a liquid in a channel, a combination of lasers and nanoparticles can detect the 'smell' of TNT, RDX, Semtex, and other high-explosives. Why might soldiers patrolling a war zone want a small device that does this?

   The soldiers could carry the devices with them to constantly sniff for hidden explosives when on patrol, so it needs to be small and light.

3. What other substances might people/companies be interested in 'sniffing' for? What locations might use a device like a chemical nose?

   Controlled substances like drugs or weapons at borders like airports or ship ports. The Transport Security Agency might want to use it to try to detect explosives or poisons to prevent them getting on airplanes. Food and drink producers might use it to test for good flavors or signs of rot (e.g., wine and coffee makers or fresh produce suppliers).

4. Thinking about these uses, what are the strengths and weaknesses of your lab-on-a-chip? What ideas for improvement do you have?

   The agar is easy to make channels with and wire is easy to get, but agar is slimy and needs to be kept in the fridge. Our channels filled slowly and took four drops of sample. If the channels were smaller and in something more durable than agar you could use less sample and take it more places. You could also test for 50 things instead of just three.

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