Michigan K-12 Lab Outreach Program Template

BACKGROUND

An aging public health laboratory workforce, coupled with a decrease in the number of students entering science careers, a decrease in the number of clinical laboratory science degree programs and available hospital sponsored internships, among other issues such as lagging compensation, have brought the public health laboratory system to a point where these challenges have begun to limit the ability of the current workforce to protect the public's health. An outreach program designed to introduce laboratory science to young students can help address this issue. Introducing students at an early age to laboratory science will guide their natural curiosity to explore science so they may choose this path later in life; whether deciding on a college major or a career.

A K-12 Laboratory Outreach Project can supplement the laboratory science educational experience received in the school environment. The Michigan K-12 Outreach Project had three tiers. In Tier 1, which includes students in kindergarten through third grade, young students are familiarized with the basics of science and introduced to "science heroes." In Tier 2, which includes students in fourth through eighth grade, students learn about specific laboratory testing and disease prevention. Students in this tier learn about the testing that a public health laboratory performs and how that testing affects the public's health. In Tier 3, which includes students in ninth through twelfth grade, students are introduced to streaking agar plates and pH determination. These students learn about instrumentation and relate testing to emerging public health issues. In addition, students are provided with information about laboratory majors and careers available within public health laboratories.

PLANNING

Initial Planning Stage (Recommended: First two months)

- Develop program goals
    - Select 3-4 activities
        - *Suggested Activities:*
            - Determine workforce requirements to complete any planned outreach activity. Consider utilization of unpaid Interns. In Michigan, this need is filled by college students looking for experience in their majors or looking to expand their resumes.
            - Develop a dedicated outreach web site for students, with sections aimed at different age groups
            - Produce printed materials, including leaflets and posters, for outreach events
            - Build awareness of the mission through posters/signage for schools
            - Consider attending exhibitions, science fairs, education shows, and public events

- Consider outreach events (wet workshops) at major universities throughout your state
- Consider local school visits/ Demo Days (wet workshops)

- Target audience
  - Prioritize the tiers
    - ***Lessons Learned:*** Our first priority was to reach Tier 2 which includes 4th-8th grade students because the majority of the students that attended our past events fell into this grade level. Our second priority was Tier 3 students. We wanted to provide these students with information about lab science majors and careers. Our third priority was Tier 1. These students are usually very interested in the hands-on applications of science experiments but may not grasp the science behind the experiments.
  - Devise plan to reach target audience
    - ***Lessons Learned:*** We utilized teachers to reach our target audience. We sponsored a booth at the Michigan Science Teacher Annual Conference and mailed out brochures containing program information to local schools. In addition, we promoted our program at local science fairs. We also reached out to local community groups like the Boys and Girls Club and Big Brothers Big Sisters.
- Assemble a team
    - ***Lessons Learned:*** We had a team of five interns who had completed or were pursuing degree in laboratory science, science or education. They reported to the lab once a week to collaborate with other team members, record video footage for web media, discuss project progress, etc. We also met via Adobe Connect once a week.

POTENTIAL PROJECTS

Pricing from less expensive ($) to very expensive ($$$$).

Printed Media Development	
Phase 1:	• Logo Development (Appendix A) - **$$** • Program Brochure (Appendix B) - **$** • Display Board (Appendix C) - **$$$**
Phase 2:	• University Event/ Kick-off Promotional Material (Appendix D) - **$**

Phase 3:	• Science Hero Posters (Appendix E) - **$**

Lessons Learned: A lot of money was saved by designing the majority of our printed media ourselves. We purchased a subscription to Thinkstock.com, which offers customizable design templates for producing print marketing materials. Our display board was professionally designed since it was to be used at science events to publicize our program.

Website Development	
Phase 1:	• Develop site structure • Develop website banner (Appendix F) - **$$**
Phase 2:	• Add program information • Add upcoming event information
Phase 3:	• Online activities developed and added at least twice a month

Lessons Learned: Consider working with your state's IT department to develop the site. This will save money and there may be policies in your state that prevent outside hosting. We worked with a design firm to develop our program logo and color scheme of our website.

- Cost:
  - Hosting of site: **$**
    - Very inexpensive because our web site was hosted on our server with our other official government web pages.
  - Logo development: **$$**
    - We worked with a private design firm to design a professional and unique logo that would be applicable to students in grades K-12. This logo would be used on our website as well as other promotional material. Our logo is shown in Appendix A.
  - Web page background/ banner: **$$**
    - We worked with a private design firm to design the background.

Science Fairs/ Exhibitions	
Phase 1:	• Register for local science exhibitions- **$** • Contact local science fairs regarding participation as a judge
Phase 2:	• Develop certificates for science fair winners • Order lab coats for science fair winners with program logo- **$**

Lessons Learned: Attending local science exhibitions and judging science fairs is a great way to promote your K-12 outreach program. Our science fair organizers and contestants thought that the lab coats were a very creative prize.

University Events (Kickoff Events)	
Phase 1:	• Contact local universities regarding space for events • Develop hands-on activities for students • Develop posters to promote university events- **$** • Compile list of local schools with mailing addresses, email addresses and principal's name. • Create online survey to track registration
Phase 2:	• Advertise events o State's Facebook page, local community calendars, etc. o Email promotional material to local schools or hand deliver material based on proximity
Phase 3:	• Order supplies for hands-on lab activities - **$** to **$$** • Order promotional giveaways - **$**

Lessons Learned: Students were allowed to pre-register for our events so that we had an idea of the amount of supplies and staff needed for each. See Appendix G for event photographs. See Appendices H and I for sample hands-on activities and Appendix J for a listing of supplies and vendors.

School Visits (Demo Days)	
Phase 1:	• Contact local schools regarding their interest in Demo Days • Develop hands-on activities for students based on grade level • Order supplies for hands-on lab activities- **$**

Lessons Learned: Developing activities that are relevant to the curriculum for that grade level will increase interest among teachers. See Appendices H and I for sample hands-on activities and Appendix J for a listing of supplies and vendors.

Appendix A

Logos

Appendix B

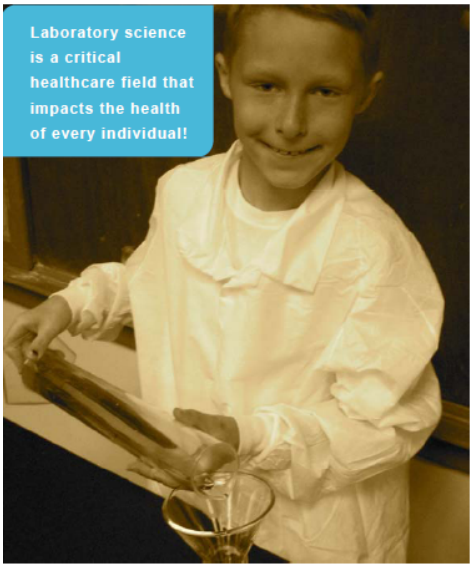
Outside of Program Brochure

Appendix B- Cont'd

Inside of Program Brochure

Who we are

The Michigan Department of Commu nity Health (MDCH) Bureau of Laboratories is the State Public Health Laboratory. The MDCH Laboratory is committed to scientif ic excellence and is dedicated to protecting the health of the citizens of Michigan. We are proud to announce our Explore Lab Science Program.



Laboratory science is a critical healthcare field that impacts the health of every individual!

Explore Lab Science Program

The goal of the Explore Lab Science Program is to introduce children to lab science at an early age. There are three tiers within this program.

Tier 1: K-3rd grade students are introduced to science in general terms.
Tier 2: 4th-8th grade students are presented with laboratory terminology and learn basic experiments.
Tier 3: High School students are presented with more complex laboratory experiments and demonstrations.

We hope introducing students at an early age to laboratory science will pique their natural curiosity to explore science so they may see this field as an option later in life when deciding on a college major or career.

School Demo Days

Local school visits provide hands-on science demonstrations to introd uce children and young adults to laboratory science.

Activities are age-app ropriate and include such things as: starch-iodine reactions, DNA extraction, pH determination, and streaking of agar plates. In addition, digital microscopes are used to view previously prepare d specimen slides of ye asts and moulds, cultures, fibers, bacteria, and/or insects.

School visits ca n be arranged by cont acting Ninah Sasy at sasyn@michigan.gov

Online Educational Activities

Visit
www.michigan.gov/explorelabscience

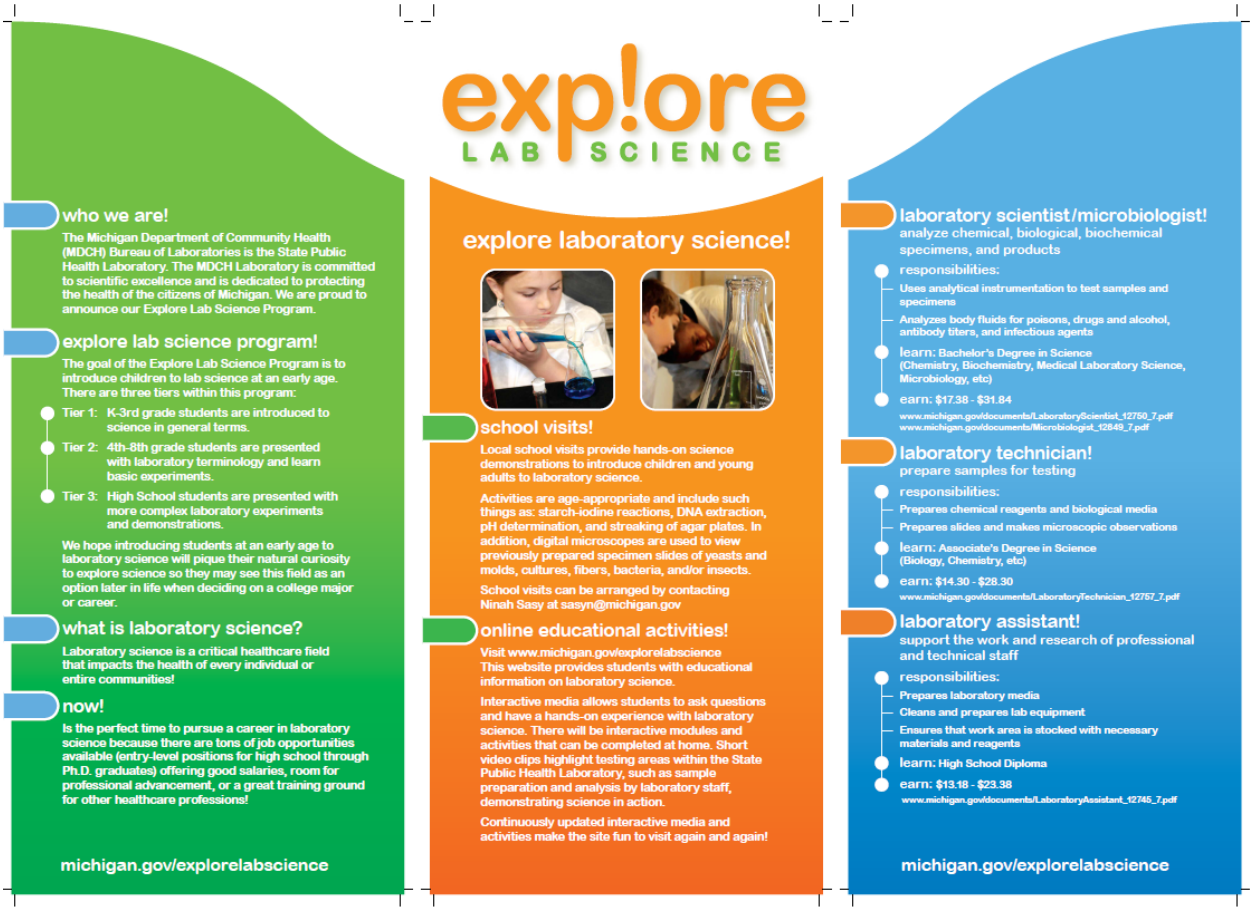
This website provides students with educational information on laboratory science.

Interactive media allows students to ask questions and have a hands-on experience with laboratory science. There will be interactive modules and activities that can be completed at home. Short video clips highlight testing areas within the State Public Health Laboratory, such as sample preparation and analysis by laboratory staff, demonstrating science in action.

Continuously updated interactive media and activities make the site fun to visit again and again.

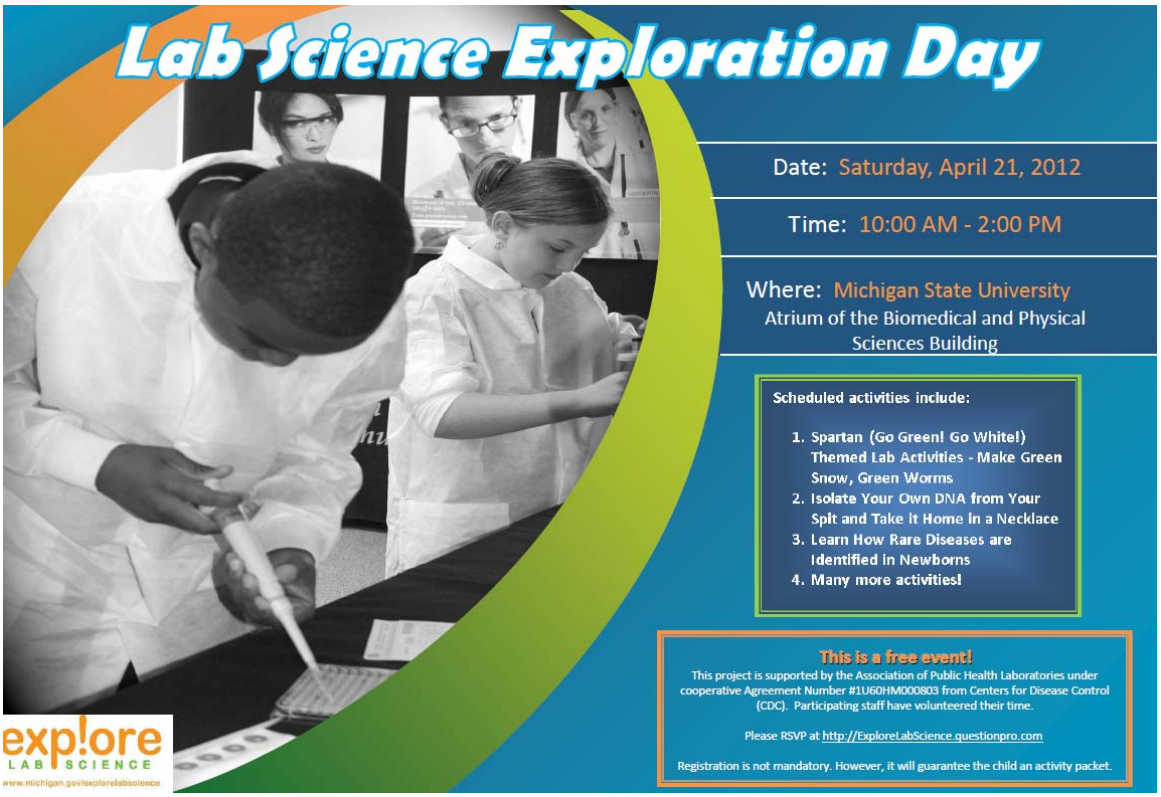
Appendix C

Display Board



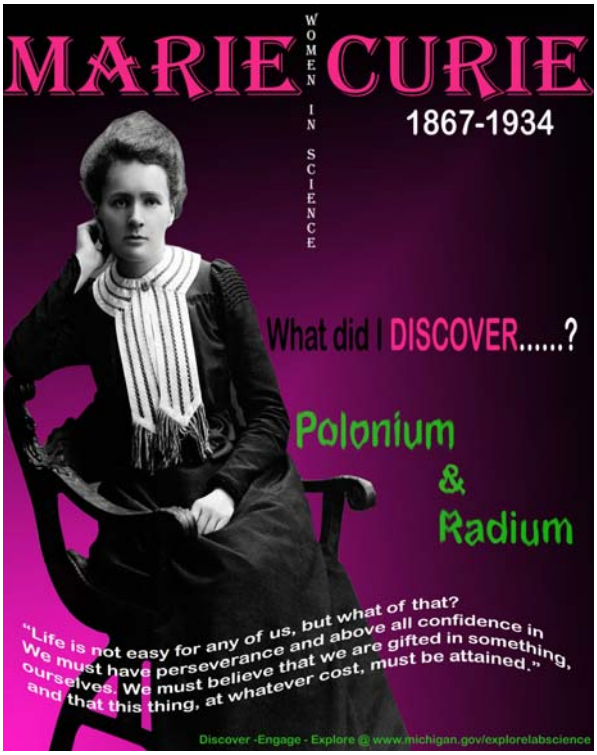
Appendix D

University Event/ Kick-off Promotional Material



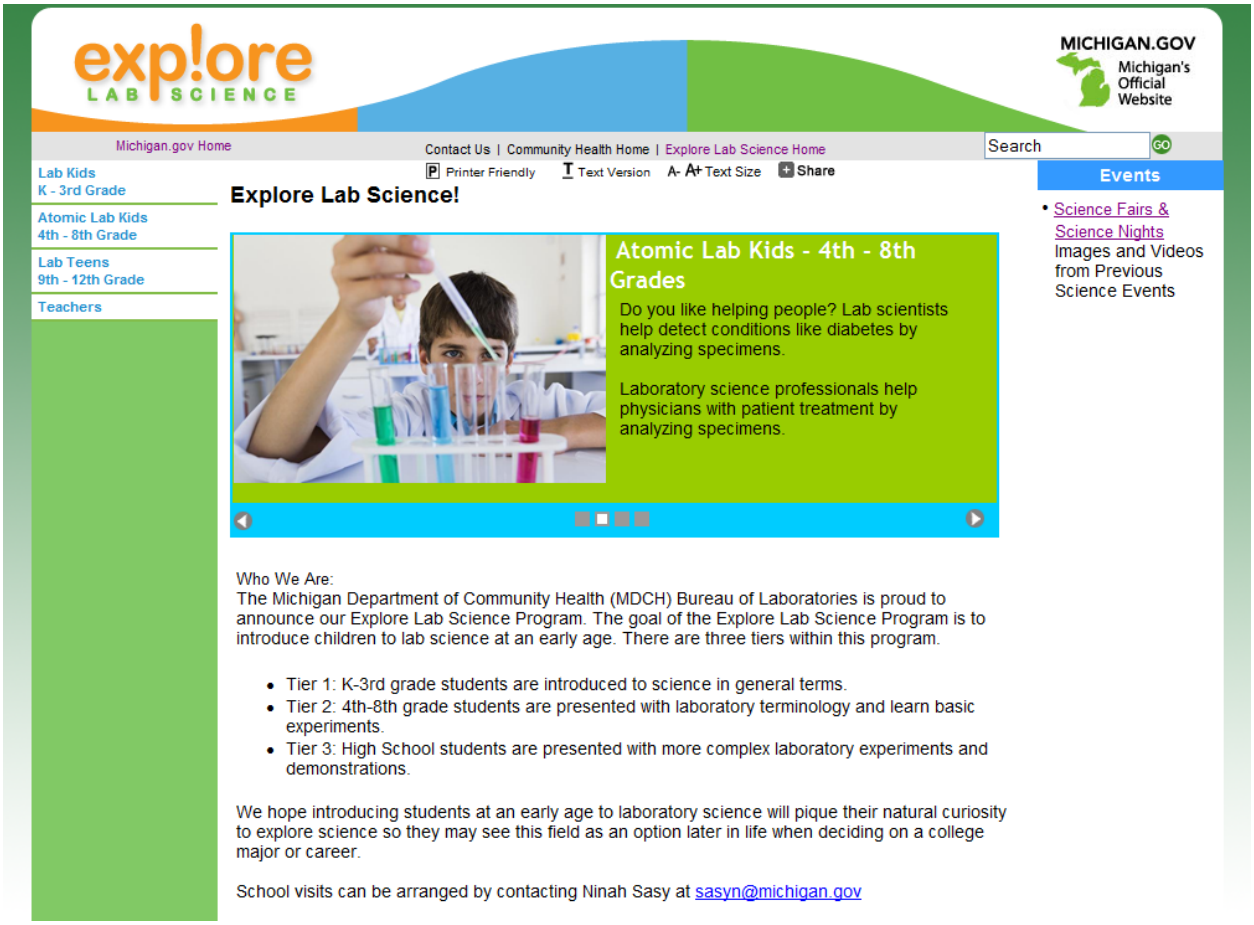
Appendix E

Science Hero Posters



Appendix F

Website Home Page



Appendix G

Event Photos


Benjamin

Appendix H

School Visits/ Demonstration Days

1. **Density Tower**
   Recommended Grade Level: K-8th Grade
   Demonstration Time: Approximately 5 minutes per child
   Objective: Students learn about density and hands-on use of laboratory pipettes

2. **Insta-Worm**
   Recommended Grade Level: K-8th Grade
   Demonstration Time: Flexible
   Objective: Students learn about polymers and absorbency

3. **Insta-Snow**
   Recommended Grade Level: K-8th Grade
   Demonstration Time: Flexible
   Objective: Students learn about polymers and absorbency

4. **Glo Germ**
   Recommended Grade Level: K-8th Grade
   Demonstration Time: Flexible
   Objective: Students learn about germs and activity allows students to see areas that they're neglecting while washing their hands

5. **Magic Color Breakdown**
   Recommended Grade Level: K-8th Grade
   Demonstration Time: Approximately 10 minutes for experiment completion
   Objective: Students learn about chromatography

6. **Magic Sand**
   Recommended Grade Level: K-12th Grade
   Demonstration Time: Flexible
   Objective: Students learn about hydrophilic substances versus hydrophobic substances

7. **Microscope/ Make Your Own Cheek Cell Slide**
   Recommended Grade Level: K-12th Grade
   Demonstration Time: Flexible
   Objective: Students in grades K- 4th can view previously prepared slides using a microscope; Students in grades 5th- 9th can prepare their own slides using their cheek cells

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8. **Newborn Screening/ Starch- Iodine Reaction**
   Recommended Grade Level: 7-12th Grade
   Demonstration Time: Flexible
   Objective: Students in grades 7th- 8th learn about the starch-iodine reaction; Students in grades 9-12th learn about the starch-iodine reaction in addition to basic understanding of the Biotinidase analysis in our Newborn Screening Laboratory

9. **DNA Extraction**
   Recommended Grade Level: 7-12th Grade
   Demonstration Time: Approximately 30 minutes
   Objective: Students learn about DNA and various laboratory applications

10. **pH Experiment**
    Recommended Grade Level: 7-12th Grade
    Demonstration Time: Flexible
    Objective: Students learn about pH and conduct hypotheses

11. **Atomic Slime**
    Recommended Grade Level: 7-12th Grade
    Demonstration Time: Flexible
    Objective: Students learn about fluorescence and polymers. High schools students are introduced to sodium tetraborate which holds the slime together.

Please contact Ninah Sasy at sasyn@michigan.gov to arrange a school visit. We are continuously updating our list of hands-on activities.

Appendix I

Activity Worksheets

Newborn Screening Station

(Recommended for 9-12th Grade Students)

What is Newborn Screening?

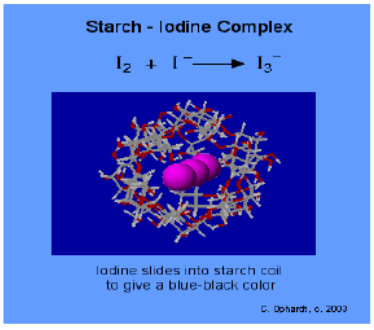
- Newborn Screening is a public health program required by Michigan law to identify infants with rare but serious disorders that require early treatment.
  - Some infants with these conditions seem healthy at birth but can become very sick in a short time.
  - Each year more than 200 Michigan babies - one in every 500 to 600 births - are found to have a disorder detected by newborn screening.

What is Biotinidase Deficiency?

- **Biotinidase deficiency** is one of the 51 disorders screened in our laboratory.
  - It's a disorder that is inherited from both parents (autosomal recessive).
  - The body is unable to synthesize **biotin,** a vitamin that is essential to many metabolic processes.
  - The deficiency can cause a range of symptoms from skin rashes to hair loss, depending on the severity of the deficiency.
  - Biotinidase deficiency can be treated easily with a supplement (a pill).

In this exercise:

- This exercise simulates a test performed in our laboratory to determine if a child is Biotinidase deficient.
  - Our simulation uses fake blood spots treated with **starch,** a large collection of linked glucose molecules (starch is used in food, as a stiffener for clothing, and as an adhesive) and **iodine**, an element found in the halogen family (a wide number of uses, including iodized salt).



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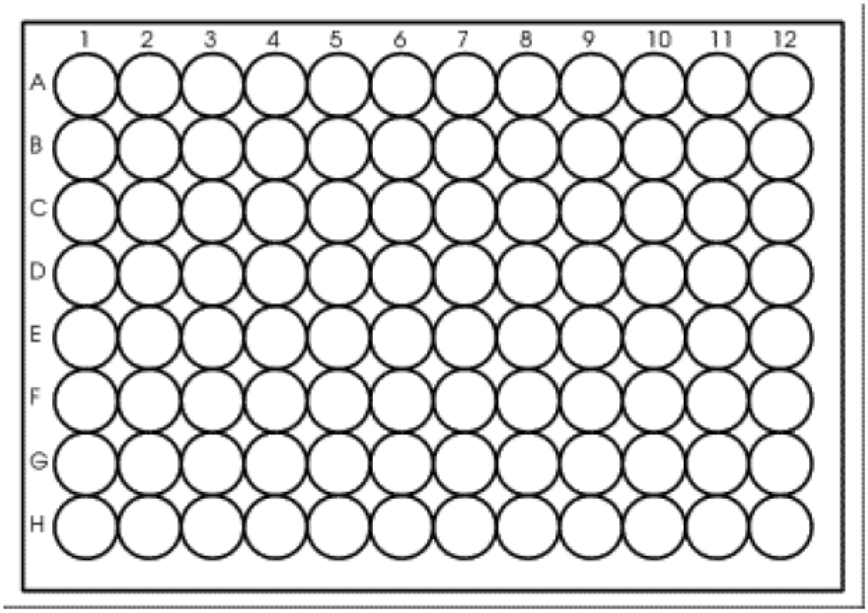
Procedure:

1) Punch a circle from each simulated blood spot on your newborn screening card
2) Place each circle in separate wells on your 96-well plate
3) Pipette iodine into each well with a circle
4) Some blood spots have starch while others may not. Can you tell the difference?
5) Using the diagram below, shade the cell(s) with the starch-iodine reaction blue and shade the cell(s) without the starch-iodine reaction red.



Analyzing Your Results:

- Let's examine the starch-iodine reaction:
  - If the blood spot remains red, after adding iodine, then there was no starch present.
  - If the blood spot changes to blue/black then the blood spot had starch and it reacted with the iodine.
- How does this relate to Biotinidase testing?
  - If the blood spot has starch and therefore reacts with the iodine we will see a color change in the well; the result simulates a normal Biotinidase condition.
  - If there is no starch present, then we will not see a color change; the result simulates a Biotinidase deficiency.

Magic Color Breakdown Station

What is Chromatography?

It is a laboratory technique used to **separate** and **identify components** (parts) of a mixture. Chromatography means "color writing" (from the Greek words chroma and graphe). There are many forms of chromatography; some of the most common are paper chromatography, column chromatography, and gas chromatography.

How is Chromatography used in the Laboratory?

Chromatography was developed in 1906 by a botanist named Mikhail Tswett, who used it for studying plant pigments (colors). It's now widely used in forensic science (for identifying samples taken from crime scenes), in pollution monitoring (for identifying small concentrations of unknown pollutants in air and water samples), and for studying complex mixtures in such things as food, perfume, petrochemical, and pharmaceutical production.

Experiment

In this experiment, you will use paper chromatography.

Materials

- Water
- Blotting paper (letter size or smaller)
- Bread Baking tin or dish with an edge
- 4-8 different colored markers (felt tip pens)

Procedure

1. Line up your blotting paper and the lids of the marker pens that you will use this experiment.
2. Make a series of dots in a row using colored markers one inch from the bottom of the paper.
3. Fold your blotting paper and place it in the baking tin. The baking tin should already have water.
4. Watch to see what happens to all of the colors as the water is being absorbed by the blotting paper. This may take 5-10 minutes.

Results

Which marker has the most colors?

How many colors can you see?

DNA Extraction Activity

What is DNA?

DNA is the molecular blueprint for our bodies, design instructions from which we are built.

*-DNA carries **information that is passed** from generation to generation*
*-Your DNA is **a combination** of half of your mother's DNA and half of your father's DNA*
*-DNA is made of 4 **bases** – **A**denine, **G**uanine, **C**ytosine, and **T**hymine*
-DNA controls your hair color, eye color, height, and other traits, along with the formation of your lungs, heart, brain, and other parts.

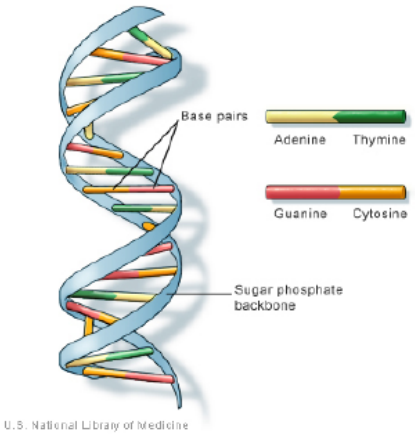
Where is DNA found?

DNA is found in living things – humans, plants, animals, even bacteria. It is present in cells, whether a human cheek cell or a single-celled bacteria.

*-In human cells, DNA is found in the **nucleus***

What does DNA look like?

DNA looks like a spiral staircase. The staircase has two long components joined by steps; DNA has two backbones joined by paired bases – A & T, C & G.



- ✓ The shape is a double helix.
- ✓ In cells, DNA is usually packed tightly, to allow the DNA to fit into the nucleus.
- ✓ All of the DNA in the cell comprises the genome.
- ✓ The genome is divided into smaller parts called chromosomes.
- ✓ Chromosomes contain many genes, which are combinations of bases that have a specific meaning.

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Another way to look at it:

The genome is like a set of encyclopedias; the chromosomes are chapters, the genes are words, and the bases are letters.

How can we make DNA visible?

Experiment Overview:

In this experiment you will collect cells from your cheek, break them open, and condense them from all the cells to make them visible.

Step 1: Collect cells from your cheek
Step 2: Break open the cells
Step 3: Remove proteins
Step 4: Condense the DNA (so you can see it!)

Step 1: Collecting cells from your cheek

You can collect thousands of cells from the inside of your mouth by gently chewing on sides of your mouth and rinsing with water.

Why? The cells of your cheeks are constantly dividing, so you can take cells from your cheeks and expect them to be replaced.

Focus question: What piece of equipment might you use to test whether you are actually collecting cells from your cheeks? (Think of magnification)

Step 2: Breaking open your cells

*Recall that DNA is inside the **nucleus** of your cells. In order to see it, we first have to get it out of the nucleus.*

In order to get to the DNA, we have to:
-Break the cell membrane
-Break the nuclear membrane

*The process of breaking open cells can be accomplished using a **detergent.** The detergent acts like dishwashing detergent or soap to get fat and grease off of cookware; the detergent breaks down cellular membranes, allowing us to get to the DNA.*

Focus question: Do you think DNA will be visible after you break open the cells? Why or why not?

Step 3: Removing proteins

DNA is tightly packed around proteins in the cell to conserve space and keep the DNA organized in the nucleus.

*Think of the proteins as a group of LEGO blocks, attached to one another. We want to break the proteins down into the individual 'blocks.' To break the proteins, we use a **protease** – an enzyme – which is a sort of cellular machine that cuts the protein up into **amino acids,** the 'blocks' of the protein.*

Step 4: Condensing the DNA

*DNA strands are so thin that we can't see them without condensing them (packing them together). Think of the DNA as a long, thin piece of thread. It's hard to see by itself, but if we pile a bunch of threads together we can see it easily. We'll do the same with our DNA by causing it to **precipitate** from our solution.*

*By adding **salt** and **cold alcohol** to the solution, we change the condition of the fluid and make the DNA come out of the solution.*

Focus question: Have you ever tried to add sugar to iced tea or hot tea? How much harder is it to get the same amount of sugar to dissolve in iced tea?

What to look for: Your Condensed DNA

Look carefully at your vial. You should see white strands of DNA.

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Appendix J

Activity Supply List

Item	Vendor	Approximate Cost
DNA Extraction Kits	BioRad 1-800-4-BIORAD www.biorad.com	$1000 for 100 students
Microscope with LCD Screen	Amazon www.amazon.com	$150
Atomic Slime Activity	Steve Spangler Science 1-800-223-9080 www.stevespanglerscience.com	$35 for 30 students
Magic Color Breakdown Activity	WalMart	$4 for 12 color markers $1 for one metal pan $23 for 50 sheets of blotting paper
Lab Coats with Embroidered Logo	Sohn's Linen 517-482-0631	$25 per lab coat
Simulated Blood Typing Kit	Education Innovations 1-888-912-7474 www.teachersource.com	$65 for 60 students
Insta-Worm Kit	Steve Spangler Science 1-800-223-9080 www.stevespanglerscience.com	$30 for30 students
GloGerm	VWR 1-800-932-5000 https://us.vwr.com/	$30 for 100 students