

# Carolina Biological Supply Company

## Forensics



For the **Biology** Laboratory

# Objectives

- **To introduce 3 new ways of exploring biology concepts using forensic science**
- **To perform several hands-on forensic science activities**



# Hands-On Activities

## Which Beer Is Best?

- **Use a Durham fermentation apparatus to observe relative sucrose fermentation rates by different yeast cultures**
- **Incorporate pH testing and microscopy**
- **Observe yeast morphology in a fun, real-world context**



# Hands-On Activities

## Caught by a Kiss

- **Test evidence for saliva to see if DNA may be isolated from different items**
- **Discredit the “test everything” mantra of *CSI***
- **Introduce enzymes**



# **Hands-On Activities**

## **Synthetic Blood Typing**

- **Perform blood typing without the risk of disease transmission**
- **Straightforward protocol with realistic agglutination reactions**
- **Can use to discuss:**
  - **Antigen-antibody reactions**
  - **Single genes having multiple alleles and other issues in genetics**
  - **Forensics**
  - **Population studies**

# Scheduling

- **Set up "Which Beer Is Best?"**
- **Set up "Caught by a Kiss"**
- **Do synthetic blood typing**
- **Read results of "Caught by a Kiss"**
- **Observe results from "Which Beer Is Best?"**

# Which Beer Is Best?

## The Case

- **A microbrewery suspects that an employee has introduced an inhibitor into its medium**
- **Students act as lab techs to determine the validity of their claim**
- **Learn:**
  - **What is fermentation?**
  - **What are the products of fermentation?**



# Fermentation in Baker's Yeast

**Baker's Yeast = *Saccharomyces cerevisiae***

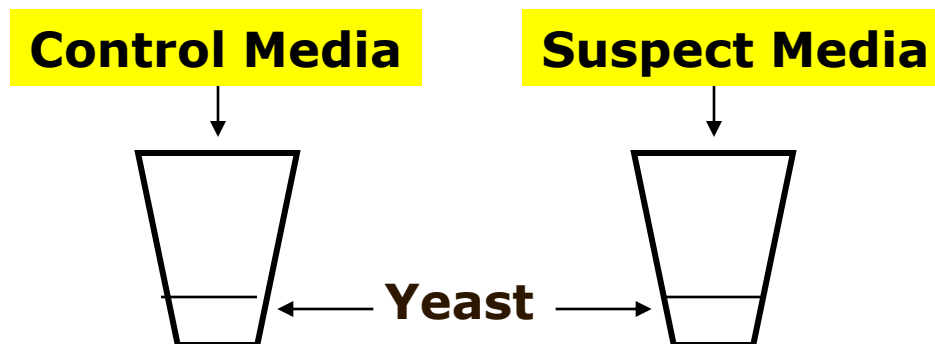
**sucrose**  $\xrightarrow{\text{Invertase } (\beta \text{ fructosidase})}$  **fructose + glucose**

**glucose**  $\xrightarrow{\text{glycolysis}}$  **2 CO<sub>2</sub> + 2 ethanols + 2 ATP's**

# Which Beer Is Best?

## Protocol

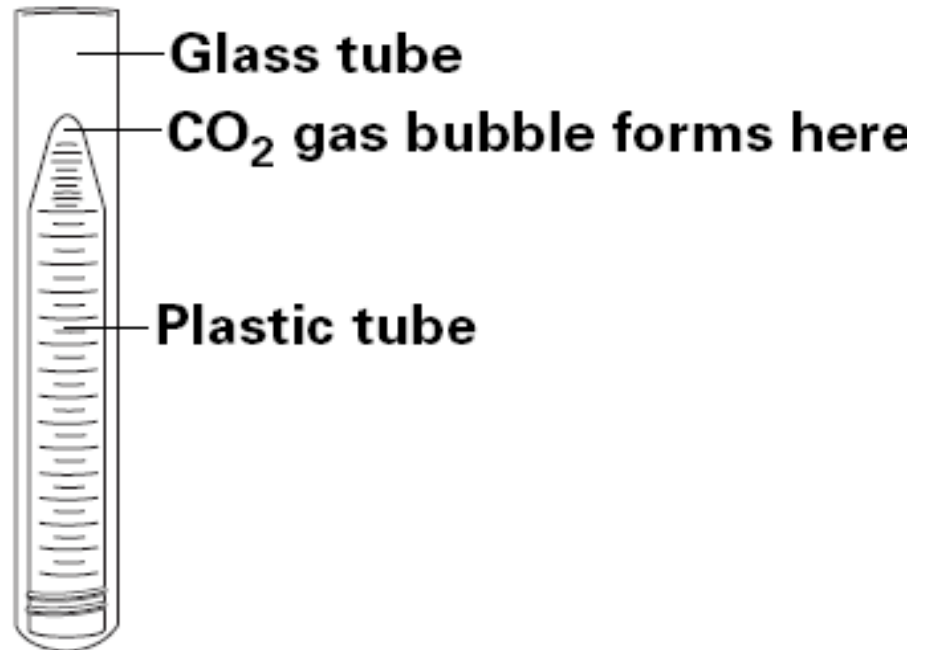
1. Label each of your plastic 15-mL tubes and glass test tubes as either "Control" or "Suspect." Also include your initials on the glass test tubes.
2. Place 2 mL (one full squirt) of yeast suspension into each of your plastic 15-mL tubes.
3. Add 12 mL (6 full squirts) of the "Control" media to the 15-mL plastic tube labeled "Control." Mix.
4. Add 12 mL (6 full squirts) of the "Suspect" media to the 15-mL plastic tube labeled "Suspect." Mix.



# Durham Fermentation Apparatus

Create a "Durham apparatus" as shown below with each of the tubes and place them into the Styrofoam<sup>®</sup> cups containing warm water.

Measure the amount of fermentation using the graduations on the tube



# Caught by a Kiss

## The Case



- **Evidence collected**
  - **Toothpick**
  - **Drinking straw**
  - **Cup**
  - **Envelope**
- **Participants act as CSIs to determine if saliva is present on the evidence**
- **Participants use an amylase assay to detect saliva**
- **If saliva is present, DNA testing should be done**



# Amylase Assay

- **Amylase is an enzyme present in saliva**
- **Saliva contains cells (with DNA!) that have sloughed off the inside of the mouth**
- **Thus, the presence of saliva indicates that DNA may be present**

# Amylase Assay Reaction



## Simple Reaction



Iodine reacts with starch to produce a **BLUE** color

Starch + Iodine  $\longrightarrow$  **BLUE**

Polysaccharide (Starch) + Amylase  $\longrightarrow$  Disaccharides

Disaccharides + Iodine  $\longrightarrow$  **CLEAR** to **YELLOW**

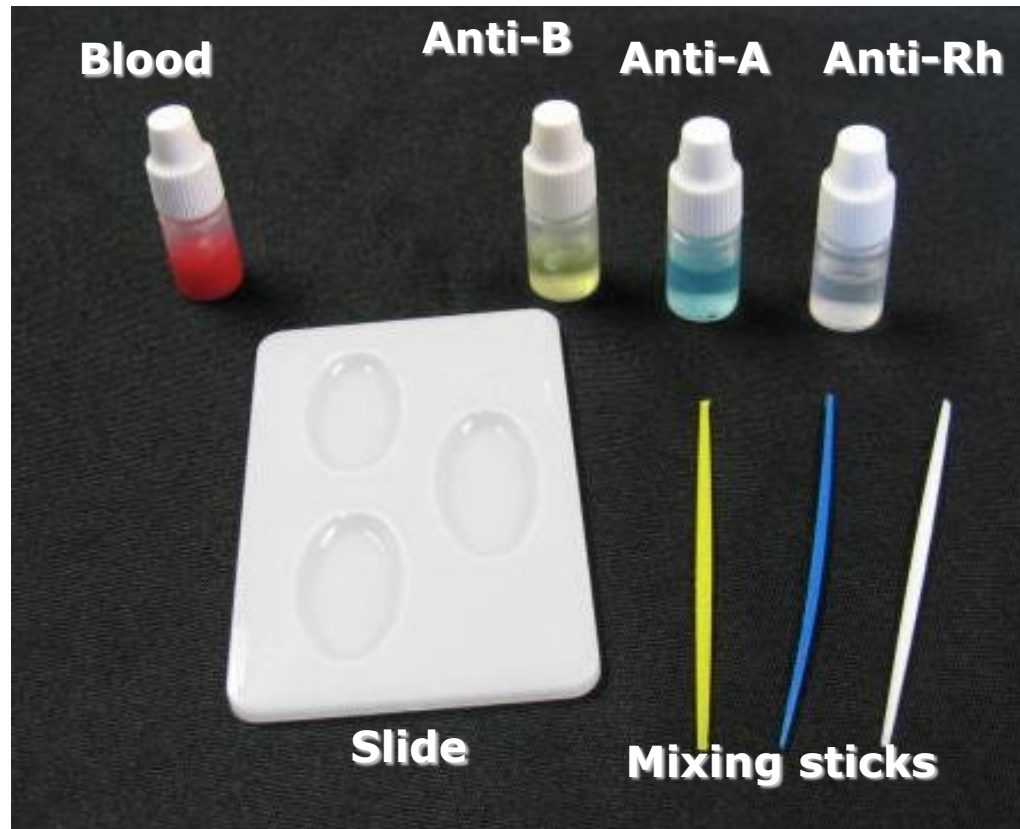
Since amylase breaks down starch, there will be an area of clearing if amylase is present.

# Caught by a Kiss

## Protocol

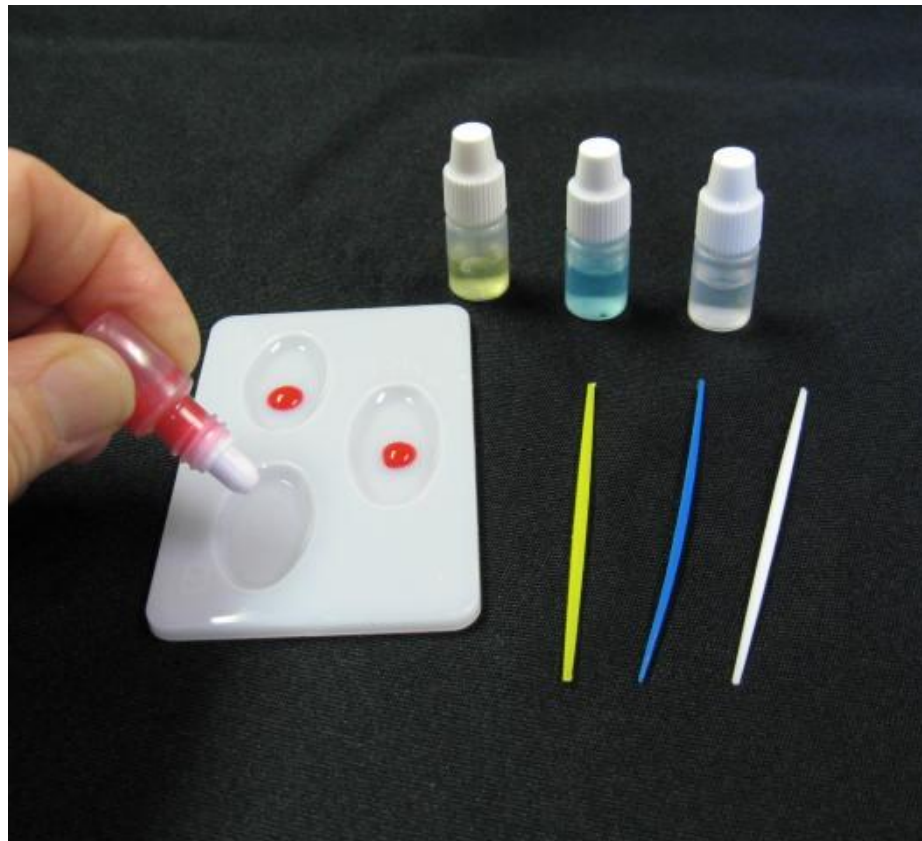
- 1. Obtain a starch agar plate and divide it into thirds (+, -, and e) with a marker.**
- 2. Moisten a cotton ball with water and swab it on the “-” section.**
- 3. Swab the same cotton ball onto the piece of evidence to be tested several times, and rub it on the “e” section.**
- 4. Place some saliva on another cotton ball and swab it on the “+” section.**
- 5. Allow the plate to incubate for 10 minutes, then flood with the IKI solution.**

# Blood Typing Setup



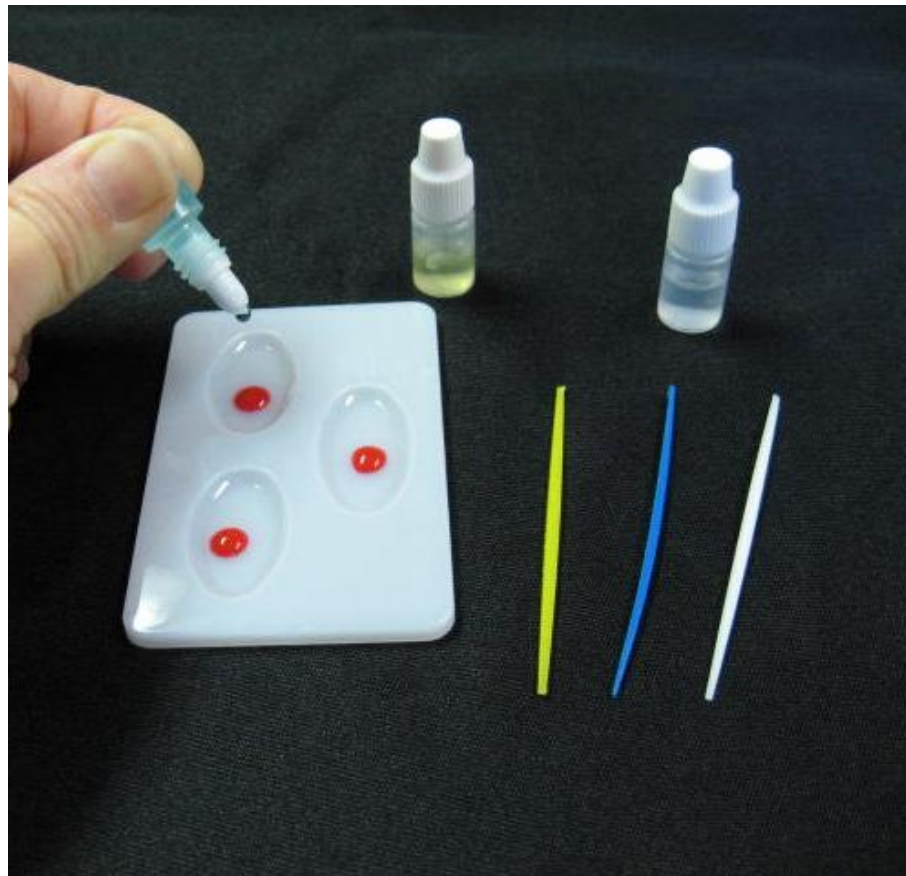
# Blood Typing Protocol

**Add one drop of synthetic blood to each slide well.**



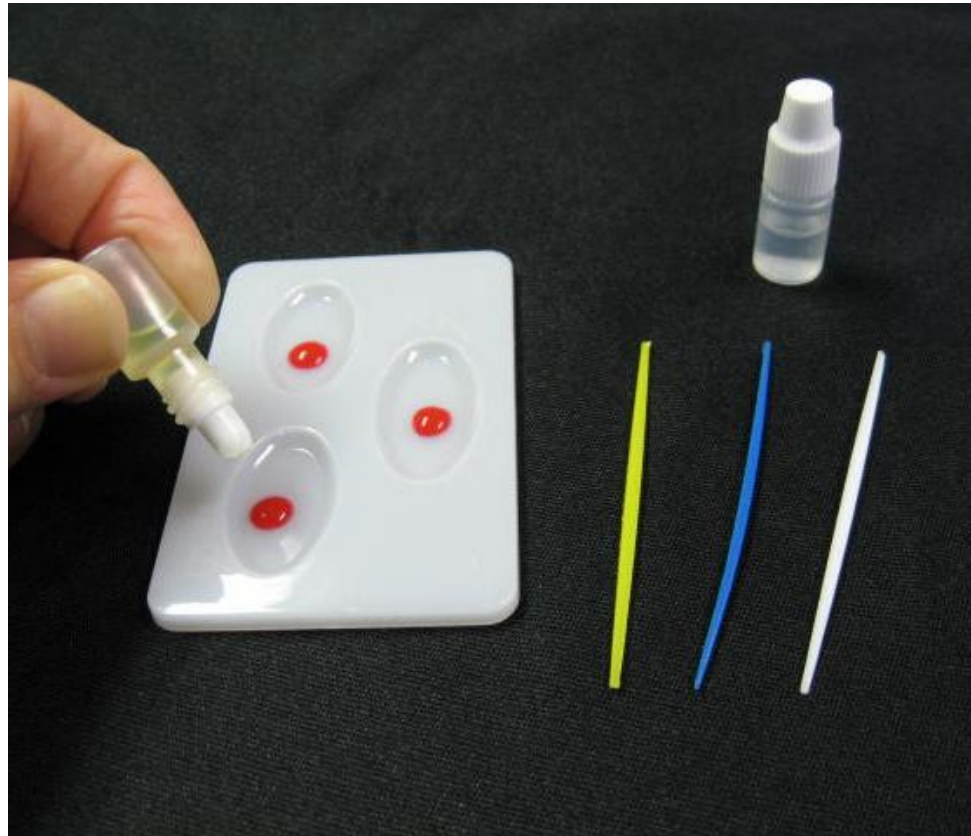
# Blood Typing Protocol

**Add one drop of anti-A synthetic antisera to well A.**



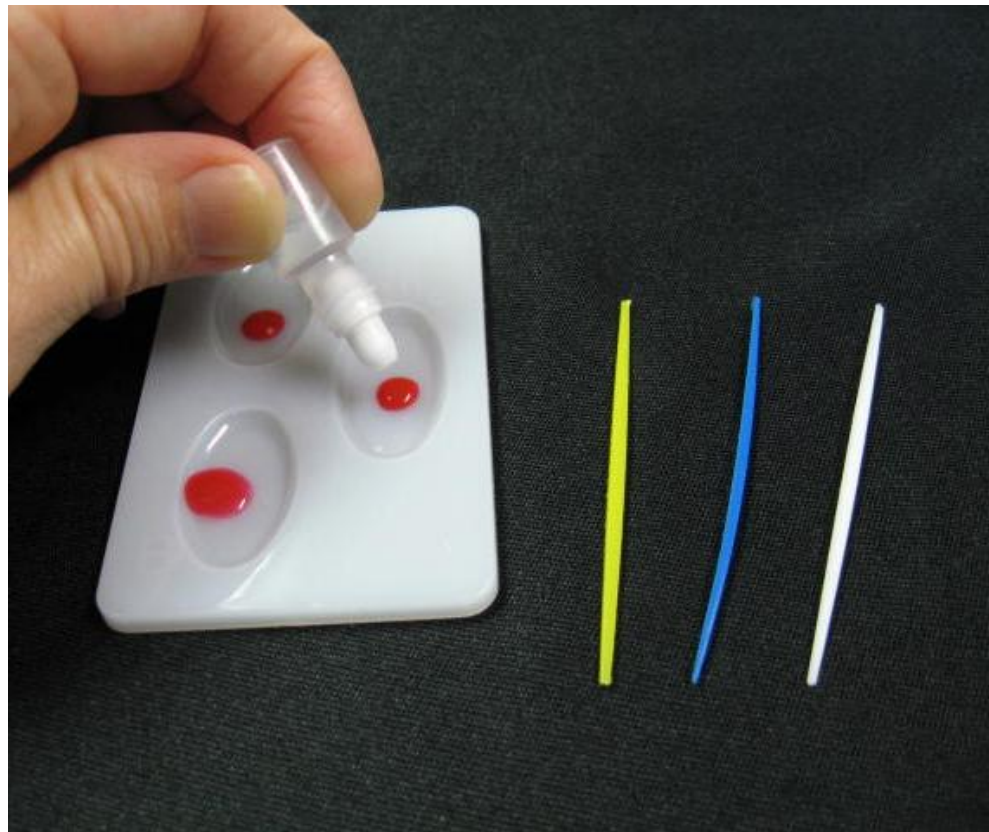
# Blood Typing Protocol

**Add one drop of anti-B synthetic antisera to well B.**



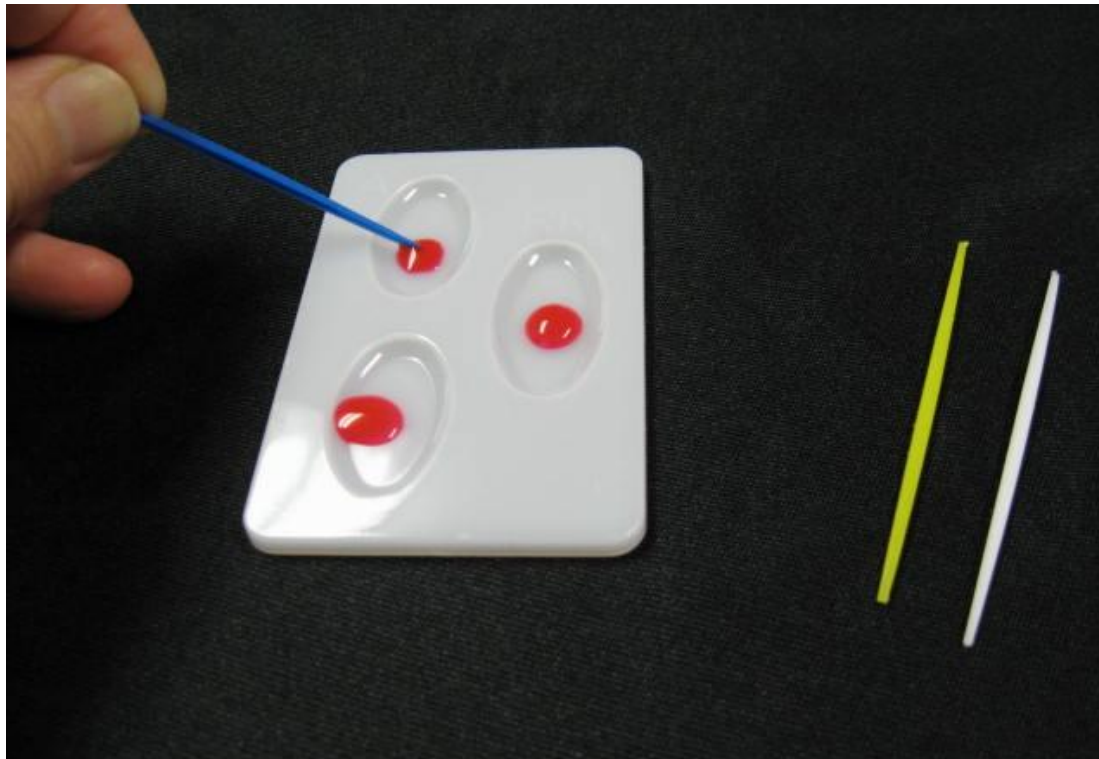
# Blood Typing Protocol

Add one drop of anti-Rh<sub>0</sub> synthetic antisera to well Rh<sub>0</sub>.



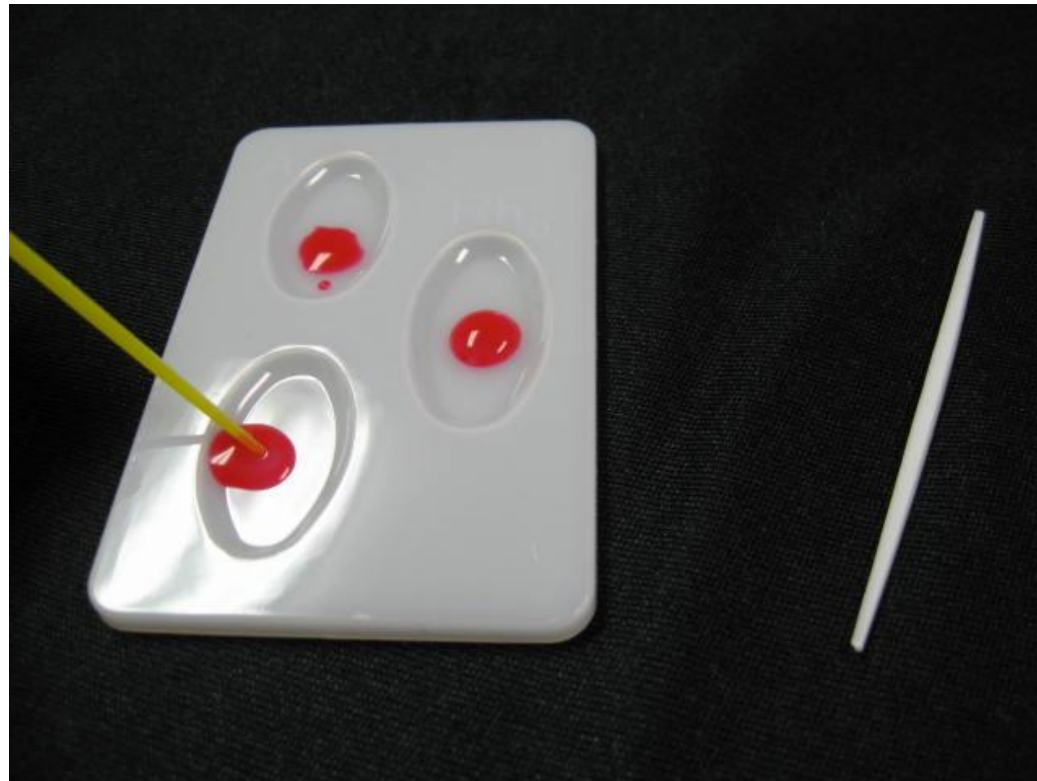
# Blood Typing Protocol

Completely mix the synthetic blood and synthetic antisera in well A. Use the **blue**-coded mixing stick.



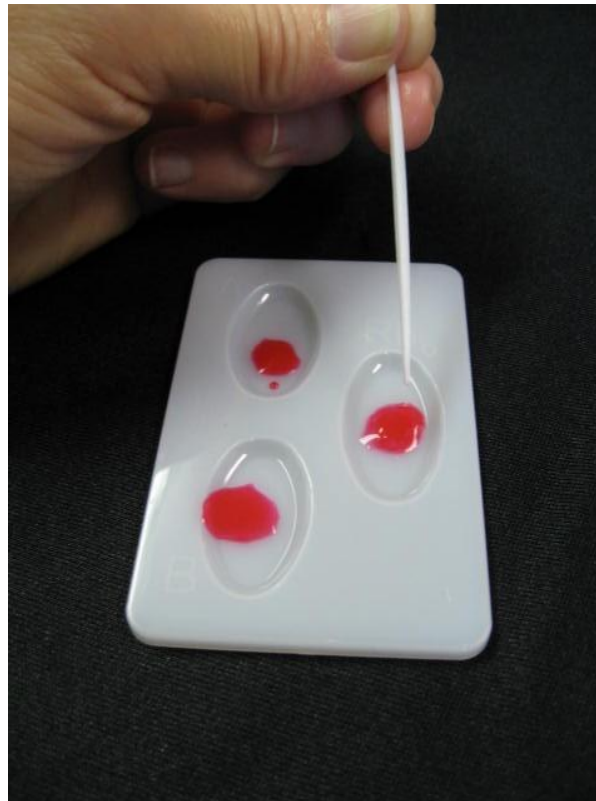
# Blood Typing Protocol

Completely mix the synthetic blood and synthetic antisera in well B. Use the **yellow**-coded mixing stick.



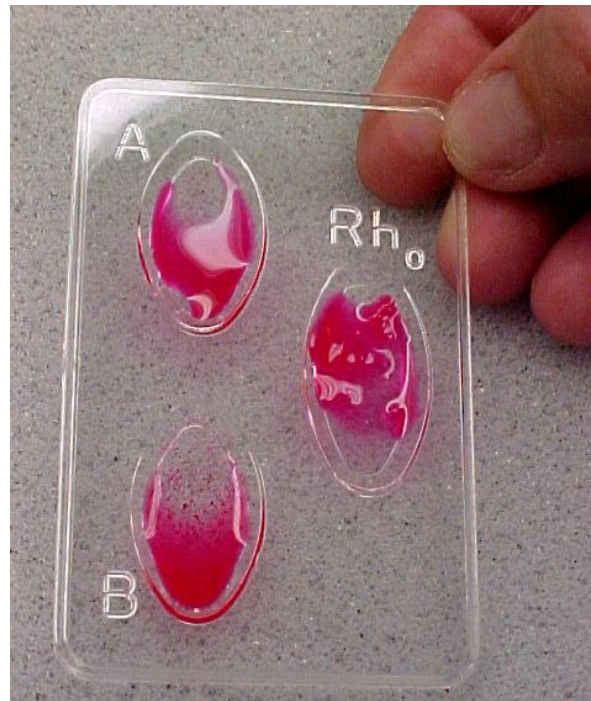
# Blood Typing Protocol

**Completely mix the synthetic blood and synthetic antisera in well Rh<sub>0</sub>. Use the white-coded mixing stick.**



# Blood Typing Protocol

**Gently tilt the slide back and forth to mix the reactions and look for agglutination.**



# **Blood Typing Results**

**What type of blood  
do you have?**

# Blood Typing Results

What type of blood  
do you have?

**A+**

# **Synthetic Blood Kits Available**

**Carolina™ ABO-Rh Typing with Synthetic Blood Kit**  
(catalog no. 700101) A great introduction to blood typing

**Carolina™ Transfusion Matching with Synthetic Blood Kit**  
(catalog no. 700104) Which of 4 friends can donate to save a man's life?

**Carolina™ Blood Group Genetics Kit**  
(catalog no. 700107) Is Daryl a long-lost son?

**Carolina™ Forensics Mystery with Synthetic Blood Kit**  
(catalog no. 700113) Perform presumptive and blood typing tests

**Carolina™ Frequency of Blood Types Kit**  
(catalog no. 700110) Is an island people's pedigree what they think it is?

# Caught by a Kiss Results

Is the evidence negative or positive for saliva?



**Remember, the presence of saliva indicates that DNA may be present.**

# Beer Testing Results

- **Have the yeast in both tubes fermented the sugar?**
- **What is the pH of each yeast suspension?**
- **Was the beer contaminated?**
- **How can you tell?**
- **Do you have any idea what it's contaminated with?**



# **Forensics for the Biology Lab Series**

## **A New Approach to Teaching Biology Concepts**

- **Inquiry-based activities for students in grade 8–college**
- **Cooperative learning experiences and “real world” applications**
- **New techniques for teaching traditional biology labs**
- **Meets the National Science Education Standards**



# Carolina Free Resources



**Carolina offers many free resources  
to help support teachers.**

**CAROLINA®**  
**www.carolina.com**



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**www.carolina.com**

# Evaluations: Share Your Thoughts!

Scale = 1 to 10

**10 = Outstanding**

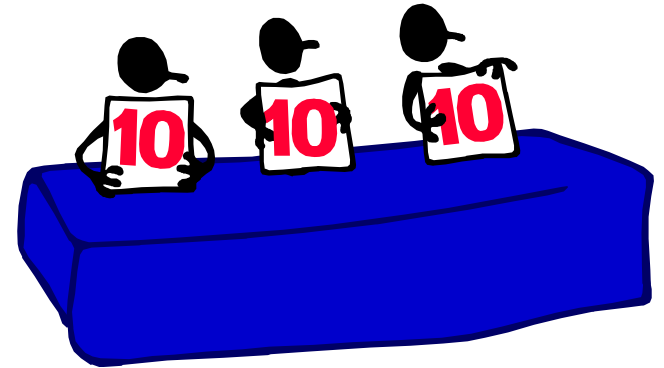
**9 = Above Average**

**8, 7 = Average**

**6, 5, 4 = Below Average**

**3, 2, 1 = Well Below Average**

**Please provide comments!**



# **Carolina Biological Supply Company**

**Thank you for investing your time  
in our training program.**

**For all of your classroom needs,  
visit our Web site at [www.carolina.com](http://www.carolina.com).**

**Enjoy the rest of the conference!**