

## **Blue Bottle and Traffic Light Oscillations**

**Description:** Methylene blue (Blue Bottle) and indigo carmine (Traffic Light) undergo reversible redox reactions with glucose under basic conditions.

### **Materials:**

#### **Blue Bottle**

1% methylene blue	Deionized water
NaOH	Erlenmeyer flask
Glucose	Rubber stopper

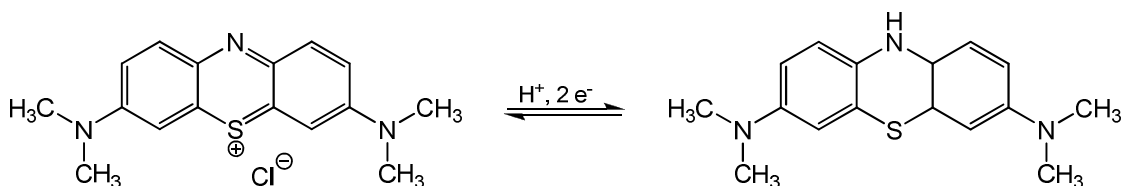
#### **Traffic Light**

1% indigo carmine	Deionized water
6 M NaOH	Erlenmeyer flask
Glucose	Rubber stopper

### **Procedure:**

1. Prepare the alkaline glucose solution by dissolving 5 g of NaOH and 3 g glucose in 250 mL of deionized water. Add several drops of indicator (methylene blue for Blue Bottle or indigo carmine for Traffic Light).
2. Let solution stand until starting color is observed. The Blue Bottle demo should be colorless while the Traffic Light demo should be yellow.
3. Stopper the flask and shake until color change is observed. The Blue Bottle solution will change from colorless to blue. The Traffic Light solution should be shaken once to achieve the red color and shaken more vigorously to change the color from red to green.
4. Let solutions stand until starting color is again observed. Repeat.

**Discussion:** The color change observed is a result of the reversible oxidation-reduction reaction of the indicator present in the reaction. In alkaline solutions, glucose is oxidized to D-gluconic acid. As the sodium gluconate, glucose undergoes a redox reaction with methylene blue to generate the reduced and colorless form of methylene blue. Upon shaking, O<sub>2</sub> (g) in the flask dissolves in solution thus oxidizing leucomethylene blue (reduced form) to methylene blue (oxidized; blue).



**Safety:** Wear proper protective equipment including gloves and safety glasses when preparing and performing this demonstration. NaOH can cause burns. When prepared, the solutions are caustic so care should be taken to avoid spills.

**Disposal:** Dispose of final solution in an appropriate aqueous waste container.

**Reference:**

Summerlin, L. R.; Ealy, J. L. In *Chemical Demonstrations: A Sourcebook for Teachers*; American Chemical Society: 1985; Vol. 1, p 79, 90-91.

Cook, A. G.; Tolliver, R. M.; Williams, J. E. *J. Chem. Educ.* **1994**, *71*, 160.

Campbell, J. A. *J. Chem. Educ.* **1963**, *40*, 578.

**Video:**

<http://www.youtube.com/watch?v=OeQtQdSFPXU&feature=related> (Blue Bottle)

<http://www.youtube.com/watch?v=9nITaGcf7OE&feature=related> (Blue Bottle)

<http://www.youtube.com/watch?v=QkUKlxzNbow> (Traffic Light version)

<http://www.youtube.com/watch?v=9i-Mg8yRej0> (Traffic Light version)