

# A Flash of Blue

## A Classic Clock Reaction



### Introduction

In a flash, a colorless solution turns a dramatic deep-blue color! Amaze your students with this popular starch–iodine clock reaction.

### Concepts

- Clock Reactions
- Indicators

### Materials

Potassium iodate solution, 0.01 M, $\text{KIO}_3$ , 100 mL	Balance
Sodium meta-bisulfite, $\text{Na}_2\text{S}_2\text{O}_5$ , 0.02 g	Beaker, 250-mL
Starch solution, 0.5%, aqueous, 100 mL	Graduated cylinder, 10-mL
Sulfuric acid solution, 1 M, $\text{H}_2\text{SO}_4$ , 3 mL	Graduated cylinder, 100-mL
Water, distilled or deionized	Stirring rod

### Safety Precautions

*Potassium iodate solution is an oxidizer. It is moderately toxic by ingestion and a body tissue irritant. Sodium meta-bisulfite is a skin and tissue irritant. Sulfuric acid solution is corrosive to eyes, skin, and other tissues and moderately toxic by ingestion. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.*

### Procedure

1. Pour 100 mL of the starch solution in a 250-mL beaker. Add 0.02 g of sodium meta-bisulfite to the starch solution. Stir to dissolve.
2. Add 3 mL of 1 M sulfuric acid solution to the beaker and stir.
3. Quickly, but carefully, add 100 mL of 0.01 M potassium iodate solution to the beaker. Stir to mix. Observe the appearance of the deep-blue color which suddenly appears (after about 10–15 seconds).

### Extension

Performing the procedure above as indicated is an attention-getting demonstration that shows the classic characteristics of a clock reaction. However, this reaction is also ideal for studying kinetics—the effects of concentration, temperature, and the presence of a catalyst on the rate of reaction. For more information, please request Flinn ChemFax #10245, Iodine Clock Reaction.

### Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Dispose of the resulting solution according to Flinn Suggested Disposal Method #12a.

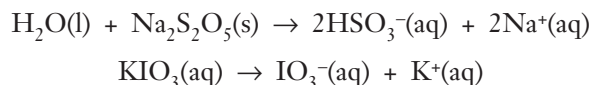
### Discussion

This reaction is a classic example of a clock reaction. A *clock reaction* is a reaction characterized by an initial period with no noticeable change, followed by a sudden change, commonly in the color of the solution. The time period during which no noticeable change occurs is called the *clock period*, and the sudden change is called the *alarm*. What actually triggers the

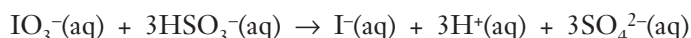
alarm varies from clock reaction to clock reaction.

In this reaction, potassium iodate and sodium meta-bisulfite react to form iodine. The starch solution serves as an indicator of the end of the reaction, forming a deep-blue colored starch-iodine complex in the presence of iodine. The chemical pathway for the formation of iodine is complicated and not completely understood, but the following mechanism serves as an outline.

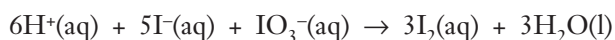
Step 1: Sodium meta-bisulfite contributes hydrogen sulfite ions,  $\text{HSO}_3^-$ , while potassium iodate contributes iodate ions,  $\text{IO}_3^-$ , to the solution.



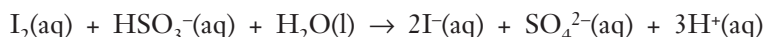
Step 2: The iodate ions react with the hydrogen sulfite ions to produce iodide ions,  $\text{I}^-$ .



Step 3: In the presence of hydrogen ions,  $\text{H}^+$ , the iodide ions react with excess iodate ions to produce iodine,  $\text{I}_2$ .



Step 4: Before the iodine can react with the starch to produce a dark-blue colored complex, it immediately reacts with any hydrogen sulfite ions still present to form iodide ions.



Step 5: Once all of the hydrogen sulfite ions have reacted, the iodine is then free to react with the starch to form the familiar dark-blue colored complex.



The deep-blue color of the complex is due to the presence of the pentaiodide anion,  $\text{I}_5^-$ . By itself, the pentaiodide anion is unstable; however, it is stabilized by forming a complex with the starch. The appearance of the deep-blue color in solution indicates that all of the reactants have been consumed and the reaction has gone to completion.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

### ***Unifying Concepts and Processes: Grades K–12***

Evidence, models, and explanation  
Constancy, change, and measurement

### ***Content Standards: Grades 5–8***

Content Standard B: Physical Science, properties and changes of properties in matter

### ***Content Standards: Grades 9–12***

Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions

## Materials for *A Flash of Blue* are available from Flinn Scientific, Inc.

Catalog No.	Description
P0064	Potassium Iodate, 100 g
S0151	Starch Solution, 500 mL
S0317	Sodium meta-Bisulfite, 100 g
AP8657	A Flash of Blue—Chemical Demonstration Kit

Consult the [Flinn Scientific website](http://www.flinnscientific.com) for current prices.