Name _____ Date _____ Period _____

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Iodine Clock Virtual Lab

Chemistry

Open **activities.zornscience.org/iodine-clock-lab/** and follow each step. You may set Playback to 4× speed; the stopwatch still shows the real reaction time. Show your work with units.

Objective

Find how the **concentration** of potassium iodate (KIO_3) and the **temperature** affect the rate of the iodine clock reaction, then use your data to make a mixture that turns blue in 20 seconds.

NGSS alignment: HS-PS1-5. Apply scientific principles and evidence to explain the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
Practices and concepts: Planning and carrying out investigations; Analyzing and interpreting data; Using mathematics; Constructing explanations; Cause and effect.

Meet the simulation

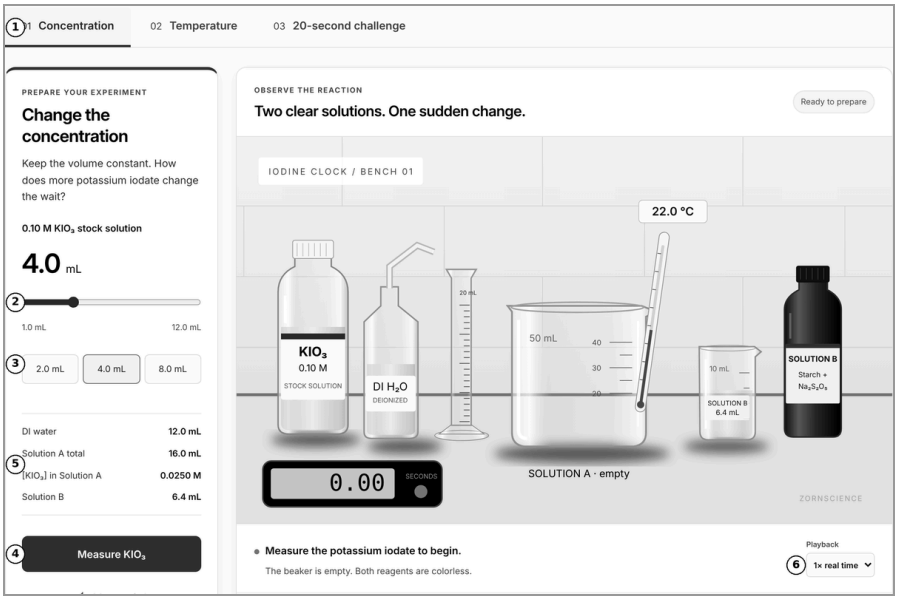


Figure 1. The Iodine Clock Lab.

1. Tabs for Parts A, B and C.
2. Slider: mL of 0.10 M KIO_3 stock (0.1 mL steps; arrow keys move one step).
3. Quick buttons for 2.0, 4.0 and 8.0 mL.
4. Main button: each step of the trial. The stopwatch starts when B touches A.
5. Recipe. Solution A is always 16.0 mL.
6. Playback: 1× or 4× speed.

Pre-lab

1. In this reaction, the mixture stays clear and then suddenly turns dark blue. What does the blue color tell you? Why is this called a "clock" reaction?

2. Use $M_1V_1 = M_2V_2$ to find $[KIO_3]$ in Solution A when each volume of 0.10 M stock is diluted to 16.0 mL. Write these values in Table 1.

a. 2.0 mL of stock b. 4.0 mL of stock c. 8.0 mL of stock

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Part A. Concentration

1. Select the **01 Concentration** tab. Set the KIO_3 volume from Table 1 with a quick button or the slider.
2. Select the main button to measure KIO_3, add DI water, then **Add B & start clock**. Record the stopwatch time when the mixture turns blue (Figure 2).
3. Select **Prepare another trial** (or **New trial**) and repeat for each volume. Rate = 1 / time.

Table 1. Effect of KIO_3 concentration on reaction rate at 22 °C

Trial	KIO_3 stock (mL)	DI water (mL)	[KIO_3] in Solution A (M)	Time to turn blue (s)	Rate = 1/time (s^{-1})
1	2.0				
2	4.0				
3	6.0				
4	8.0				
5	10.0				

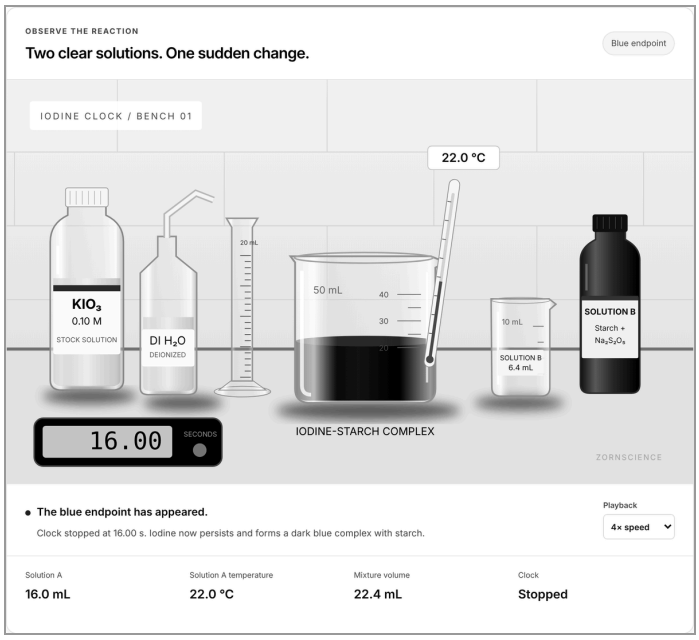


Figure 2. The blue endpoint for trial 4. The stopwatch and the message under the bench show the time.

3. Graph rate (y-axis) against [KIO_3] (x-axis) for Table 1. Give the graph a title, label both axes with units, and draw a line of best fit.

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4. Describe the relationship between [KIO_3] and rate (direct, inverse, or none). Use trials 2 and 4 to show it with numbers. What happens to the **time** when the concentration doubles?

5. Explain with collision theory why more KIO_3 makes the reaction faster.

Part B. Temperature

1. Select the **02 Temperature** tab. Every trial uses 4.0 mL KIO_3 + 12.0 mL water (0.0250 M).
2. Choose a bath (Figure 3). Measure, add water, select **Condition Solution A**, then add B. Record the temperature of Solution A, the thermometer reading right after mixing, and the time.

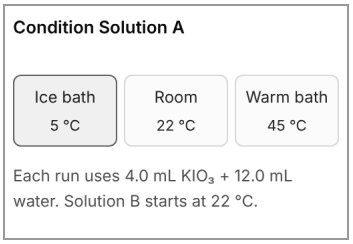


Figure 3. Bath choices.

Table 2. Effect of temperature on reaction rate at 0.0250 M KIO_3

Bath	Solution A (°C)	Mixture after adding B (°C)	Time to turn blue (s)	Rate = 1/time (s^{-1})
Ice				
Room				
Warm				

6. Solution B (6.4 mL) is always at 22 °C. Explain why the mixture in the ice-bath trial is warmer than 5 °C. Then show that 9.9 °C makes sense: the mixture temperature is a weighted average, $T = (16.0 \times T_A + 6.4 \times 22) / 22.4$.

7. Describe the relationship between temperature and rate. Is it a straight-line pattern like Part A? Use Table 2 and collision theory to explain why heating makes the reaction faster.

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Part C. The 20-second challenge

8. You want the mixture (at 22 °C) to turn blue in 20.0 s. What rate is that? Use your Part A pattern to calculate the [KIO_3] you need and the volume of stock to measure. Show your work.

9. Select the **03 20-second challenge** tab. Set the slider to your volume and run the trial. Record your volume and time. Was the challenge met (20.0 ± 1.0 s)? If not, how would you change your volume?

Analysis

10. Name two sources of error in a real iodine clock lab that the simulation does not have. Suggest a way to reduce each.

Conclusion

11. Write a claim that answers the objective. Support it with evidence from Table 1 and Table 2 (specific numbers), then explain your reasoning with collision theory. Write in the past tense, third person.

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