HOW FAST CAN YOU PRODUCE HYDROGEN GAS WHEN YOU ARE IN CHARGE?

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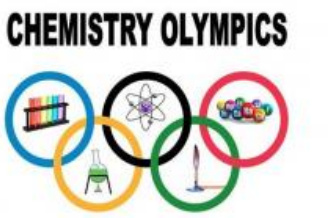


(https://connex.stao.ca/sites/default/files/media/chem-olymp-logo.jpg)

DESCRIPTION OF ACTIVITY:

- Timeline (5-6 periods)
- Overall Explanation of Activity:
    - Students would investigate how to produce and collect 50 mL of a gas using their prior knowledge on stoichiometry and chemical reactions from the SCH3U course.
    - Students are competing in groups to obtain the fastest rate for their reaction. Students would explore many of the factors that would affect the rate of a reaction such as a temperature, concentration, catalyst, surface area, pressure and nature of reactants in order to determine the optimal conditions for their experiment.
- Safety: usual safety procedures
- Instructional Planning and Delivery:

Lesson 1: Teacher should introduce rates of reactions, calculations of average and instantaneous rates.

Lesson 2: Exploring different experimental methods of measuring rates.

Lesson 3: Students complete a worksheet on factors affecting the rate of reactions as part of their prelab.

Lessons 4 to 6: Students design and complete the inquiry.

- The expected results:
    - Students would either succeed or fail at collecting at least 50 mL of the gas. They would have to refine/modify their procedure and calculations and repeat the experiment to reach their goal. Under the guided inquiry the time it took to produce 50 mL of the gas was approximately 1.5 min.
    - Students would arrive at the ideal settings in order to speed up their rate.
- The inspiration for this activity: The winter Olympics, just trying to bring some fun, spirit of competition. Consider giving a prize for the winning team.

Overall Expectations:

D.2 investigate and analyse energy changes and rates of reaction in physical and chemical processes, and solve related problems

D3. demonstrate an understanding of energy changes and rates of reaction.

Specific Expectations:

D2.8 plan and conduct an inquiry to determine how various factors (e.g., change in temperature, an addition of a catalyst, increase in surface area of a solid reactant) affect the rate of a chemical reaction.

D3.5 explain, using collision theory and potential energy diagrams, how factors such as temperature, the surface area of the reactants, the nature of the reactants, the addition of catalysts, and the concentration of the solution control the rate of a chemical reaction.

A) Planning for the activity:

1. Students need to learn about the different methods possible to measure the rate of a reaction (handout A).
2. Students need to learn about factors that can affect the rate of reactions and complete handout B.
3. Students need to measure and investigate the rate of a chemical reaction in a competition setting. Each group will need to choose one of the reactions (or teacher might decide that the whole class is doing the same reaction and discuss which method of measuring the rate of reaction to choose? They write a list of materials needed on (handout C) and they check with their teacher that the equipment and chemicals are available to them.

Reactions possible: 1) neutralisation of vinegar and baking soda

2) decomposition of hydrogen peroxide with a catalyst

3) Single displacement: hydrochloric acid and magnesium

4) Other: _____

Note that each reaction yields a different gas. I chose to do all three reactions so I allowed students to compete in their own category (reaction). So I had three winners. You could decide how you want to do this...

4. Students need to complete the planning sheet (handout C) to determine the amounts needed.
5. Students try their first trial at room condition. If the attempt fails, they will need to make adjustments.
6. After succeeding to collect 50 mL of the gas, they will choose one factor to change and investigate the new rate. (use handout D)
7. They repeat with 2 more factors for a level 4 achievement. (use handout D and feel free to add more sections for additional factors.
8. Students will need to decide on optimal conditions and be ready for the day of competition. (Final procedure due before the day of competition).
9. The students will need to submit handouts C and D for evaluation or feel free to decide what you want
10. Every group perform on the competition day. There will be a prize for the winners.

Ideas for prizes: - A pass to skip writing a formal lab report (they love this one)

- A free meal from the school cafeteria (talk to your principal)

- An offer of 5% bonus on the energy and rate unit test

- Chocolate/ candies

B) Accommodations:

A prepared standard procedure for students in need of further guidance. (A version is provided)

C) Teacher's notes:

- You can decide if you want your whole class to investigate the same reaction or try the 3 proposed reactions or even choose different ones. If you're limited on supplies, the vinegar and baking soda reaction can fit your budget.

- Some groups require help and more directions so you may want to use the guided inquiry on the hydrochloric acid and magnesium lab provided. The students are given a general procedure to follow but they still need to make modifications to introduce the factors.

- For evaluation, you may choose to collect a formal lab report, or handouts C and D only, or a reflection on the activity and what they have learned. Another way could be to ask them to submit sources of error and ways to improve the lab.

D) Evaluation: Collect handouts C and D and observe their performance. Use rubric provided to evaluate their work.

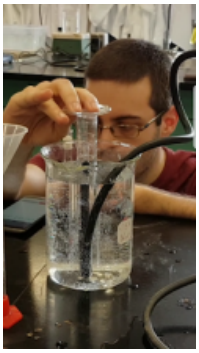
E) Extension ideas:

- Change the goal to: how fast can you inflate a balloon? They will need to figure out how much gas they need to produce to inflate the balloon. It will be more challenging to judge a winner but might bring more fun to the activity.
- Investigate the rate law of the reaction. Possibly produce graphs to show the order.

CLASSROOM-READY RESOURCES

- Teacher's notes
- Handouts A and B: to use for lesson planning
- Handouts C and D: to use for student-guided inquiry
- Handout E: to use for teacher-guided inquiry
- Rubric for evaluation

Student Exemplar Submission: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A special thanks for Nicholas Desjardins (pre-service teacher) for his help in designing this activity.

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COMMENTS

racquel carlow
October 8 at 11:10pm

A learning activity that is fun and also innovative. For your submission, please include (1) details of student assessment and evaluation (i.e., rubrics) and (2) future opportunities or extensions. Please also include your own reflection about the project.

Permalink (/comment/644#comment-644)

RESOURCES

- Handouts A, B, C, D; guided inquiry; Rubric for evaluation and teacher's notes (https://drive.google.com/drive/folders/1m_6GCm1soz4szk1qiu9yz6QA8bufTqUW)
- Sample of student work: video (https://drive.google.com/file/d/1rpnPyZQBSbXlJsfAE_9D0pReh6jE1Z5h/view)

ELEMENT

- Inquiry (/expert-elements/inquiry)

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