



Argument Driven Inquiry:

A way to transform laboratory experiences

Please sit 4 to a table.

What is Inquiry?

- Student-centered
- The way scientists do their work
- Includes questioning scientific phenomenon, collecting evidence, argumentation and justification.

Why Inquiry?

- [Texas Essential Knowledge and Skills- Science and ELA](#)
- [College Board Advanced Placement](#)
- [Portrait of a Graduate](#)
- Inquiry is not a new approach it has been a pillar of teaching and learning since 1922
- ADI is a structure that allows students and teachers to inquire with scaffolded stages
- Cognitive Disequilibrium
- True Science and recipes analogy

Research and Articles

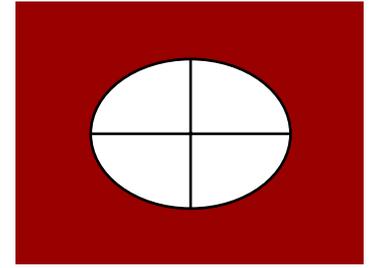
- [How People Learn](#)
- [ASCD Effective Practices 7-12 Science](#)
- [Argument Driven Inquiry Research](#)
- [Chemical Education and ADI](#)
- [Science Teachers and Scientific Argumentation](#)

ADI CTMS STAAR Data

District: 81%	CTMS: 88.4%	Delta: +7.4%
AA: 68.4%	AA: 58.3% .	-10.1%
H: 74.9%	H: 83.7%	+8.8%
W: 85.6%	W: 93.5%	+7.9%
SE: 60.4%	SE: 68%	+7.6%
Male: 80.5%	Male: 86.3%	+5.8%
Female: 81.5%	Female: 90.5%	+9%

The Average change: +7.75%

Inquiry Supports PCM



- **Core:** The essential nature of a discipline
- **Connections:** The relationships among knowledge
- **Practice:** The applications of facts, concepts, principles, skills, and methods as scholars, researchers, developers, or practitioners
- **Identity:** Developing students' interests and expertise, strengths, values, and character

Marble ADI

We will run a short version of this process to experience the process.

Marble ADI

Please take a copy of the text and read **first Introduction paragraph ONLY**. Feel free to do as recommended and experience the equipment as it describes.

Stop reading BEFORE the 1st T-chart.

Marble ADI

Please take a copy of the text and read **first Introduction paragraph ONLY**. Feel free to do as recommended and experience the equipment as it describes. **Stop reading before the 1st T-chart.**

Make notes in the T-Chart → about what you read and explored.

Things I OBSERVED...	Things I WONDER about...

Marble ADI

Discuss your results and ideas with table mates.

Things I OBSERVED...	Things I WONDER about...

Marble ADI

Now read **the second paragraph** and mark the text with the following protocol.

- Underline anything that seems important.
- Circle anything that is unfamiliar.

Marble ADI

Discuss with your table group what you **KNOW** and **Need to KNOW**.

<p>Things we KNOW from what we read...</p>	<p>What we will NEED to figure out...</p>
---	--

Marble ADI

Let's share as a large group what you **KNOW** and **Need to KNOW**. Feel free to add to your chart if you hear something new.

Things we KNOW from what we read...	What we will NEED to figure out...

Marble ADI

Have someone in your group read aloud “The Task”.

What is the guiding question?

Read the materials, equipment and safety rules.

Any questions so far?

Marble ADI

Investigation Proposal.

Turn to Page 3 of your packet.

With your team, please complete the “Investigation Proposal”. Have your proposal signed by an instructor when you are done.

Collect your data when you have had your proposal signed.

Marble ADI

Argument.

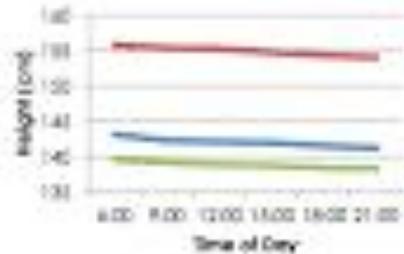
Arguments consist of 4 parts:

- 1) The guiding question
- 2) The CLAIM- which is the answer to the guiding question
- 3) The EVIDENCE- which is the data and analysis that supports the claim
- 4) The JUSTIFICATION- The importance of the evidence.

Guiding Question: Does a person's height change throughout the day?

Claim: A person's height decreases throughout the day.

EVIDENCE: Data



The height of the people measured decreased by an average of 1.7 cm per day.

Justification:

- The gravity of the earth pulls on a person as they stand all day, pulling their joints closer together, making them shorter.
- We assume the measurements are accurate.
- We are limited by how many times we can measure the person's height.
- This matters in the real world because it might explain why people have back pain.

Argumentation:

We will now share our arguments in a gallery walk.

Argumentation- ROUNDS 1 and 2:

If you have #1 or #3 on your lanyard, you will **STAY** with the board to answer questions and receive feedback.

If you have #2 or #4 on your lanyard, you will **STRAY** to other groups' boards to ask questions and give feedback. You will move in a **CLOCKWISE FASHION**.

Argumentation- TEAM TALK

Go back to your team and discuss what you saw and heard, both from “staying” and “straying”.

Argumentation- ROUNDS 3 and 4:

If you have #2 or #4 on your lanyard, you will **STAY** with the board to answer questions and receive feedback

If you have #1 or #3 on your lanyard, you will **STRAY** to other groups' boards to ask questions and give feedback. You will move in a **COUNTER-CLOCKWISE FASHION.**

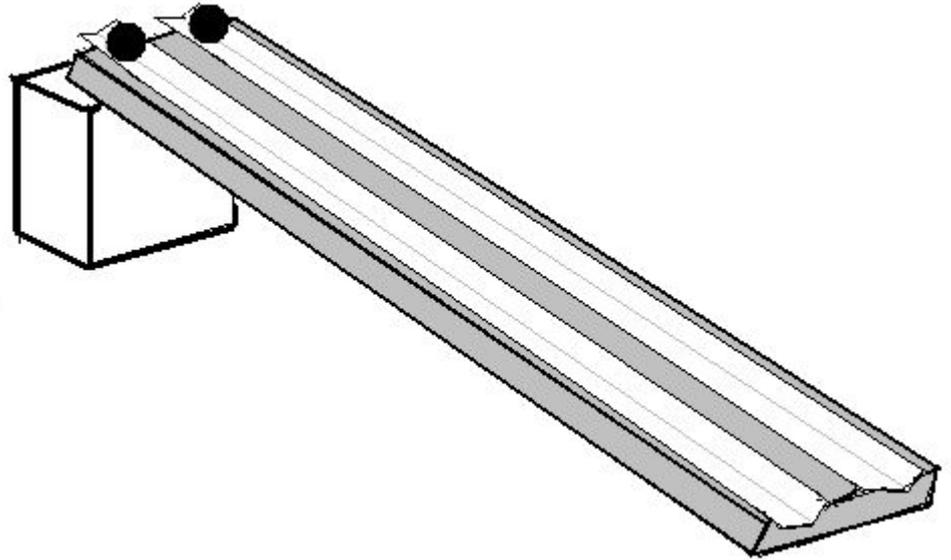
Reflective Discussion:

What did you and your team do well?

What could you do differently if you could do this again?

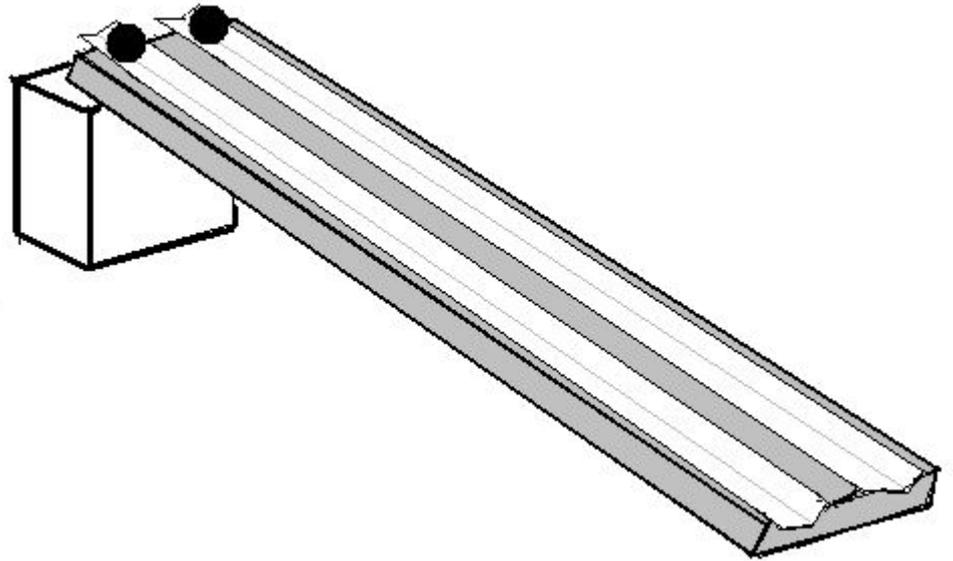
Reflective Discussion:

What do you see
here?



Reflective Discussion:

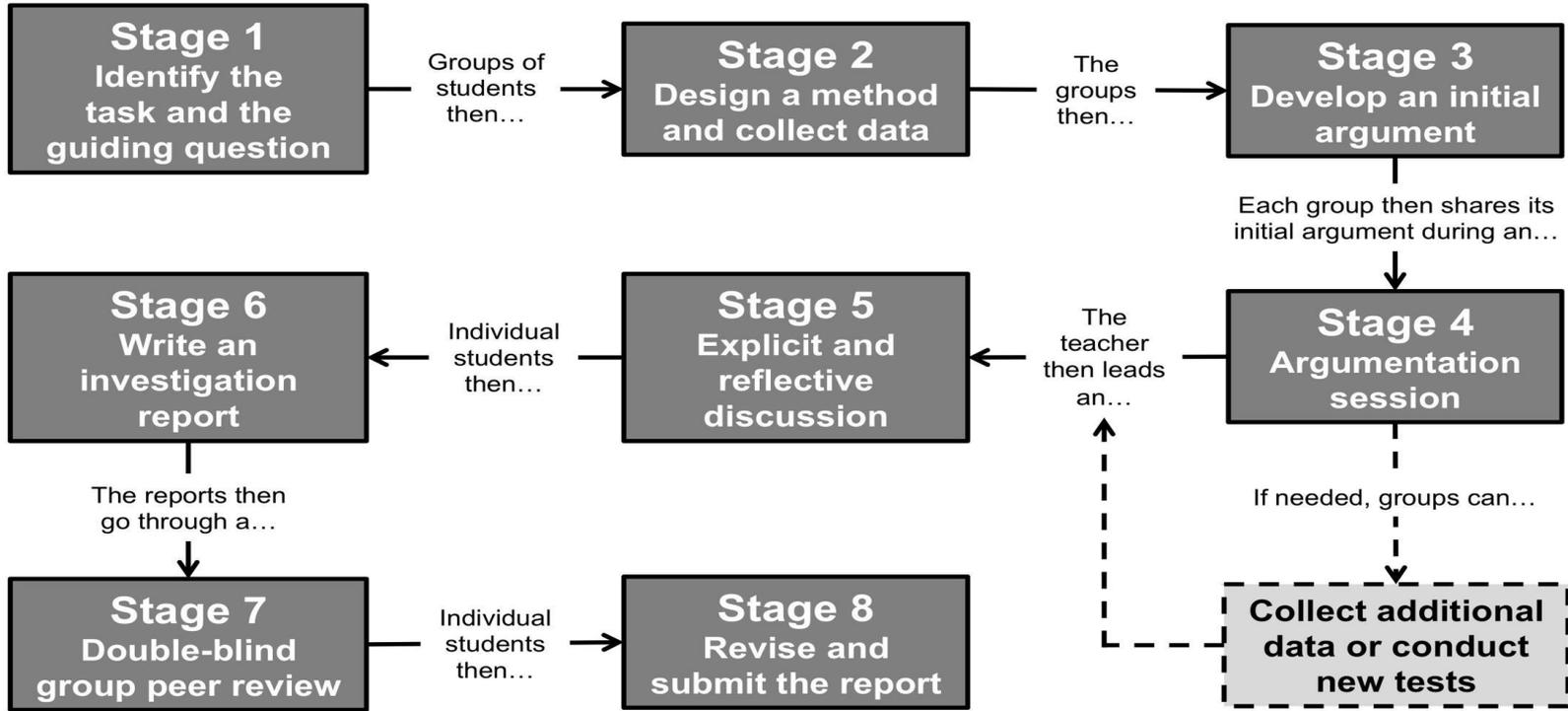
How could I increase the potential energy of the marbles?



Debrief

Discuss this process at your tables.

How did each activity increase your understanding of the scientific concepts?



Argument-Driven Inquiry consists of eight stages

Stage 1. Identify Task

SKIM through the introduction reading,
mark the text and find the Guiding
Question.

Stage 1:

- Materials that can be used during the lab
- Lab Safety
- Hints or things to think about

Stage 1: Introduce the task and the guiding question

Students mark the text as follows:

- Underline things that seem important
- Circle anything unfamiliar or “fuzzy”
- Box information useful in procedure design.

Stage 1: Introduce the task and the guiding question

After marking the text, students will create a KNOW/Need to KNOW and WORD WALL chart in NBs.

This chart is used later in writing arguments and the report.

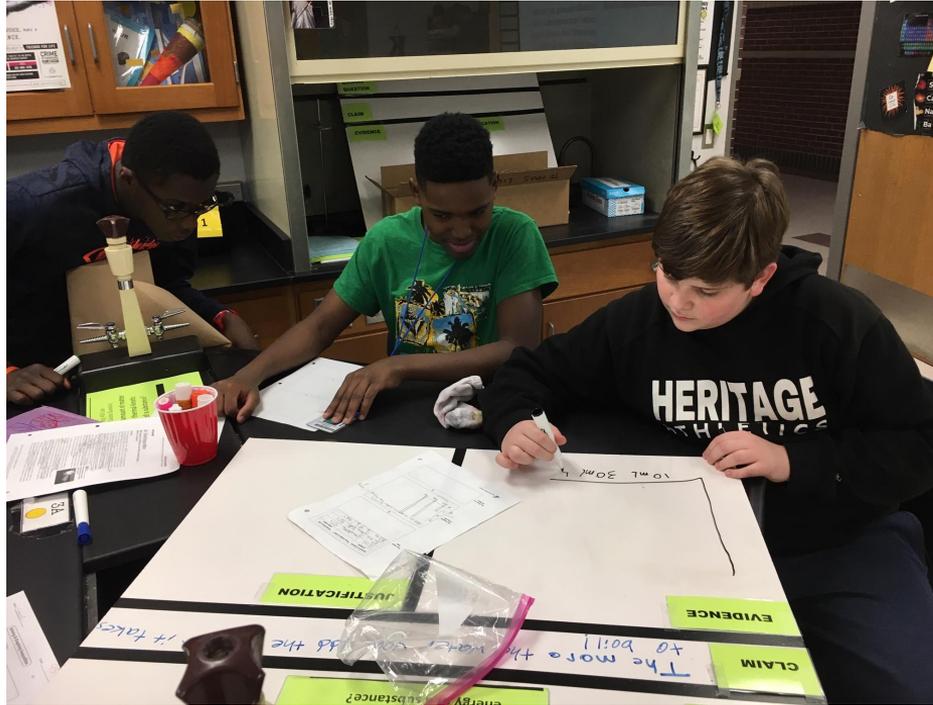
KNOW	Need to KNOW	WORDWALL
<ul style="list-style-type: none"> - 3 States of matter S, L, G - Gases move more freely than S or L - Each state of matter has physical properties that distinguish it - Volume is the space gas occupies 	<ul style="list-style-type: none"> - How can a gas expand from its container? - How do T + V affect gases? 	<p>Matter</p> <p>liquid</p> <p>Solid</p> <p>gas</p> <p>Volume</p> <p>Temp</p> <p>Pressure</p> <p>Container</p> <p>expand</p> <p>confined</p> <p>property</p> <p>affect</p> <p>interact</p>

Stage 2. **Design** and Collect Data

Use the form to design how to collect the data.

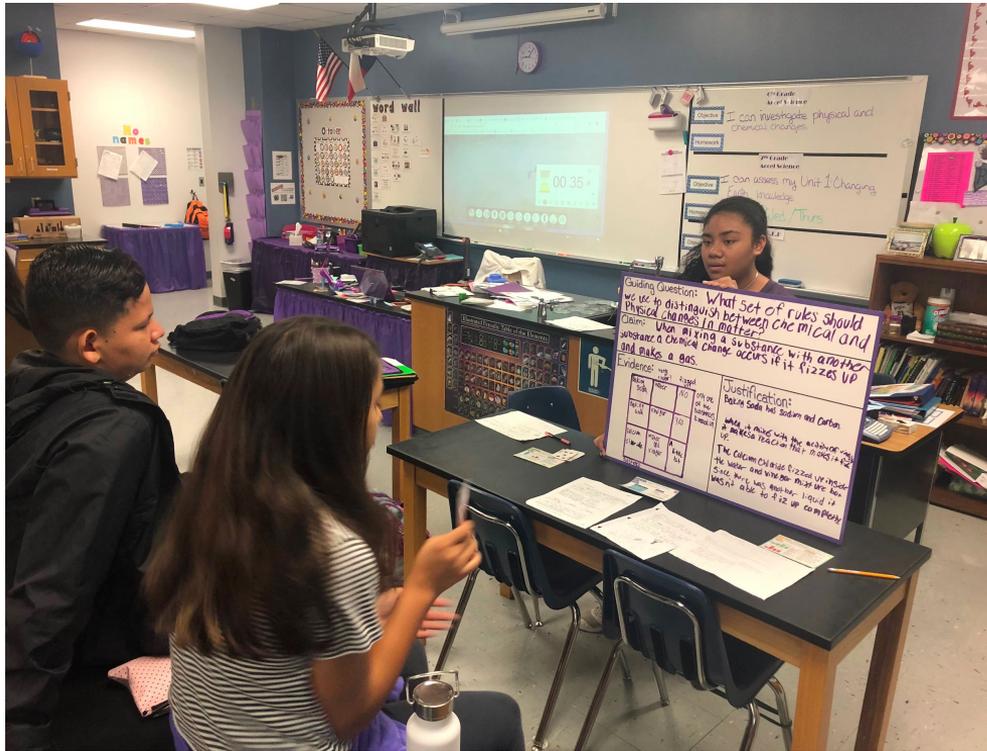
Collect the data and analyze.

Stage 3: Develop an Initial Argument



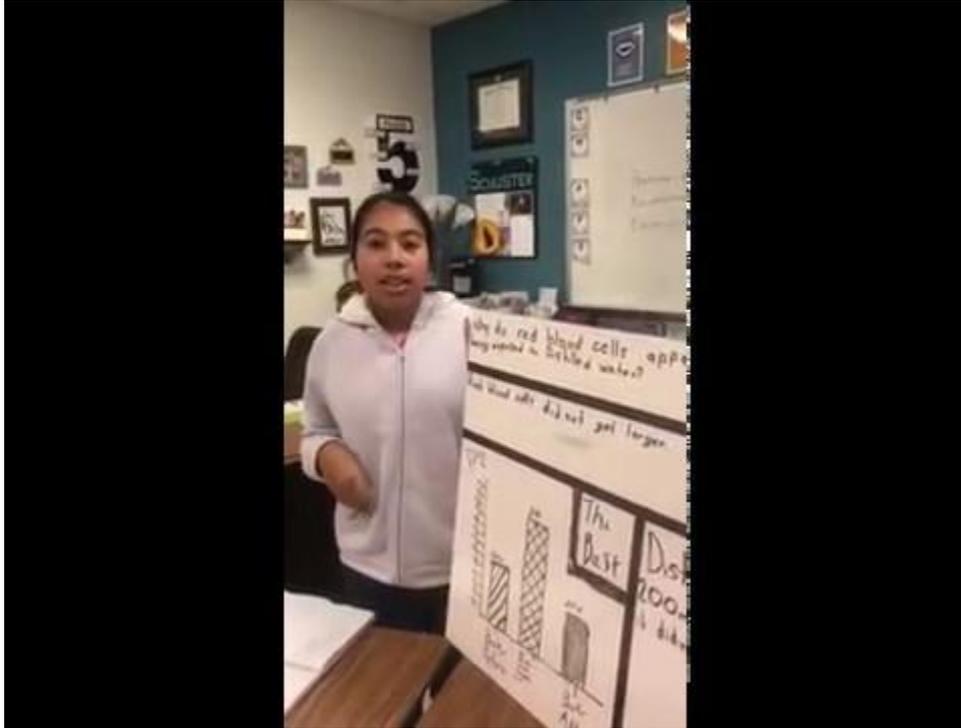
Each group analyzes the data they collected and then they craft an initial argument

Stage 4: Argumentation Session - Gallery Walk



Students present their initial arguments. The students are encouraged to discuss and critique each argument. They then revise their initial argument.

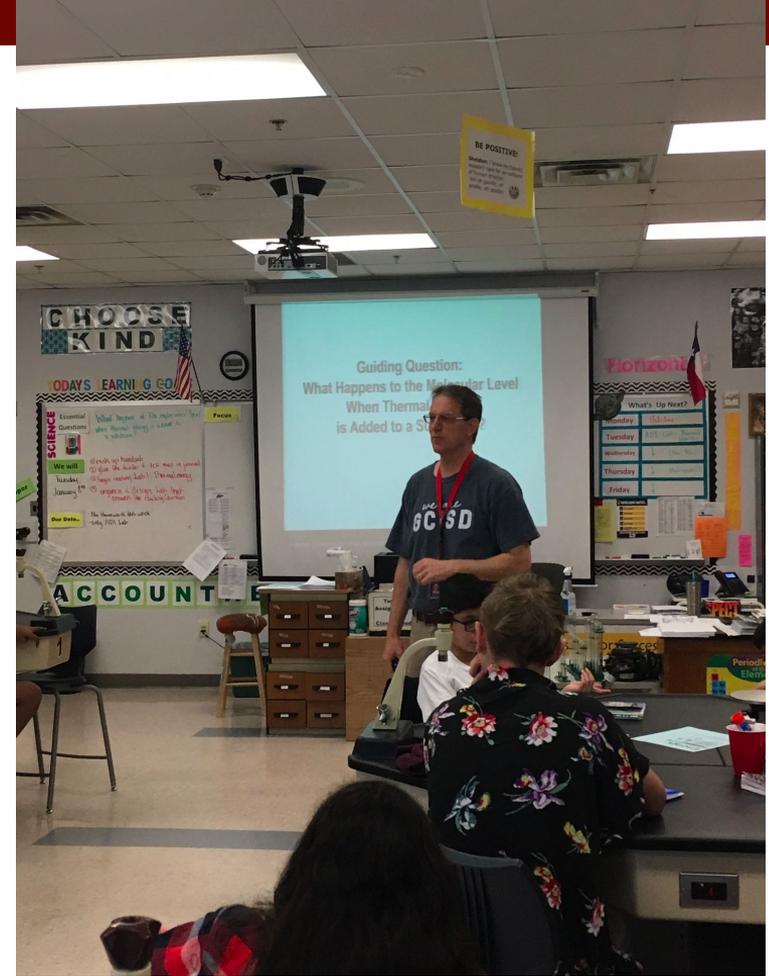
Stage 4: Argumentation Session - Gallery Walk



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Stage 5: Explicit and Reflective Discussion

The teacher leads a class discussion about the core ideas at the heart of the lab, the quality of the students' investigations, and nature of scientific inquiry



Stage 5: Individual Formative Assessment

Teachers
administer an
formative
assessment to
ensure student
mastery

Gas Laws Check-in 1

Please respond to these questions.

***IMPORTANT INFORMATION:**

- 1- All temperatures must be in the unit K for gas law calculations. Use $C + 273 = K$ to make this conversion.
- 2- All pressure units must MATCH in gas law calculations. Use $1 \text{ atm} = 101.3 \text{ kPa}$ for conversions.
- 3- All volume units must MATCH in gas law calculations. Use $1 \text{ L} = 1000 \text{ mL}$ for conversions.

1- Briefly describe the relationship of Temperature and Pressure in a gas.

Your answer

2- Briefly describe the relationship of Volume and Pressure in a gas.

Your answer

3- A gas is at a temperature of 100K and a pressure of 1 atm. The temperature reduces to 60 K. What is the new pressure?

Your answer

4- A gas is at a volume of 2 L and a pressure of 2 atm. What is the new volume if the pressure increases to 3 atm?

Your answer

Stage 6: Write an Investigation Report

Report. Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!

Students write a report to encourage both ‘writing to learn’ and ‘learning to write’ in science

Stage 7: Double-Blind Group Peer Review



The reports go through a double blind group peer review

Stage 8: Students revise and submit their reports to the teacher

2009006

Lab 12

Section 1

In this lab, we worked with Sodium Chlorate, NaClO_3 , an odorless white solid that melts at 248 degrees Celsius. When it is heated to about 300 degrees, it loses oxygen. As a result of the thermal decomposition, the product is a white solid and an oxygen gas. Because of its molecular formula, there are three possible reactions:



It is important to learn about sodium chlorate because it is used in oxygen canisters that are found on airplanes, submarines, and the space station. It is a form of emergency oxygen. The ultimate research question is what the actual chemical equation for the thermal decomposition of sodium chlorate is.

Section 2

We must balance the equations out and then figure out the actual chemical equation for the thermal decomposition of sodium chlorate. The first step of this lab was to balance the possible equations. The stable results were:



Then, we found the atomic mass of each potentially real compound:



We tested each of the possible formulas. Our procedure went as follows:

1. weigh .5 grams of NaClO_3
2. burn sodium chlorate in test tubes
3. weigh it again
4. switch the formula to moles

Section 3

We did the procedure slightly incorrect. The correct process discovered by the class involved taking the number of grams, 0.5, and dividing it by the molar mass, 106.44. This equaled .004699. We needed to multiply that by the balanced molar mass of NaClO_3 without gas to find out how many grams there are of NaClO_2 . The mathematical process and resulting number of grams are:



After 3 tests, the average was exactly 0.23 grams. Because this was closest to the number of grams in $2\text{NaClO}_3 \rightarrow 2\text{NaCl} + 3\text{O}_2$, 0.274, this was the actual chemical equation for the thermal decomposition of sodium chlorate.

After ADI reflection



Questions?