**Evidence Based Argumentation**

**NSTA Conference Presentation**

**Background Information: Examine the following Four Containers**

Container A: Container B: Container C: Container D:



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**Activity 1: Claim-Evidence Game**

1. In the left column, fill in the blank to create a claim.
2. Pass your paper to the person to your right.
3. The person on your left will pass you a paper. Write a piece of evidence for their claim.

|  |  |
| --- | --- |
| **Claim**: a statement that you can debate or defend | **Evidence**: A reason why the claim is true |
| **The volume in container \_\_\_\_\_\_\_ will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** | **This claim is true because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
| **The pressure in container \_\_\_\_\_\_ will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** | **This claim is true because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

**Activity 2: Choosing the Best Evidence Mini Debate**

1. Read the provided Background Information, Claim, and evidence
2. In a group of three, assign each person a piece of evidence.
3. Each person will have one minute to stand and make a speech describing why their evidence best proves the claim.
   1. In the first column, write two reasons why your evidence best proves the claim. Use these reasons to make your speech (If you need help, refer to the HINT CARDS.)
   2. During your opponent’s speech, record their reasons in the second and third columns
4. As a group decide who won the debate

**Background Information**

|  |  |  |
| --- | --- | --- |
|  | Charles’ Law | Boyles Law |
| Equation | https://www.clippard.com/cms/sites/default/files/wiki_images/charles-law1.jpg | http://thescienceclassroom.org/wp-content/uploads/2013/04/Boyles-Law.png |
| Definition | The volume of a gas is directly proportional to its absolute temperature (when pressure is held constant) | The volume of a gas is inversely proportional to its volume (when pressure is held constant) |
| Variable and Units | Volume- mL or L  Temperature- K | Volume- mL or L  Pressure- atm, mm Hg, Torr, Pa, kPa |
| Most common example | Heating or cooling a balloon | Piston or syringe |
| Example Problem | A balloon is filled to a volume of 0.5 L at a temperature of 300 K. What will the new volume of the balloon be if the temperature is increased to 450 K? | A 300 mL balloon is filled at a pressure of 1.0 atm. The balloon is released and floats to new altitude where the pressure is 0.75 atm. What is the new volume of the balloon? |

**Claim**: Students of any age group will have an easier time understanding Charles’ Law than they will understanding Boyle’s Law

**Evidence 1**: Everyday examples of Charles’ Law are more familiar to them

**Evidence 2:** The variables and units in Charles’ Law are more familiar to them

**Evidence 3:** Solving a Charles’ Law word problem is easier than solving a Boyle’s Law word problem.

**Choosing the Best Evidence Mini Debates – Which evidence best proves the claim is true?**

Before the Mini Debate write the two reasons you believe your Evidence best proves the claim is true.

|  |  |  |  |
| --- | --- | --- | --- |
|  | My Evidence (Evidence \_\_) best proves the claim is true because… | My 1st opponent argues Evidence \_\_\_ best proves the claim is true because… | My 2nd opponent argues Evidence \_\_\_ best proves the claim is true because… |
| **1st Reason** Evidence best proves the claim is true. |  |  |  |
| **2nd Reason** Evidence best proves the claim is true. |  |  |  |

**Activity 3: Counterargument Class Challenge**

1. Read the text “Real Life Examples of Charles’ Law and Boyles Law”
2. Join a group at one of the two posters containing a claim for this topic.
3. As a group, write a piece of evidence from the text to support your claim.
4. Go to the opposing poster and read the claim and evidence. Write a counterargument for this claim and evidence.
5. Return to your poster and read the counterargument. Write a response to this counterargument.

**Claim (**A statement that you can debate or defend**)**

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| --- |
| **(copy from poster)** |

**Evidence** (Evidence from the text and analysis of how it proves the claim)

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| --- |
| **The example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **demonstrates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

**Counterargument** (A reason why the claim and Evidence are wrong)

*Summarize their argument*

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| --- |
| **The fact that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is not true because**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**  **OR**  *Summarize their argument*  **The idea that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is less important than the fact**  **that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** |

**Response** (Explains how the counterargument does not harm the claim)

*Summarize their counterargument*

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| --- |
| **The fact that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is not true because**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**  **OR**  *Summarize their counterargument*  **The idea that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is less important than the fact**  **that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.** |

Real Life Examples of Charles’ Law

* When heat is applied, hot air balloons increase in size (causing a decrease in density which makes them rise). When the heat is removed, the balloons shrink and fall.
* Humans' lung volume is reduced in colder weather; runners and other athletes may find it harder to perform in cold weather for this reason. Some runners train in cold weather to force their body to compensate (even if the competition is in hot weather).
* When bread is baked in an oven, air bubbles from yeast or other ingredients are heated and the volume rises, causing the dough to “rise.”
* Car engines work when the heat from the combustion of the fuel causes gas in the cylinder to expand, which pushes the piston and turns the crankshaft.
* When car tires, sports balls, or balloons are inflated in warm environments, they will shrink when they are exposed to the cold. The opposite is also true.

Real Life Examples of Boyle’s Law

* Syringes and turkey basters are operated by Boyle's Law: pulling back on the plunger increases the volume inside the syringe, which decreases the pressure, which causes liquid to be drawn into the syringe (which shrinks the volume and fixes the pressure).
* In whipped cream intense pressure inside the can pushes on the liquid inside the can, trying to escape, and forces the liquid out when there is an opening. When the liquid is outside the can and surrounded by lower pressure air, the whipped cream grows.
* When you inhale, muscles create a larger volume in your lungs. This makes the pressure in the lungs lower than the outside world, which causes air from the outside to move into your airway and lungs. The opposite occurs when you exhale.
* When air is forced into a balloon, ball, or tire, the pressure is increased. This pressure causes the volume to grow until the pressure inside decreases and is equal to the outside world.