Example of Use of Multiple Demonstrations and/or Hands on Activities: Bernoulli's Principle

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Bernoulli's Principle

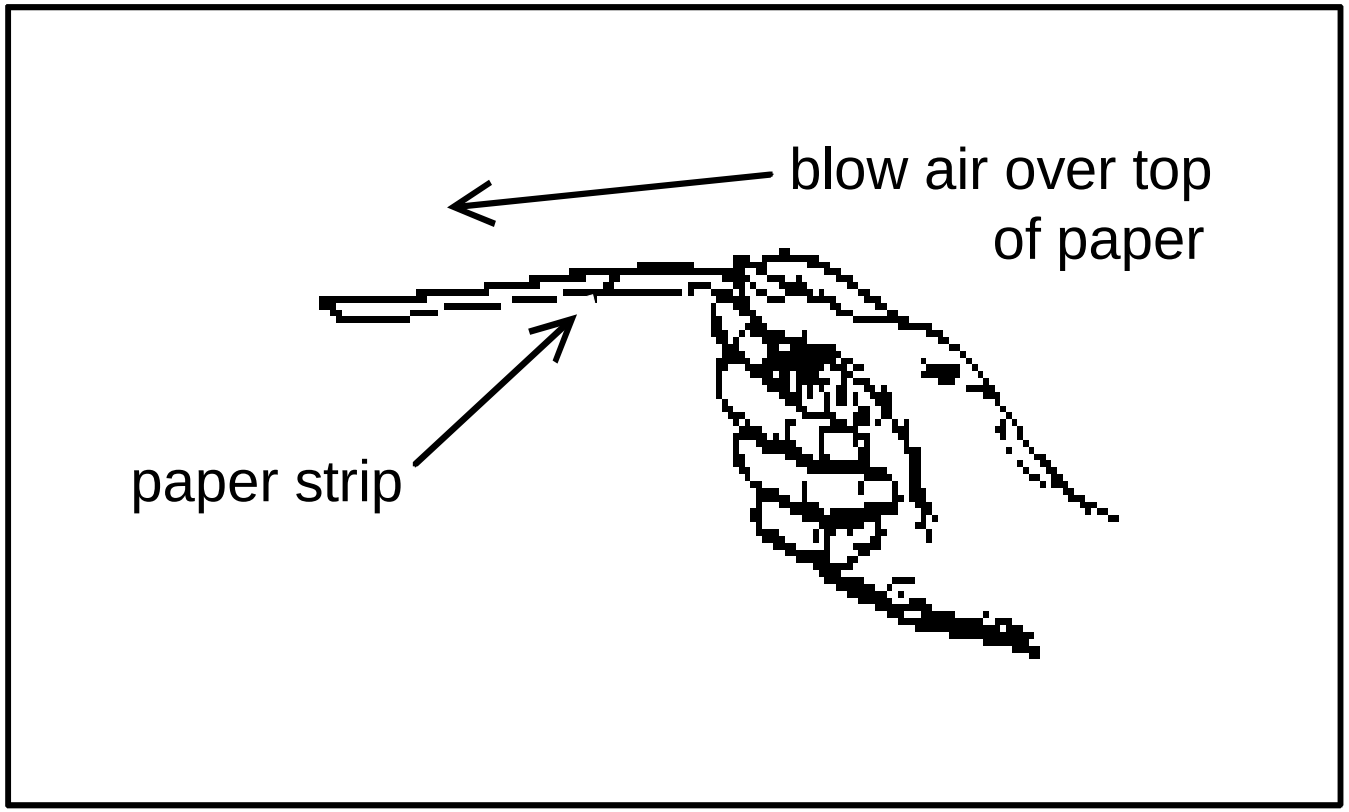
Bernoulli's principle states that where the velocity of a fluid is high, the pressure is low, and where the velocity is low, the pressure is high. Pressure is defined as force per unit area where the force F is understood to be acting perpendicular to surface area A. It is an experimental fact that fluid exerts a pressure in all directions. At a particular point of a fluid at rest, the pressure is the same in all directions.

Considering Vocabulary from Bernoulli Text

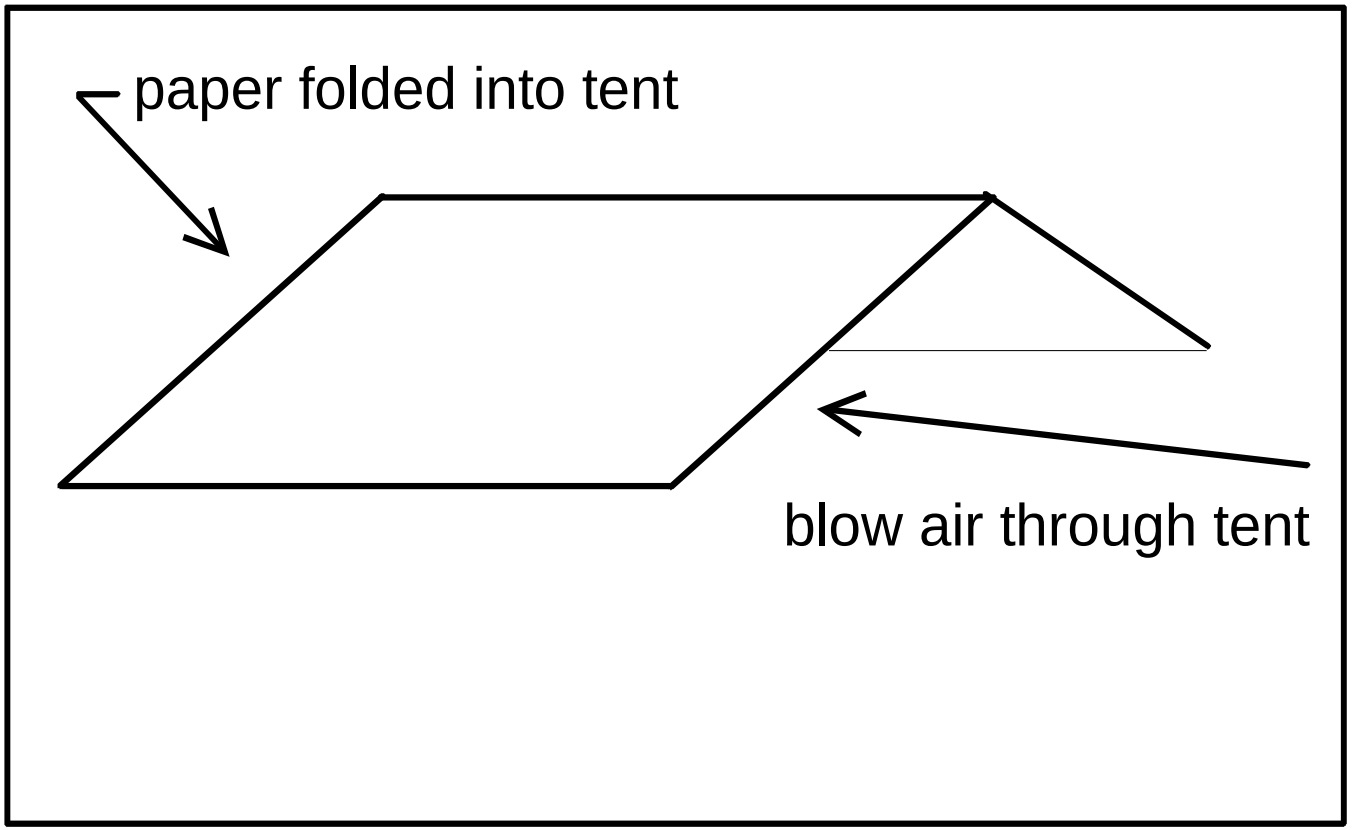
(Note- these terms are all used in explaining the following hands-on experiments)

- **Principle**
- **Velocity**
- **Fluid**
- **Pressure**
- **Force**
- **Per Unit Area**
- **Perpendicular**
- **Experimental Fact**

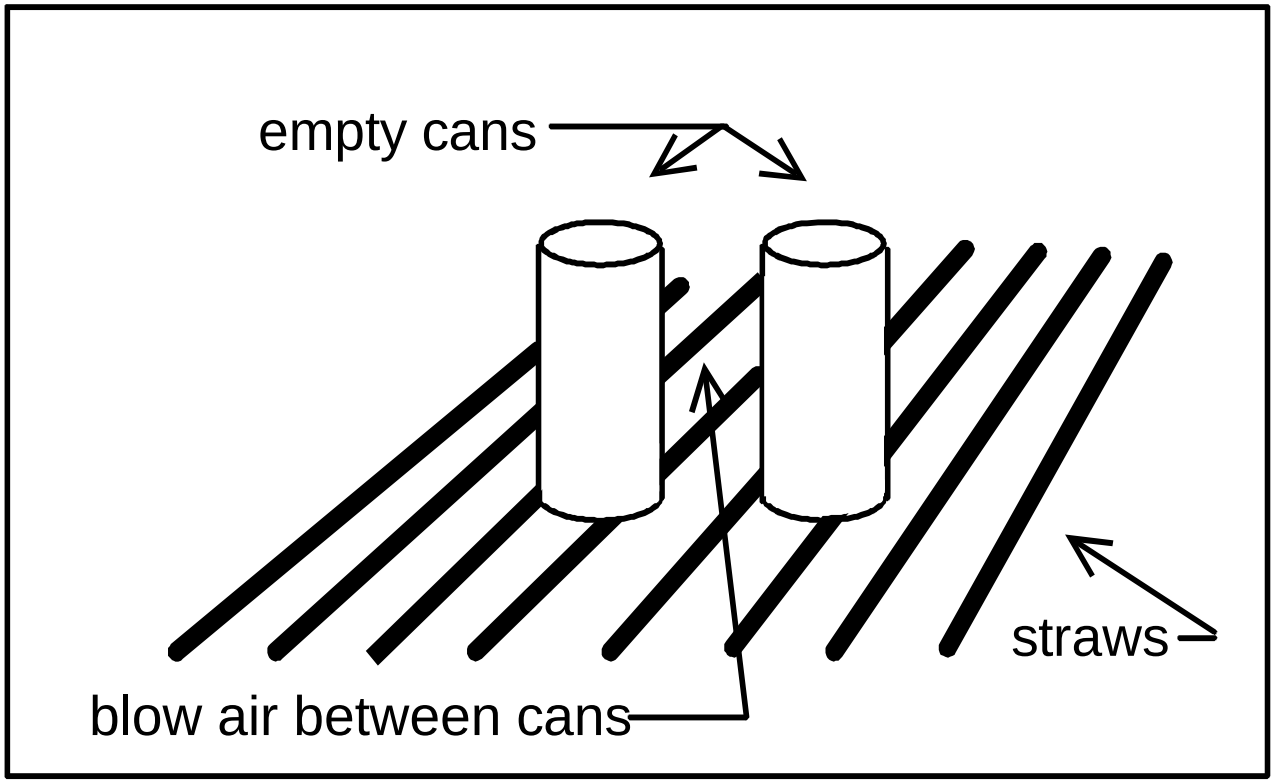
Bernoulli Demonstration– Example 1 (Demonstration and/or Hands-On + Explanation of Why Paper Strip Rises)



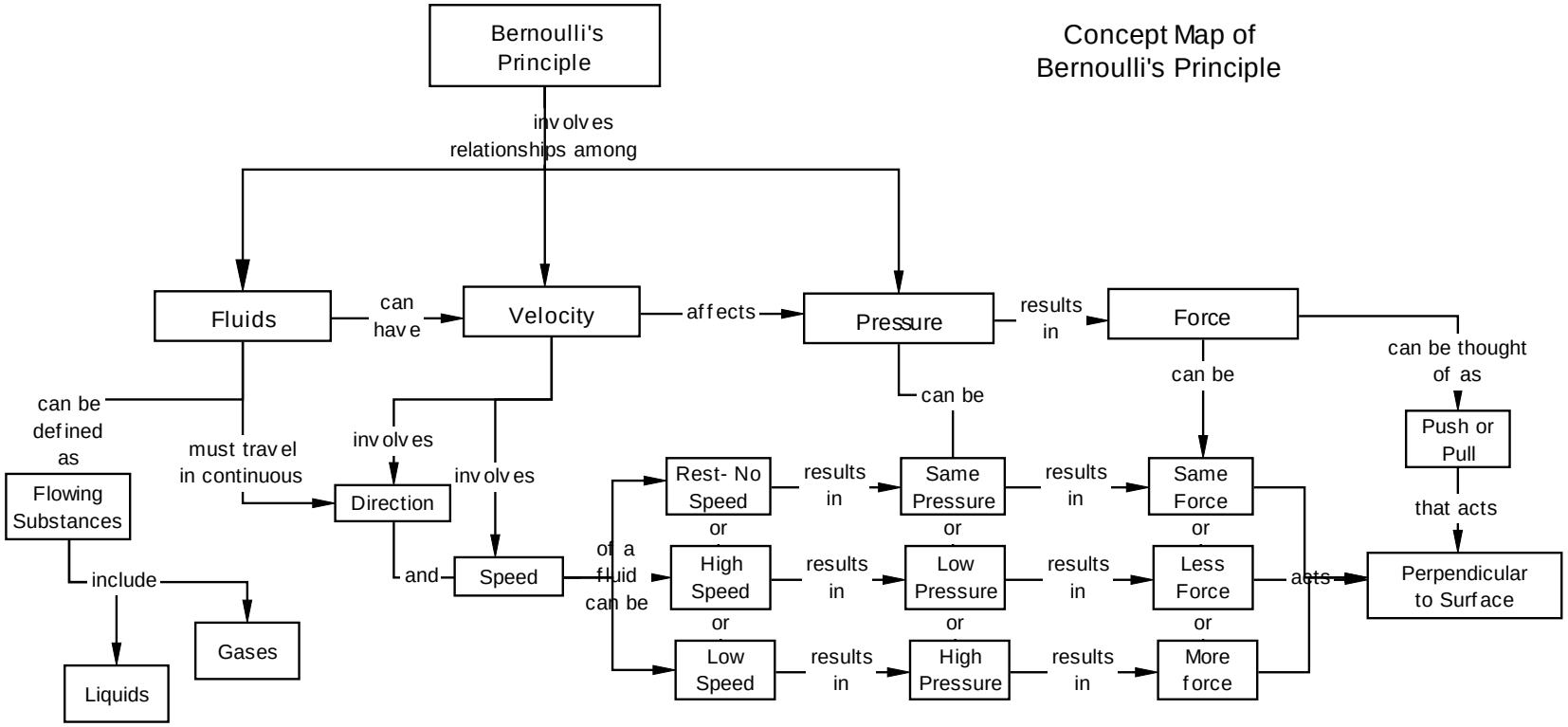
Bernoulli Demonstration– Example 2 (Demonstration and/or Hands-On + Explanation of Why Tent Collapses)



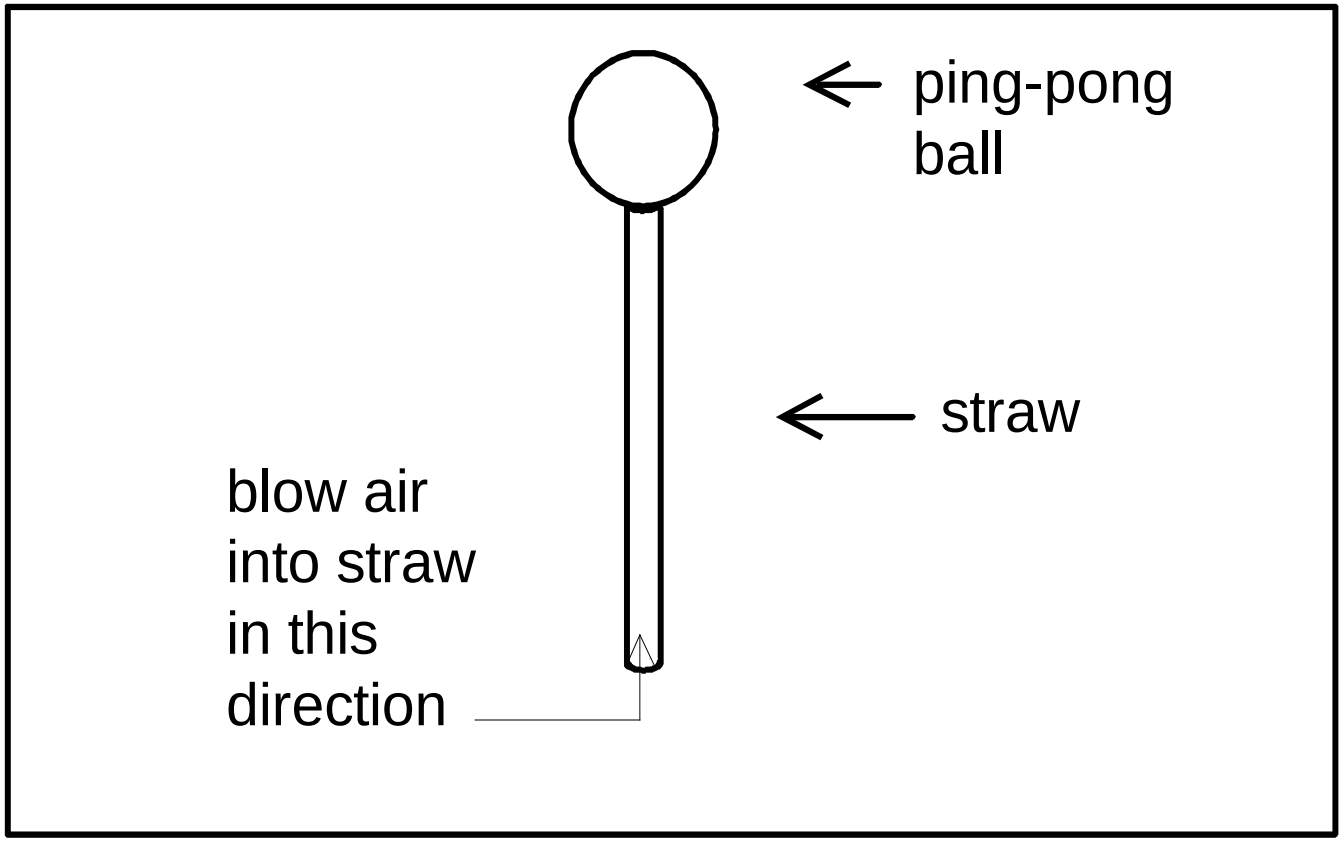
Bernoulli Demonstration– Example 3 (Demonstration and/or Hands-On + Explanation of Why Cans Fall Together)



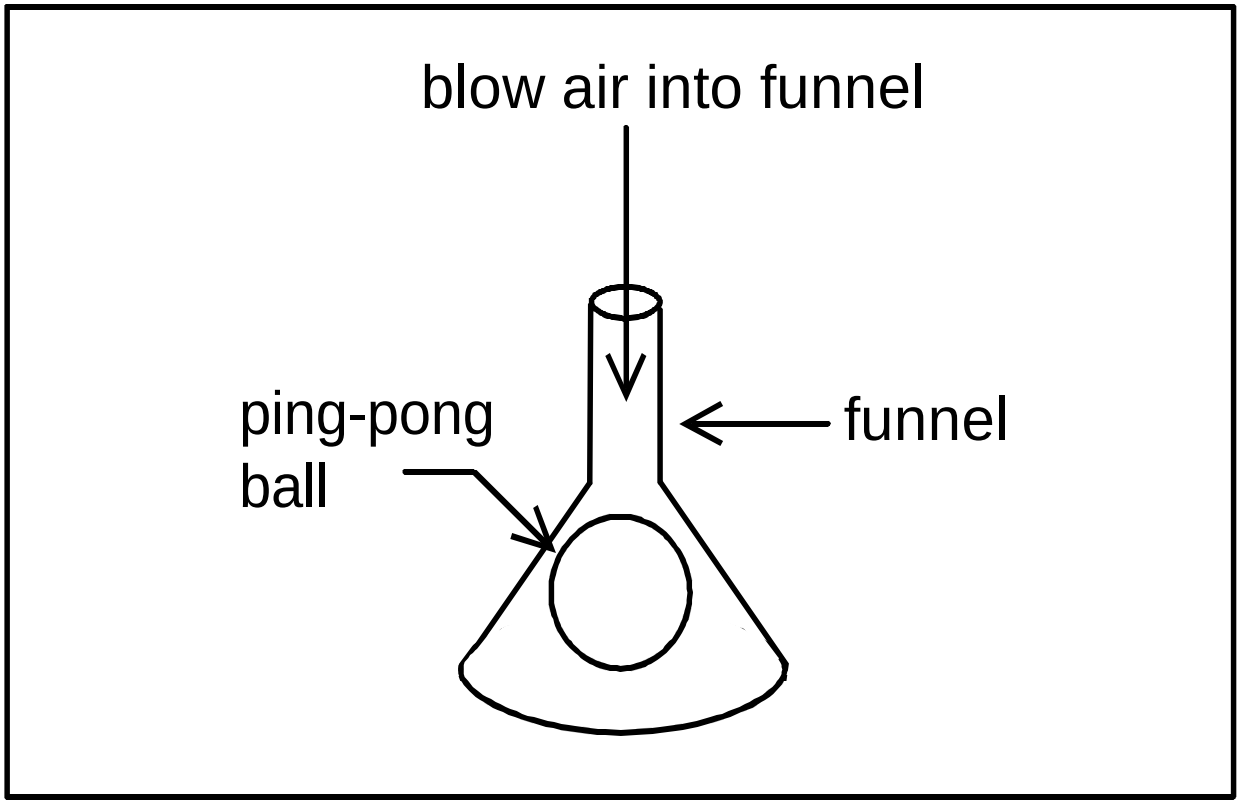
Bernoulli Propositional Concept Map (Representation of Bernoulli's Principle + Referenced to Prior Examples)



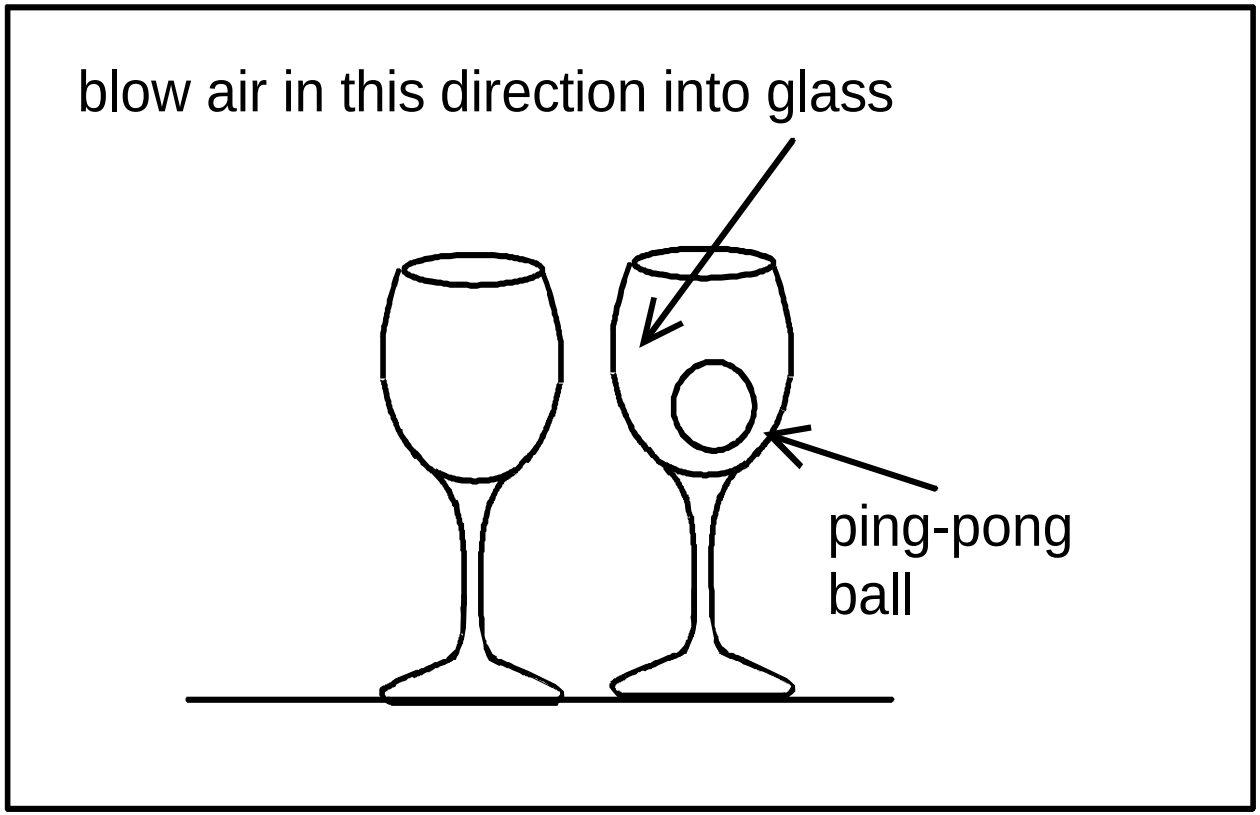
Bernoulli Demonstration– Example 4 (Demonstration and/or Hands-On + Explanation of Why Cans Fall Together)



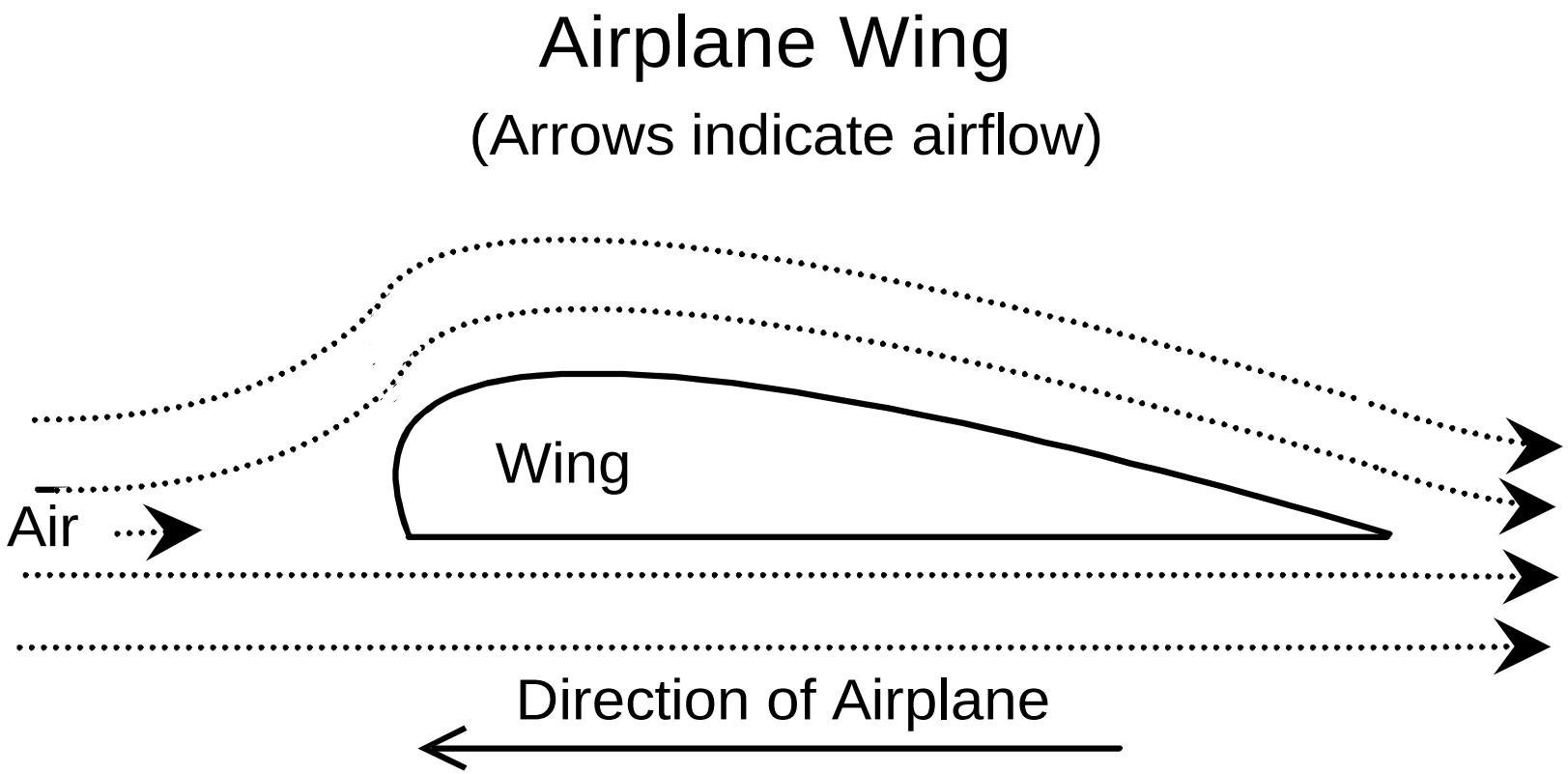
Bernoulli Demonstration– Example 4 (Prediction of Outcome Prior to Demonstration and/or Hands-On: Confirming Ball Does Not Fall Out of Funnel)



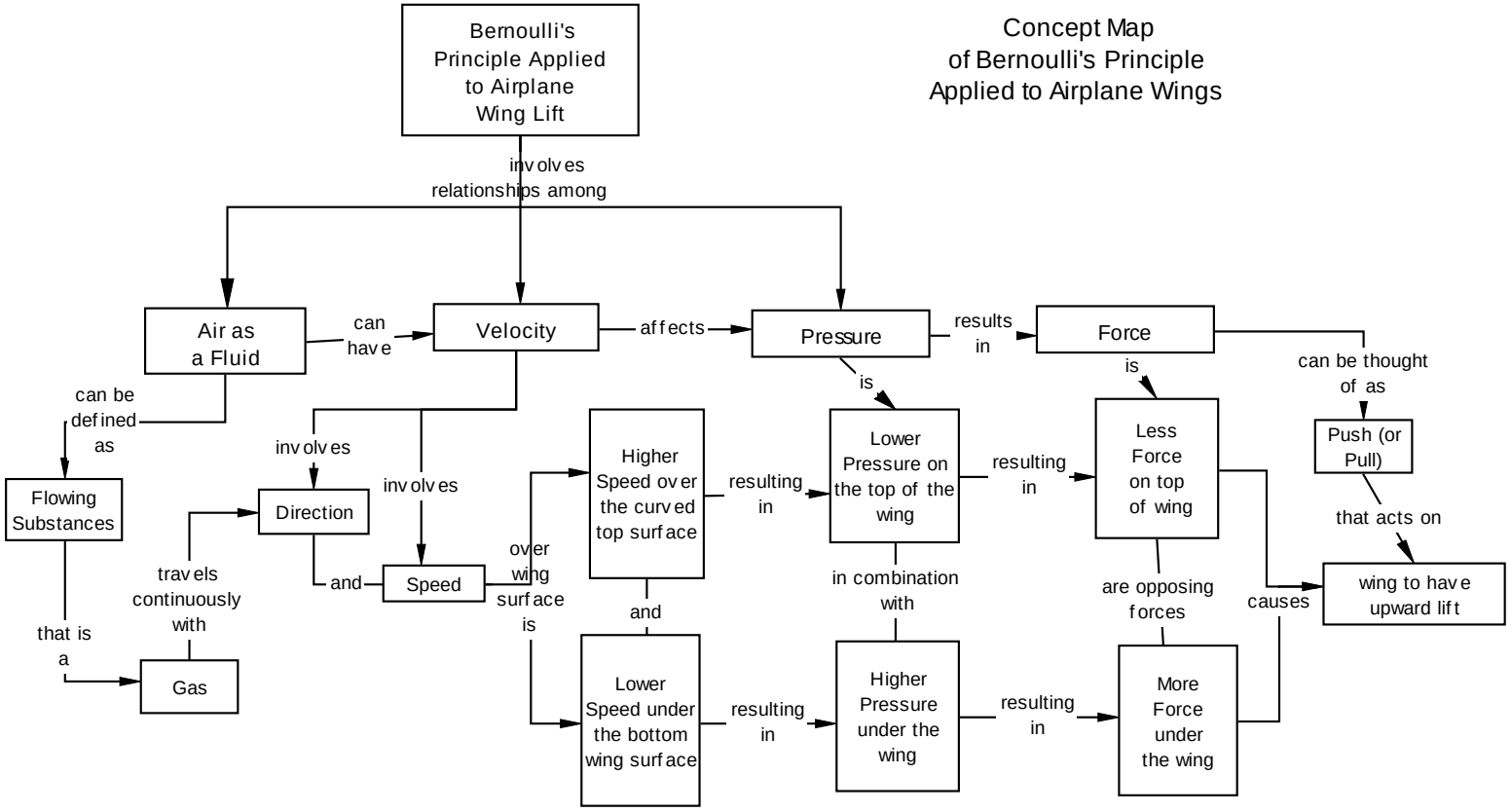
Bernoulli Demonstration– Example 5 (Prediction of Outcome Prior to Demonstration and/or Hands-On: Confirming Ball Jumps from One Glass to the Other)



Bernoulli's Principle- Generalization to Explain Lift of Airplane Wings



Bernoulli Propositional Concept Map (Representation of Bernoulli's Principle Applied to Lift of Airplane Wings)



Implications of Hands-On Sequence in Teaching for Understanding

Points to Note About Bernoulli Demonstrations

- **Role of conceptual knowledge in understanding and application**
- **How conceptual knowledge provides the means for relating different events (i.e., the series of different activities and the extension to airplane wings)**
- **How, without conceptual knowledge, the activities would have been done in rote fashion by simply doing the experiments and literally describing what happened**

Using Organization of Knowledge in Concept Map as a Key for Writing

Writing Assessment Assignment

Instructions: Use the Bernoulli Concept Map as a Guide to develop a multi-paragraph passage: *How airplanes are able to fly*.

Scoring assumptions for writing task:

- **Focus -- how clearly the idea or theme is presented or maintained**
- **Organization -- how the logical development of the supporting ideas to the main idea are developed throughout the paragraph**
- **Support -- the quality of details used to explain, clarify, or define**
- **Conventions -- appropriate grammar usage**

Note- How the concept map would be useful in writing. How the writing task would be approached with vs. without the Concept Map.

Bernoulli's Principle Revisited (Now Understandable in Terms of Hands-On + Explanations Using Bernoulli Terms)

Bernoulli's principle states that where the velocity of a fluid is high, the pressure is low, and where the velocity is low, the pressure is high. Pressure is defined as force per unit area where the force F is understood to be acting perpendicular to surface area A. It is an experimental fact that fluid exerts a pressure in all directions. At a particular point of a fluid at rest, the pressure is the same in all directions.

Possible Test of Student Understanding of Bernoulli's Principle

1. **According to Bernoulli's Principle, what happens to the pressure of a fluid when velocity changes from high to low?**

2. **According to Bernoulli's Principle, fluid at rest exerts pressure that is: a. low b. high c. equal in all directions**

3. **According to Bernoulli's Principle, what factors influence the amount of pressure on a surface exerted by a fluid?**

4. **Use Bernoulli's Principle to explain how a steeply sloped roof might be affected by hurricane force winds.**

5. **Suppose you were building a race car. How could you use Bernoulli's Principle to design "wings" for your car that would help it hold the road at high speed?**