knue
Korea National University of Education

A STEM Learning

Korea National University of Education

Department of Technology Education

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STEM education

What is STEM Education?

By Elaine J. Hom February 12, 2014

STEM is a curriculum based on science, technology, engineering and mathematics.

STEM is not teach each subject separately.

STEM integrates them into a cohesive learning paradigm.

STEM is based on real-world applications.

This STEM Learning

1. Area

- Science: Understanding of Relationship of Pressure and Volume in Air, Fluid Movement by Air Decompression
- Technology(Engineering): Understanding of Valves, Making of Human-operated Water Pump
- Target Student: K-5 ~ K-9 students

in k-7(middle school) science textbook, Korea

2. Aim & Activity

- Students understand relationship of pressure and volume in air.
- Students observe fluid movement by air decompression.
- Students understand a traditional human-operated pump by this scientific phenomenon and make a small and simple water pump using syringes, steel balls, etc.
- Students understand a check valve and its role in pipelines.

Science

- ✓ Extracted from K-7 Science textbook, Korea
- ✓ Relationship of Pressure and Volume in Air

3. 주사기의 피스톤을 밀어 넣으면서 공기의 압력이 1.5, 2.0, 2.5, 3.0 기압이 되었을 때 주사기 안에 들어 있는 공기의 부피를 각각 측정하여 기록한다.

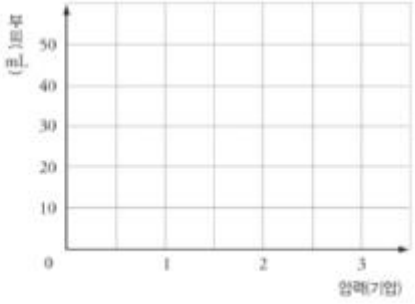
정리하기

1. 실험 결과를 표에 기록해 보자.

압력(기압)	1.0	1.5	2.0	2.5	3.0
부피(mL)	50				
압력×부피					

2. 공기의 압력이 높아질수록 주사기 안 공기의 부피는 어떻게 변하는가?

3. 공기의 압력과 주사기 안 공기의 부피 관계를 그래프로 나타내 보자.



그래프 작성 방법
자료실 256쪽의 안내에 따라 그래프를 그려 보자.

보고서 작성 방법
자료실 254쪽의 안내에 따라 보고서를 작성해 보자.

관계

과학, 기술을 만나다

기체 연료의 저장

기체 연료는 부피가 크기 때문에 저장과 운반이 편리하도록 연료에 높은 압력을 가하여 기체의 부피를 줄인다. 따라서 기체 연료를 저장할 때는 높은 압력에도 견딜 수 있는 특수 용기를 이용한다.

진다. 따라서 기체 입자가 용기의 안쪽 벽면에 충돌하는 횟수가 증가하므로 용기 안의 기체 압력이 높아진다.

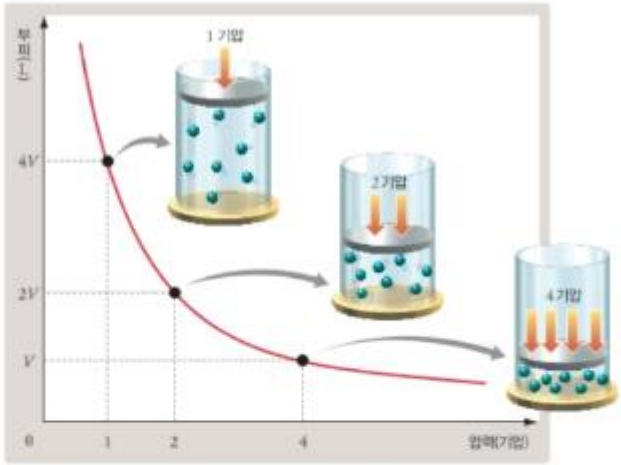


그림 Ⅳ-8 기체의 압력에 따른 부피 변화와 기체 입자의 운동 모형

추리하기 공기 주머니가 들어 있는 운동화를 신고 뛰면 공기 주머니 덕분에 착지할 때 충격이 덜하다. 이 운동화를 신고 뛰었다가 착지할 때 공기 주머니 속 기체의 부피와 압력은 어떻게 변할지 써 보자.

기체의 부피 변화:

기체의 압력 변화:

Korea National University of Education

Science

- ✓ Extracted from K-7 Science textbook, Korea
- ✓ Relationship of Pressure and Volume in Air

Scientific Phenomenon

When the temperature is constant, the volume and pressure of the air are inversely proportional to each other. In a closed system, when the air pressure is lowered, the air volume is increased, and when the pressure is increased, the volume is decreased.

$PV = constant$, if Temperature is constant

Referred to **Boyle's Law**

Science

Experiment

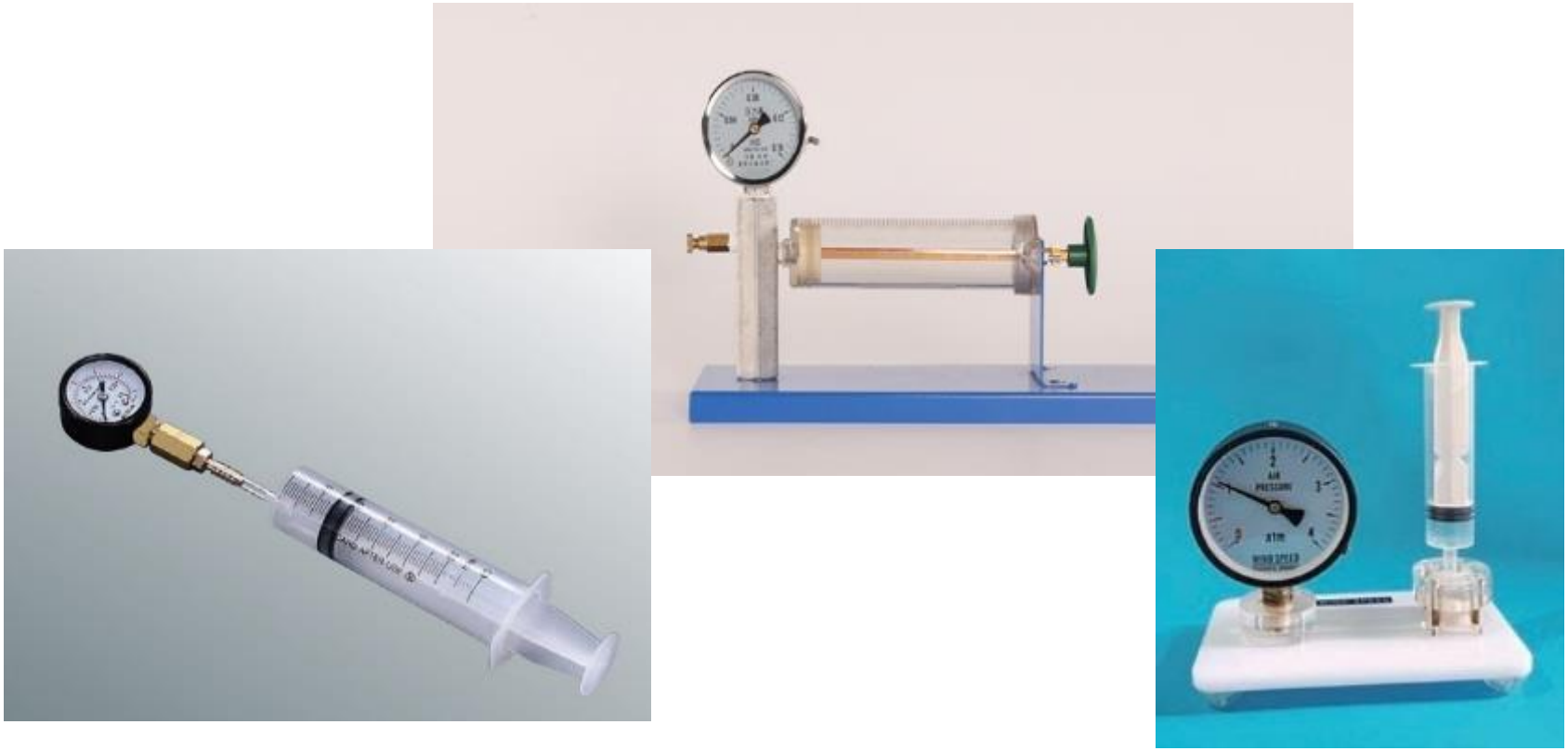


Figure. Experiment Kit for Boyle's law

Science

Data Recording

Division	Starting Condition	Press Piston more & more →			
Air Volume in the syringe (mL)	60	*55*	*50*	*45*	*40*
Air Pressure in the syringe (atm)	1	*1.09*	*1.2*	*1.33*	*1.5*
Volume × Pressure (atm·mL)	60	*60*	*60*	*60*	*60*

Table. Relation of Pressure & Volume of Air

Mathematics

Graph

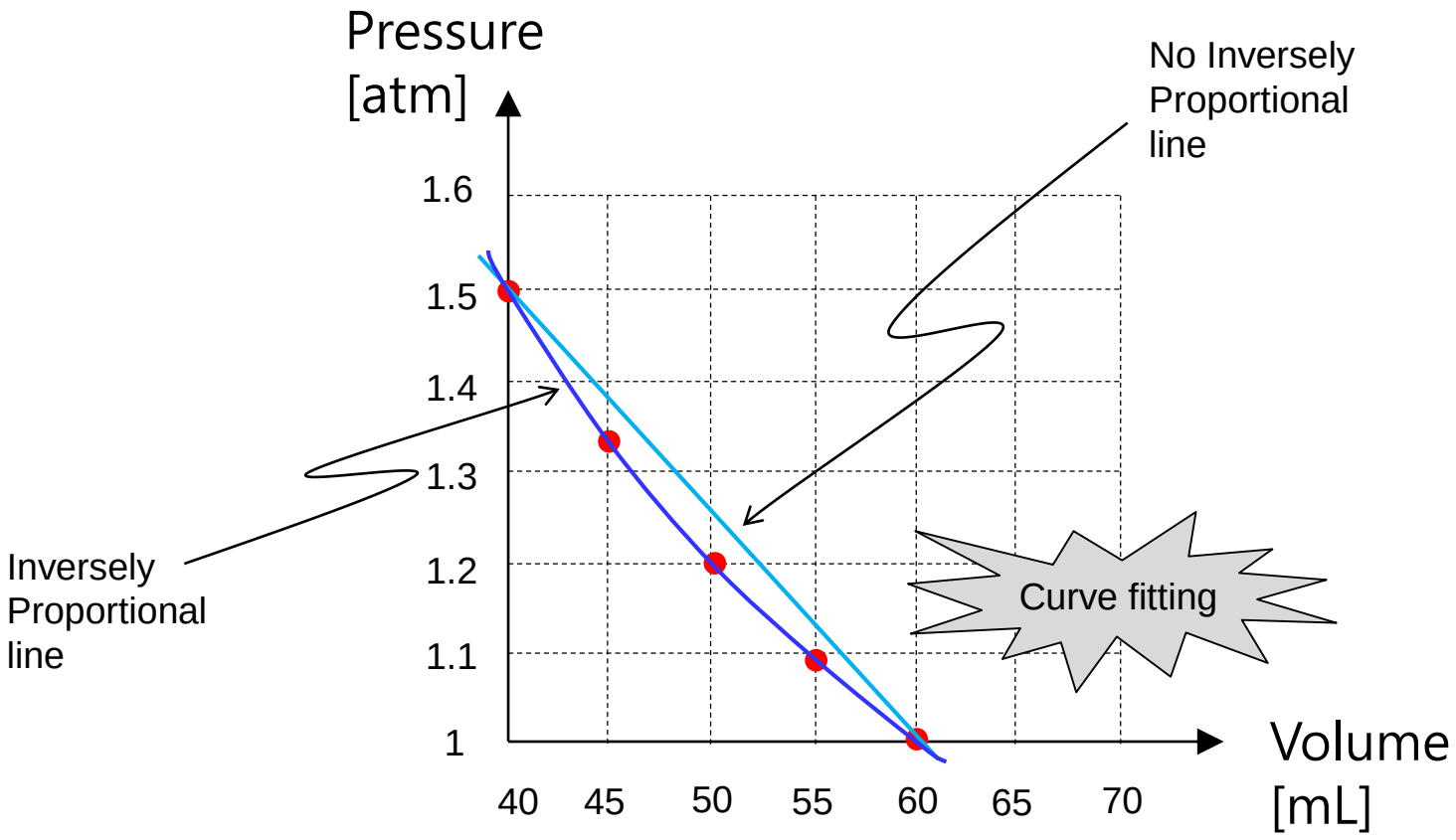


Figure. Pressure & Volume Graph

Science

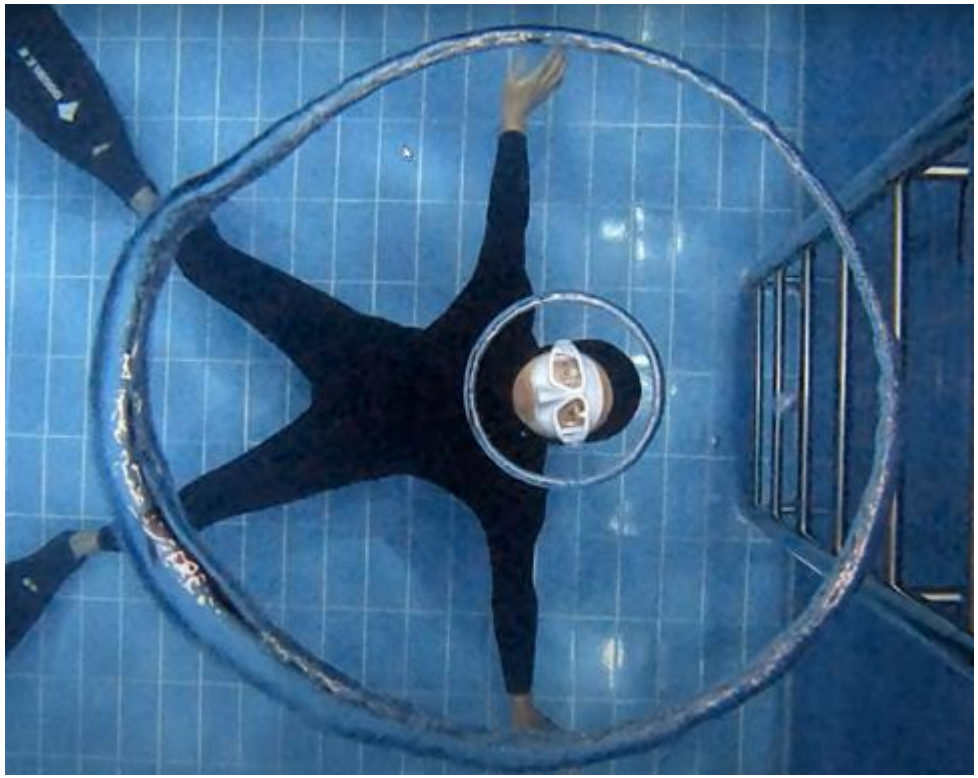
Mashmallow Expansion Test

https://youtu.be/w5aFnutBcPM?t=50

Figure. Mashmallow in Decompression Vessel

Science

Diver Bubbling Experiment



https://youtu.be/Rb5vpBQss64?t=222

Figure. Diver Bubbling

Science

Observing Similar Cases

Shoes Cushion

Bicycle Pumping

High Pressure Gas Tank

Science

Fluid Movement by inducing Air Decompression

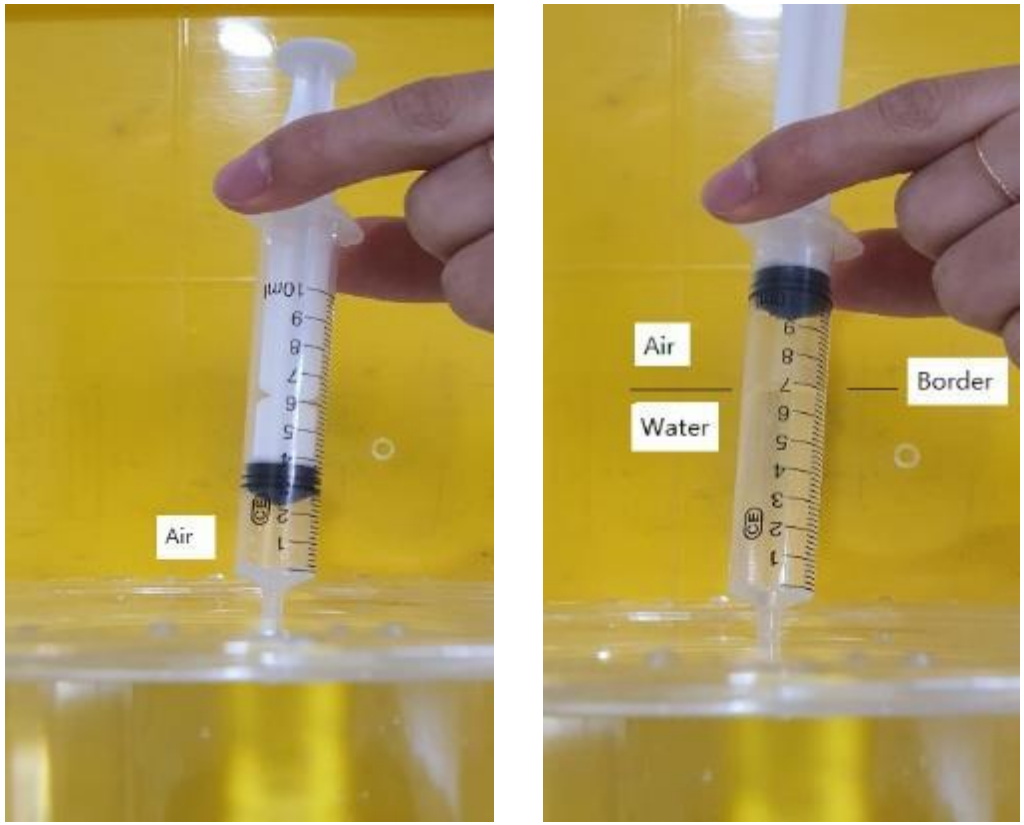


Figure. Water Pumping

Low pressure of air (air decompression) causes fluid movement such as the rise of water.

Relationship of Pressure and Volume in Air

↓

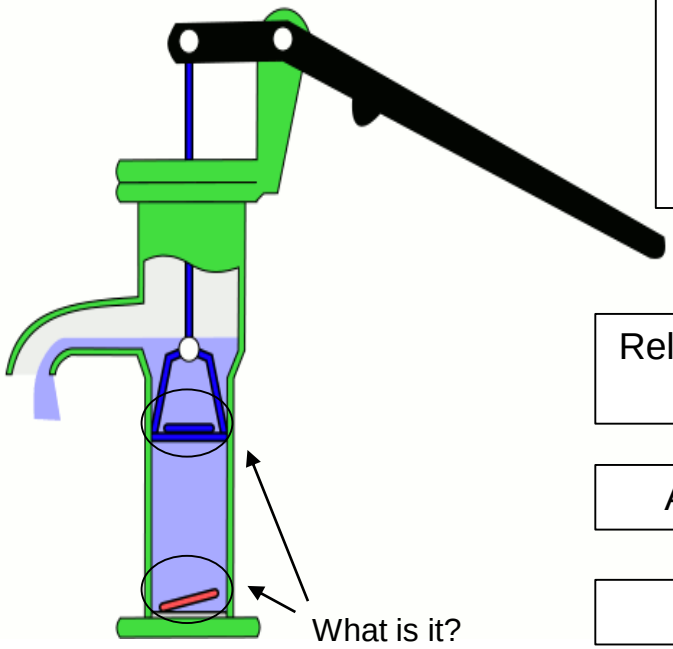
Air Decompression

↓

Fluid Movement

Technology

Human-operated water pump



What is it?
Open & close?

Check valve!!

Relationship of Pressure and Volume in Air

↓

Air Decompression

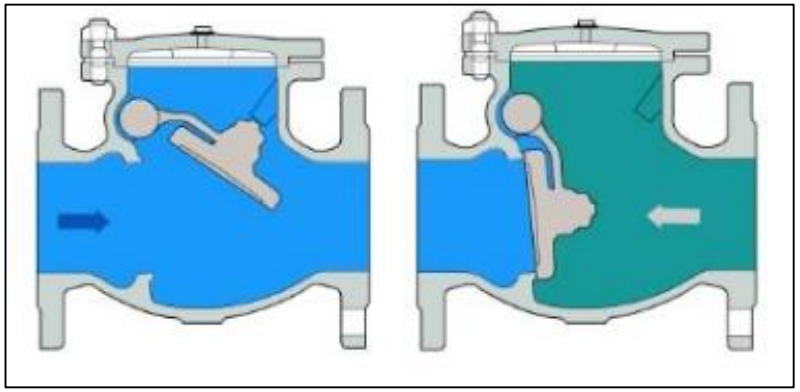
↓

Fluid Movement

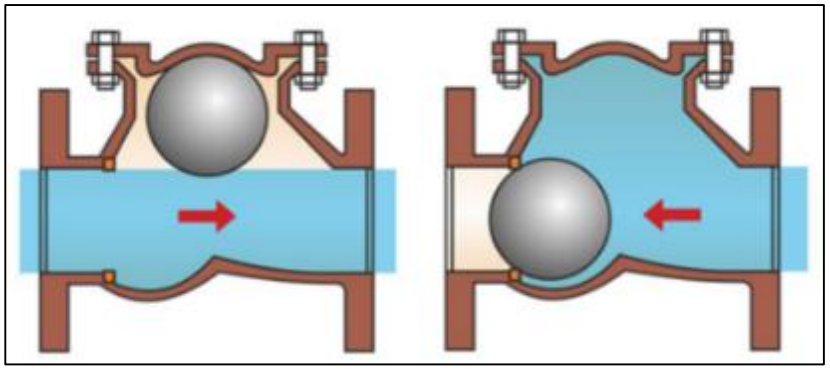
Technology

Check Valve

A check valve is a valve that is installed in a pipe and used to allow the fluid to flow in only one direction.



Swing type check valve



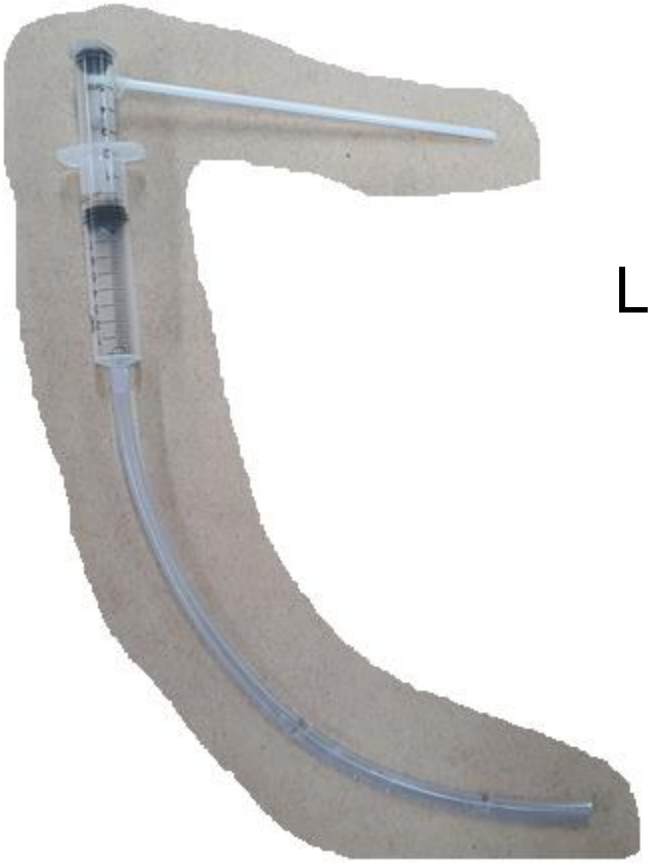
Ball type check valve

https://ko.aliexpress.com/af/check-valve.html?d=y&origin=n&SearchText=check+valve&catId=0&initiative_id=SB_20210810214506

Technology

Human-operated water pump

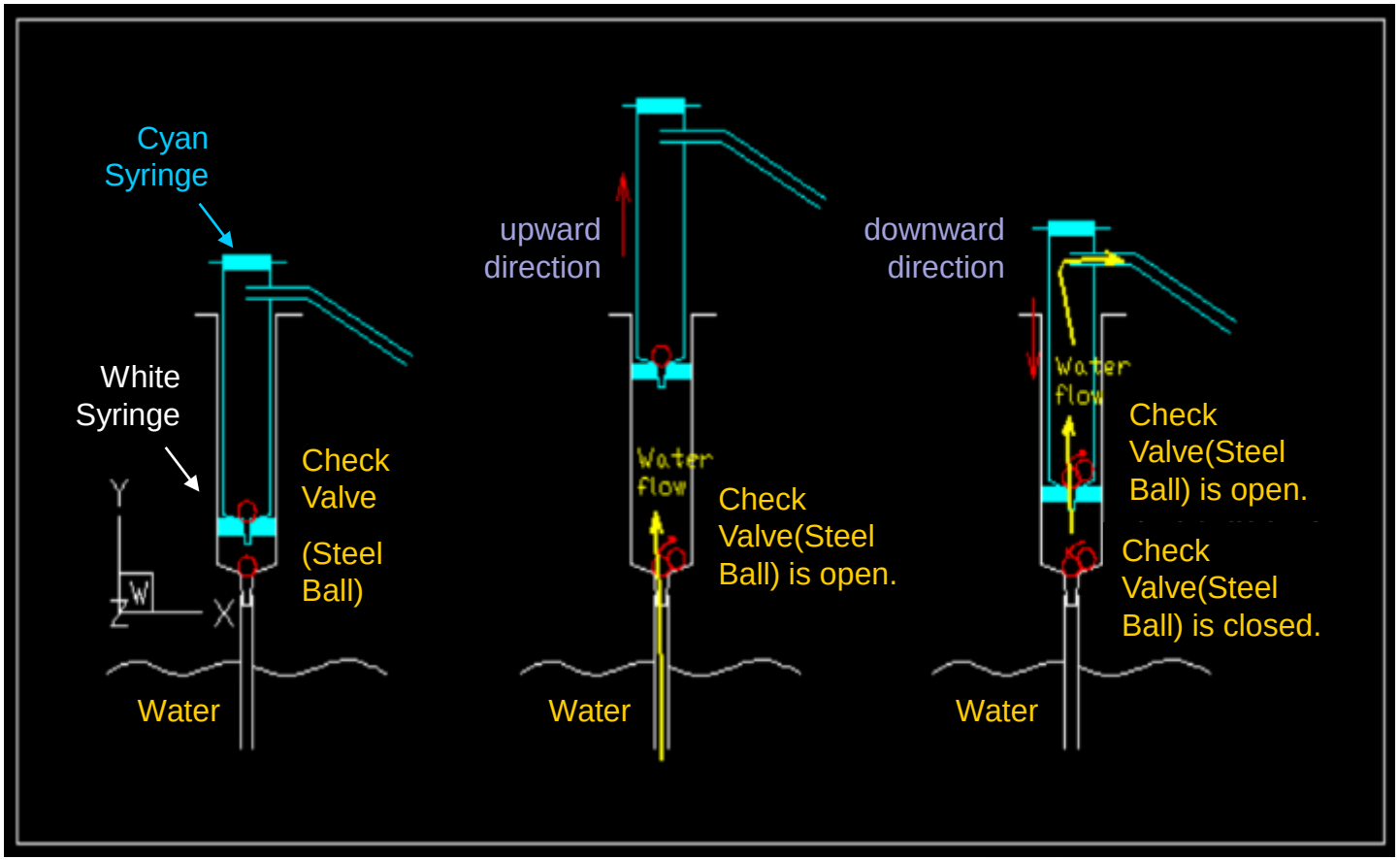
What is it?



Let’s make it!

Technology

Human-operated water pump

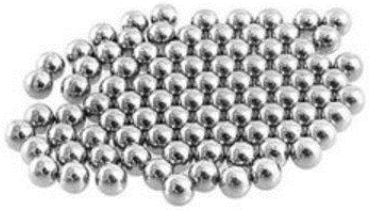


Technology

Materials & Parts

Syringe without needle

https://a.aliexpress.com/_mODl6lh



https://a.aliexpress.com/_mrhcffv

https://a.aliexpress.com/_m0xpwvZ

Technology

Making Process

1		Prepare 2 syringes(5mL, 10mL), 2 steel balls, straw, tube.
2		After pulling out the piston rubber from 10mL syringe, pierce the center of the rubber using an awl.
3		Using glue-gun, Attach a piston rubber with a hole in the needle hole of 5mL syringe.

Technology

Making Process

4		Put steel-ball into 5mL syringe.
5		Using glue-gun, attach piston rubber of 5mL syringe to the opening of the small syringe.
6		Using hot-iron, make a hole on 5mL syringe for the straw near the opening of 5mL syringe.

Technology

Making Process

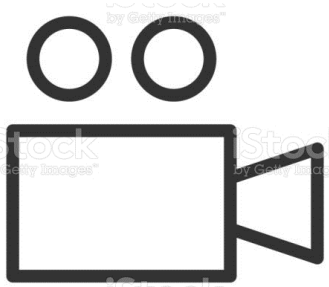
7		Put the straw into the hole which you made in the 5mL syringe. The straw should come into the middle of the syringe.
8		Using glue-gun, Fix the straw with the glue-gun to prevent the straw. Be careful not to dissolve the straw in heat.
9		Put steel-ball in 10mL syringe and combine with 5mL syringe assembly.

Technology

Making Process

10		Insert the needle hole of 10mL syringe into a flexible tube. Then, it's done.

Technology



Video for Making Process

Additional Activities after Making

(1) Mission: Transfer the water from a vessel to another vessel.

(2) Question: Understanding the principle of the water pump

① Explain how the water moves when you push and pull 5mL syringe in the water pump.

When pushing 5mL syringe:

When pulling 5mL syringe:

② Explain the principles of the water pump.

③ Briefly describe the structure of the water pump.

Thank you for your hearing and watching!!

대단히 감사합니다.