Demonstration (5th-10th grade)	**Hydrogen Synthesis**	**time:** 10-15 min.

Safety:

The stoppers should not be pressed too firmly into the test tubes. Under strong production of gaseous products the stopper may pop out and the gases be released. Also, if the stopper is too firmly seated, the test tube may explode under high gas pressures.
The tops of the canulas should be cut off with shears. Be careful that the canula is not crushed during the process. The 20ml syringe should be smooth. Extreme care must be employed when dealing with concentrated acids!

Instruments:

- 2 (pink) canulas (1,2 / 40mm)
- 1 test tube (Duran 16/160)
- 1 soft rubber stopper
- 1 5ml syringe
- 1 20ml syringe
- 1 Bunsen burner
- 1 lighter / match
- 1 plastic pipette
- 1 set shears
- Retort stand, clamps, etc.

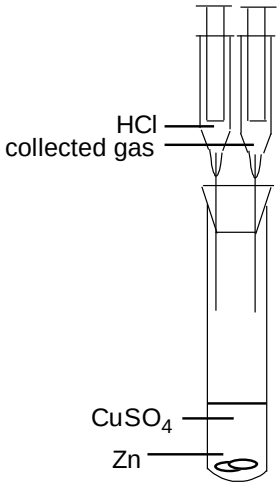
Chemicals:

- Zinc granulate (H: 260-250-410; P: 222-223-231+232-273-370+378-422)
- copper sulfate solution, $CuSO_4$, circa 1 mol/l (302-219-315-410; P: 273-305+351+338-302+352)
- concentrated hydrochloric acid, HCl (H: 314-335; P: 260-301+330+331-303+361+353-305+351+338-405-501)
- silicon oil and steel wool

Preparation:

The tops of the canulas should be cut off with shears. Be careful that the canula is not crushed during the process. The 20ml syringe should be smooth and lubricated with silicon oil.

Experiment:



- Construct the apparatus as shown in the above picture.
- Fill the 5ml syringe with concentrated hydrochloric acid.
- Place one zinc granule in the test tube and pour copper sulfate into the test tube to a height of approximately 2 cm.
- Drip hydrochloric acid into the test tube and capture the resulting gaseous product using the 20 ml syringe.

indicator reaction:

- Test for the presence of hydrogen by blowing the gas from the syringe into a Bunsen burner flame.

Observations: A gas is produced, which can be captured and then tested for the presence of hydrogen.

Results: The copper sulfate solution activates the zinc, which reacts with the HCl to form zinc chloride and hydrogen gas. The gas can be tested by exposing it to a flame and listening for the typical hydrogen "pop".

$Zn + 2\ HCl \rightarrow H_2 + ZnCl_2$

hydrogen reaction in flame:
$2\ H_2 + O_2 \rightarrow 2\ H_2O$

Disposal: Zinc and copper products must be disposed of as heavy metal waste.
