



# **CHEMIST**

## **User Guide**

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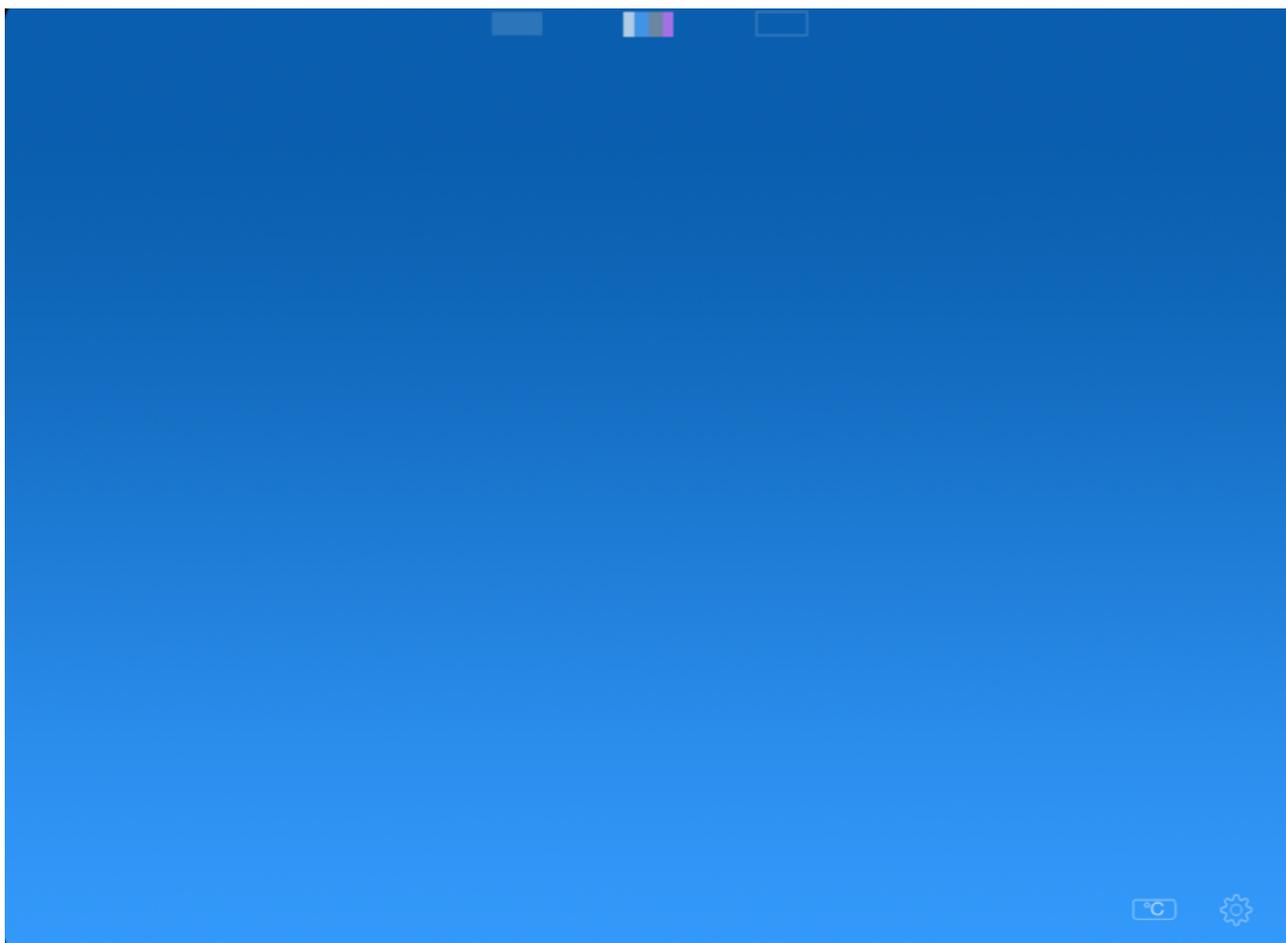
## What is CHEMIST?

CHEMIST is a virtual chemical laboratory running on iPad/iPhone and Android devices where you can experiment with various lab equipment, procedures, and chemicals however you want—without the potentials of being harmed.

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## Get Started

After opening the app, you see the experiment area and three buttons on the top.



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### Get Apparatus (See Apparatus on page 2)

Note the three buttons at the top of the screen. Tap on the lefthand button to open apparatus library. Then drag down the apparatus to the blue area.

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### Add Chemicals (See Chemicals on page 5)

Tap on the button in the middle among three to open chemical library. Select categories. Drag chemical to the vessel and hold. Adjust the amount you want to add by moving fingers up and down on the vessel.

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### Use Tools (See Tools on page 6)

Tap on the right hand button to open tools menu. Drag tools to the destination apparatus.

## Apparatus



There are 17 different apparatus including 10 vessels:

- 100 mL beaker
- 100 mL erlenmeyer flask
- 100 mL boiler
- 50 mL test tube
- 250 mL beaker
- 250 mL erlenmeyer flask
- 250 mL boiler
- 250 mL gas bottle
- Watch glass
- Evaporating dish
- Funnel
- Alcohol lamp
- Bunsen burner
- Steel stand
- Tripod
- Glass tubes
- Lid

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### Vessel Heat Capacity

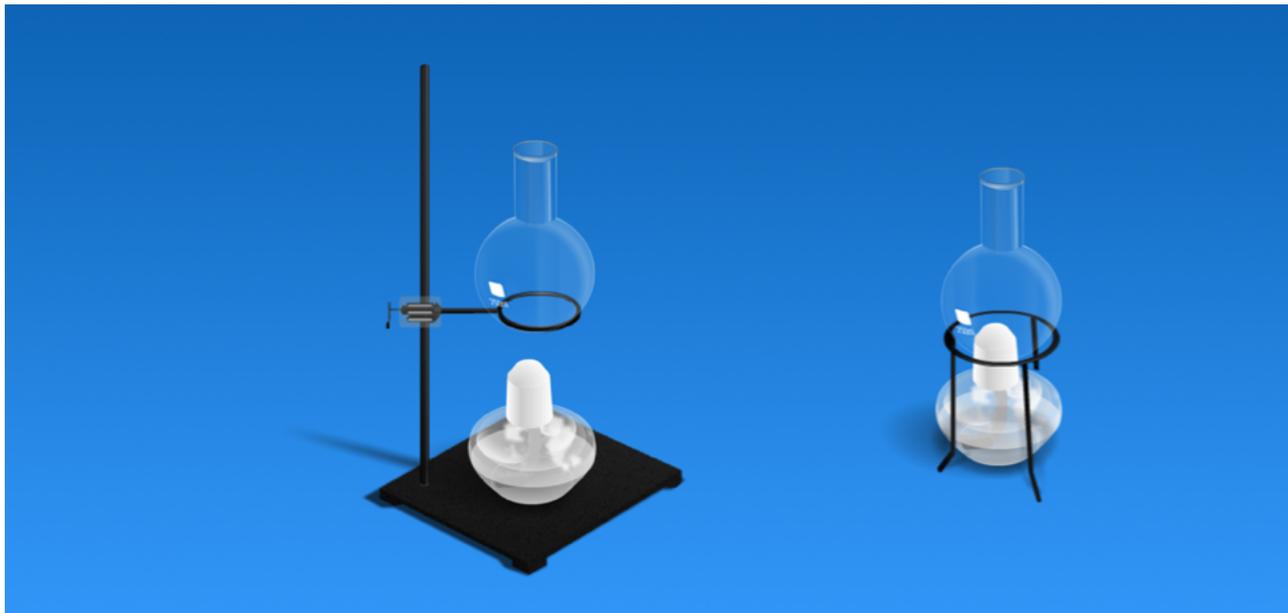
All vessels have a maximum heat capacity of 900 °C except the 100 mL and 250 mL boiler, which have higher heat capacity of 1200 °C.

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### Vessel Volume Capacity

All substances over the maximum volume will be removed from the vessel automatically. The gases in the lab atmosphere will fill in when there is space in the vessel.

## Heating



- Use steel stand: Set vessels on the steel ring and place the burner on the base. Move the steel ring up and down to adjust the heating temperature.
- Use tripod: Place burner under the tripod and set the vessel on the top of it. Heating temperature will be the maximum heating temperature of the burner.

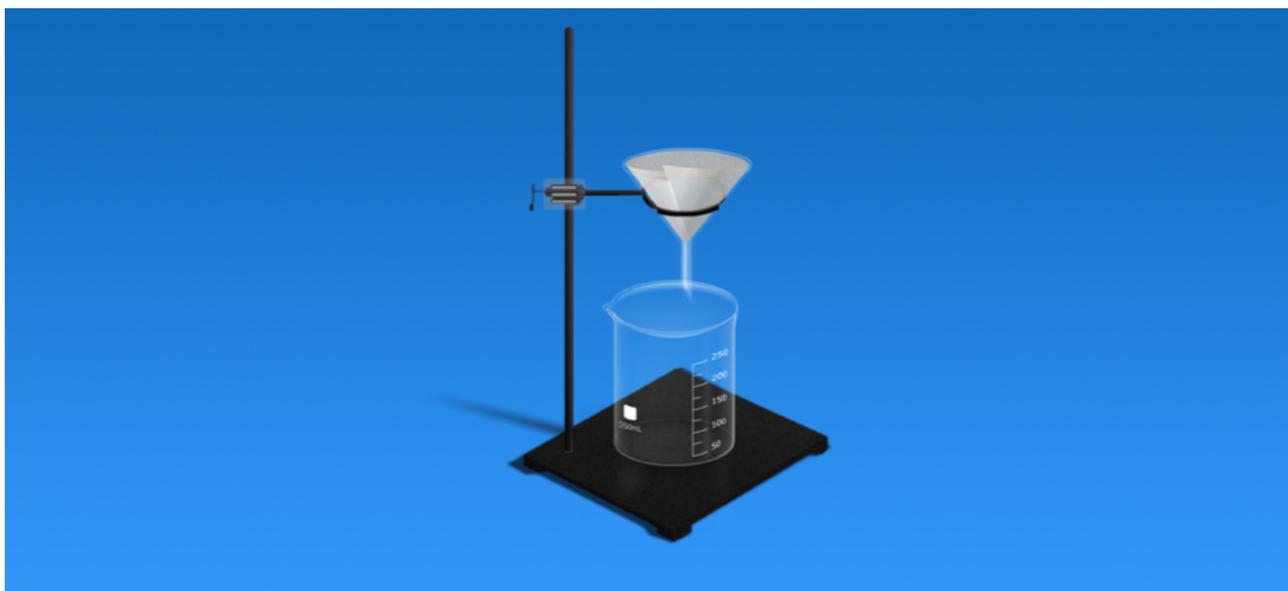
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## Maximum Heating Temperature

- Alcohol lamp: 400 °C
- Bunsen burner: 900 °C

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## Filter



Place filter on the steel ring of the steel stand and stand a vessel on the base.

## Lid

Drag the lid to the vessel to cap it. The lid can prevent gas from leaving the container. Tap on the red cross above the lid to remove it.

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## Glass Tube



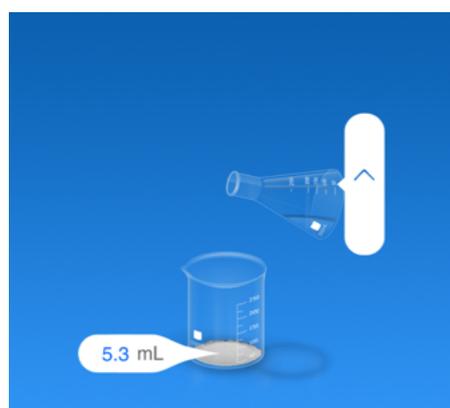
Drag the glass tube to the vessel. Drag the other end of the tube to another vessel to link them. Tap the red cross in the middle of the glass tube to remove it.

The 100 mL and 250 mL beaker, watch glass and evaporating dish can not be used to transfer chemicals through glass tubes.

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## Pour

You can transport substances from one vessel to another by holding one vessel above the other and pouring.



To pour, drag the vessel onto another vessel, and hold for 2 seconds until a box shows up around the vessel. Release your finger and the vessel will move to the position for pouring. Move the arrow up and down to pour. Moving the vessel will cancel the pouring.

## Chemicals



There are four categories of chemicals: Mixture (e.g., sulfuric acid solution, which is the mixture of water and sulfuric acid), Solid (e.g., pure copper metal), Liquid (e.g., pure sulfuric acid; notice the difference from the sulfuric acid solution in Mixture), Gas (e.g., oxygen).

All chemicals are categorized under the temperature of your lab. You can change the lab temperature. (See Lab Settings on page 9)

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## Chemical Information

Data	Reactions
★ Iron	55.85
Density (g/cm <sup>3</sup> )	7.874
Solubility (g/100 <sub>mL</sub> )	0
🔥 1538°C	🔥 2862°C

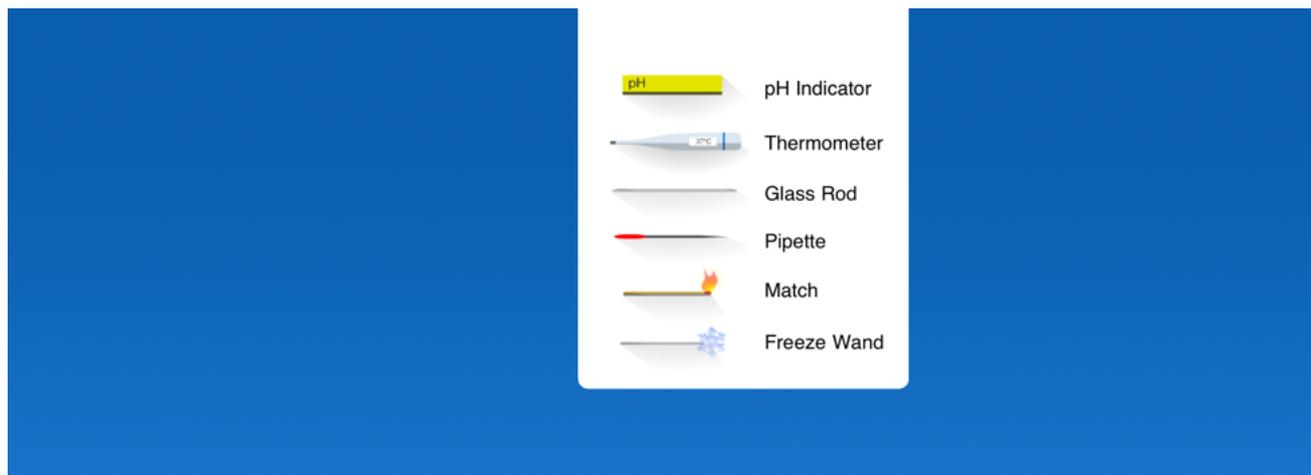
On the chemical tray, tap on a reagent bottle to open the notes on that chemical. The data tab shows the basic physical properties. Tap the Reaction button in the tab to see all reactions related to this chemical. The chemical data of mixtures shows their composition in mass percentages.

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## CloudLab

CloudLab is a feature that will automatically download new chemicals to your lab while connected to the Internet. A chemical downloaded by CloudLab will have a small dot above it.

## Tools



### pH Test Paper

The pH test paper shows the pH value of a solution in a vessel.

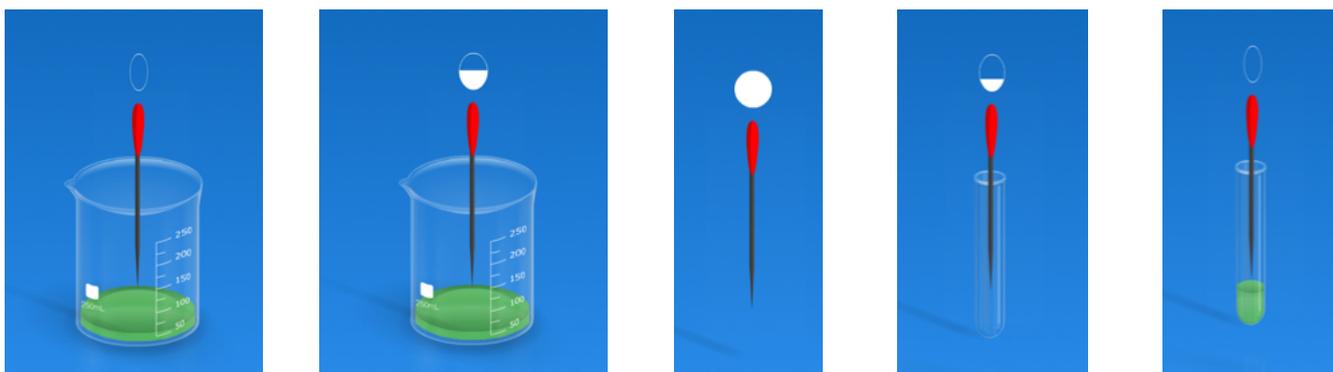
### Thermometer

The thermometer shows the average temperature in Celsius in the vessel.

### Glass rod

The glass rod allows you to stir the solution. Stirring can accelerate chemical reaction, temperature change and color transform.

### Pipette



The pipette allows you to transfer small quantity of liquid from one vessel to another. Drag the Pipette to the vessel and hold. A small circled ball will show up. To draw a solution from the vessel, move your finger up the pipette until the ball is full and shaking. Then move your finger to the destination vessel and a full ball shows up. Move your finger down until the ball is empty and liquid will be dropped into the vessel. The capacity of the Pipette is 5mL.

## Match

The match can be used to ignite chemicals, or to light the alcohol lamp and bunsen burner. Drag a match on the vessel and hold. The Match can burn the substances in the vessel as long as you hold it. The Match can also be used to test the gas in the vessel. If you drag a match to the vessel filled with pure oxygen, the match will flare up. Drag a match to the vessel without oxygen and it will go out. Drag the Match to the vessel filled with hydrogen and oxygen and the Match will sparkle.

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## Freeze wand

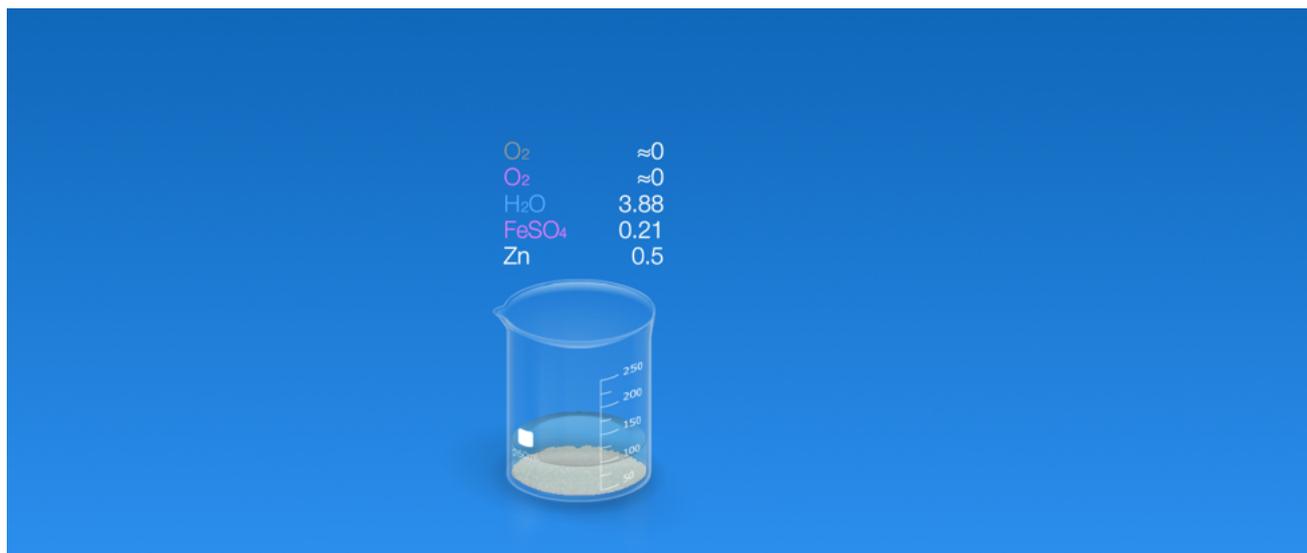
The Freeze wand works like the match tool except that it cools down the substances.

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## Multi-task

You can use multiple tools at the same time by using two or more fingers. For example, drag a thermometer to a vessel to test its temperature with one hand. At the same time, use another hand to drag a glass rod to stir the substances in the vessel. Or you can ask someone for help when more tools need to be applied.

## Label



Label is a feature that enables you to see the accurate and real-time data of all substances in all vessels.

To enable Label feature, tap on the small rectangle button in the bottom right. Select the property you want. Then the chemical names and the relevant value of the property will appear above all containers.

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### Color of the text

- White indicates a solid
- Blue indicates a liquid
- Grey indicates a gas
- Pink indicates a solute in the water

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### Properties of substances

There are five different properties of every substances can be displayed:

- Mass in gram
- Volume in cm<sup>3</sup>
- Amount of matter in mol
- Celsius Temperature
- Molarity in mol/L

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### Values

The numbers are rounded to an accuracy of 0.1. "<0.1" means the value is less than 0.1 but greater than 0. "-" means the value is not eligible for this substance in the selected property.

## Settings

Tap on the gear button at the right bottom of the screen.

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### Explosion

When the explosion switch is on, all explosions will occur as in reality. To see the consequence of an explosive reaction without the explosion, you can turn off the explosion switch to disable all explosion effects.

Any explosive chemical reaction and temperature higher than the heat capacity of vessels will result in an explosion.

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### Audio Effect

You can turn off all sound effects by switching off the Audio switch in setting menu.

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### Lab Settings

You can adjust the temperature, speed of time, and gas composition of your lab.

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#### Temperature

Tap Temperature in the setting menu. Tap the up or down arrow to change the temperature or swipe vertically to change it in larger increments.

The states of all chemical reagents in the tray are based on your lab temperature. For example, if your lab temperature is over 100 °C, the water will be in the gas category, not in the liquid. However, the chemicals already in the vessel will not be influenced by the change of your lab temperature.

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#### Speed of time

Tap Speed of Time in the setting menu. Select the time speed of your lab. You can pause your experiment by selecting 0x time speed. The speed of time will affect chemical reactions and physical changes as well.

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#### Gas Composition

Tap the Gas Composition in the setting menu. Select the gas composition of your lab. There are five different compositions:

- Pure oxygen: 100% O<sub>2</sub>
- Protected gas: 100% N<sub>2</sub>
- Normal gas: 78% N<sub>2</sub>, 22% O<sub>2</sub>
- Natural air: 78% N<sub>2</sub>, 21% O<sub>2</sub>, 0.03% CO<sub>2</sub>, 0.94% He, 0.02% H<sub>2</sub>O

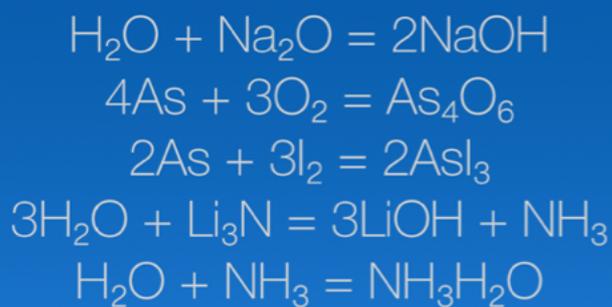
The vessels already existing will not be influenced by the change of your lab gas composition.

## Lab Report

To generate a lab report, tap Lab Report in the Setting menu.

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## Reaction History



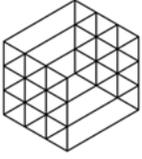
You can view the reaction history of your experiment by scrolling down the Reaction Formula.

Resetting the experiment will clear the reaction history.

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## Reset

To reset your experiment or clear the table, tap the Reset button at the lower right corner.



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