

Molecule Mission  
Support File  
**- CHEMISTRY -**  
NovaScience

Support File



# Background

Your company, **ION Inc.**, specializes in the **prevention of chemical and industrial disasters**.

You are the leader of a team that plans to use a Temporal, Spatial and Digital Projection machine to gather information about various ecological disasters.

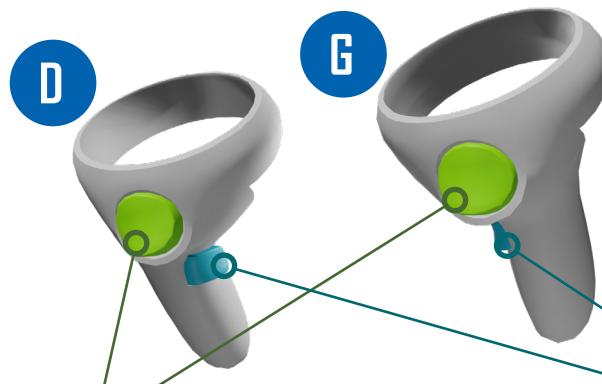
**You will be projected back to the 1970s to gather information about the molecules behind these disasters.**

Complete the chart to confirm that you have the competencies required to be projected into the past.



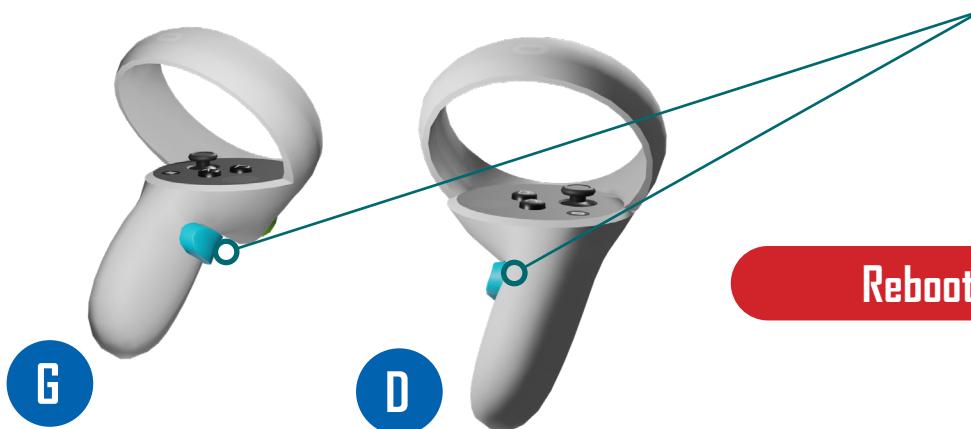
# Assistance for the partner

Your colleague will have **special equipment on hand**. Carefully explain how to use the control levers.



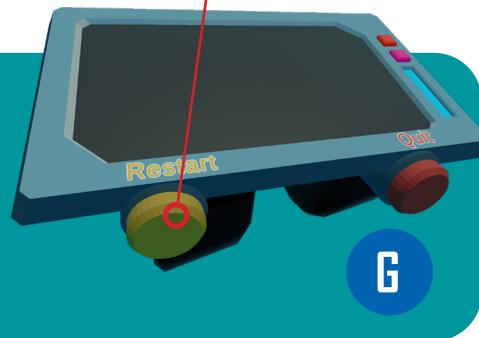
**Teleport :**  
press and release

**Pick up/put down an item :**  
press and release



**Reboot the level**

\* Your colleague will also receive the information on the screen on their arm. Remind them to look at it.



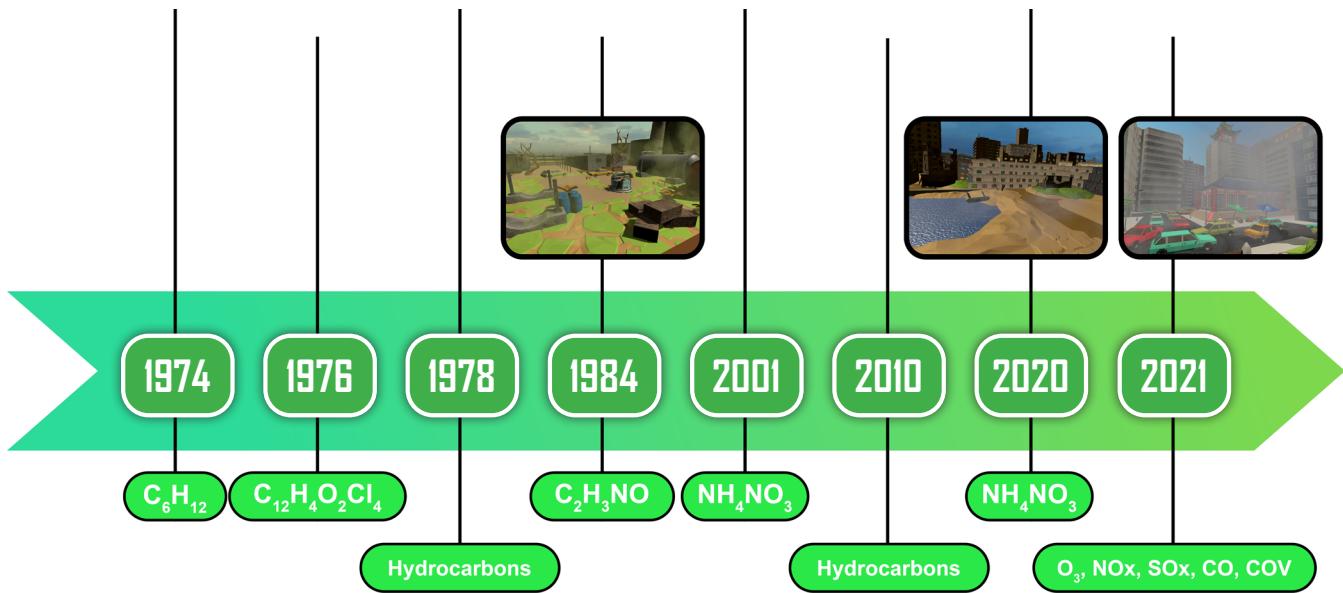
# Timeline



To access the Temporal, Spatial and Digital Projection machine, **help your colleague place the word magnets on the chart.**

## Disasters to place

- **Bhopal disaster (India)**
- **Explosions in the Port of Beirut (Lebanon)**
- **Pollution cloud in Beijing during COP26 (China)**



\*Use your mobile device to find the answers faster

# Communications

As a staff member of ION Inc., you have to communicate with your colleague to solve the riddles linked to the molecules in play in certain ecological disasters. The clues on the following pages will be a big help. Get ready for your big journey!

## First temporal jump:

Pollution cloud in Beijing during COP26

Thick fog enveloped the city of Beijing during **COP26 (United Nations conference on climate change, held in Glasgow in 2021)**. These clouds of pollution contained fine particles, as well as carbon, sulphur dioxide, nitrogen oxides and ozone.

To turn on the Temporal, Spatial and Digital Projection machine, **your colleague has to choose the correct WHMIS and NFPA pictograms**.

The following pages show the **correspondence between these pictograms and the characteristics of the molecules (number of effective electron pairs around the central atom, molecular geometry, hybridization, etc.)**.

After examining the **Lewis structures**, communicate with your peer to figure out **which pictogram should be selected**.

# First temporal jump

Ozone

Choose the right combination for ozone and tell your colleague which pictogram(s) to place

Clues: Molecular geometry

# effective electron pairs around the central atom	Molecular geometry	WHMIS pictogram
2	Angular	
3	Linear	
3	Angular	
3	Trigonal planar	
4	Angular	
4	Trigonal planar	

Note: An incorrect response will lower the energy level of the Temporal, Spatial and Digital Projection machine.



Ozone

Do the same for the next riddles.

Clues: Hybridization and bond angle

Hybridization

Bond angle

NFPA

WHMIS pictogram

sp

-

4



sp<sup>2</sup>

$\text{X} < 120$

0



sp<sup>3</sup>

$\text{X} < 120$

3



sp<sup>2</sup>

$\text{X} < 109$

2



sp<sup>3</sup>

$\text{X} > 109$

1





# Carbon monoxide

## Clues: Hybridization and bond angle

Hybridization	Bond angle	NFPA	WHMIS pictogram
sp	-	4	
sp <sup>2</sup>	<del>4</del> < 120	0	
sp <sup>3</sup>	<del>4</del> < 120	3	
sp <sup>2</sup>	<del>4</del> < 109	2	
sp <sup>3</sup>	<del>4</del> > 109	1	



# Carbon monoxide

## Clues: Chemical bonds

$\pi$

### Chemical bonds

Number of  $\pi$  bonds

1



4

Number of  $\pi$  bonds

2



0

Number of  $\pi$  bonds

3



3

$\sigma$

Number of  $\sigma$  bonds

1



3

Number of  $\sigma$  bonds

2



3

Number of  $\sigma$  bonds

3



2

# First temporal jump

Sulfur dioxide

Clues: Molecular geometry

# effective electron pairs    Molecular geometry    WHMIS pictogram  
around the central atom

2

Angular



3

Linear



3

Angular



3

Trigonal planar



4

Angular



4

Trigonal planar



**Note:** An incorrect response will lower the energy level of the Temporal, Spatial and Digital Projection machine.



# Sulfur dioxide

## Clues: Hybridization and bond angle

Hybridization	Bond angle	NFPA	WHMIS pictogram
sp	-	4	
sp <sup>2</sup>	<del>4</del> < 120	0	
sp <sup>3</sup>	<del>4</del> < 120	3	
sp <sup>2</sup>	<del>4</del> < 109	2	
sp <sup>3</sup>	<del>4</del> > 109	1	



# Sulfur dioxide

## Clues: Chemical bonds

Chemical bonds	Number of $\pi$ bonds	WHMIS pictogram	NFPA
$\pi$	1		4
	2		0
	3		3
$\sigma$	1		3
	2		3
	3		2

# Communications

## **Second temporal jump : Explosions in the Port of Beirut**

**On August 4, 2020, Beirut was shaken by two violent explosions that led to the collapse of many buildings.** These explosions appear to have been caused by the presence of ammonium nitrate in a building at the port.

To solve the riddles and launch the next temporal jump, **follow the on-screen instructions, which your colleague will communicate to you.**

## **Third temporal jump : Bhopal disaster**

**The Bhopal disaster in India occurred in December 1984.** It was caused by the explosion of a methyl isocyanate storage tank in a pesticide plant.

**Communicate with your peer to solve the final riddles of your time travel journey.**



# References

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