

# Edgeworth User Study Instructions

Date: Jul 23, 2024

Participant #: 4

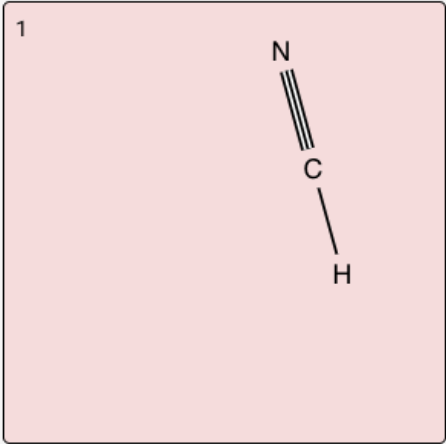
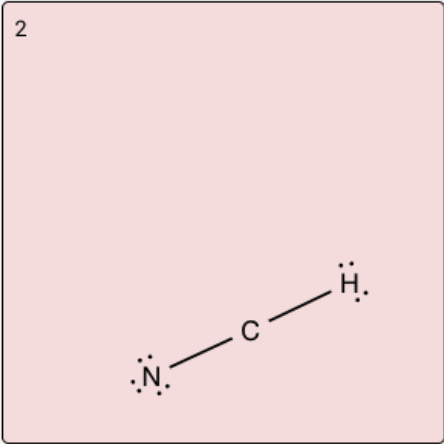
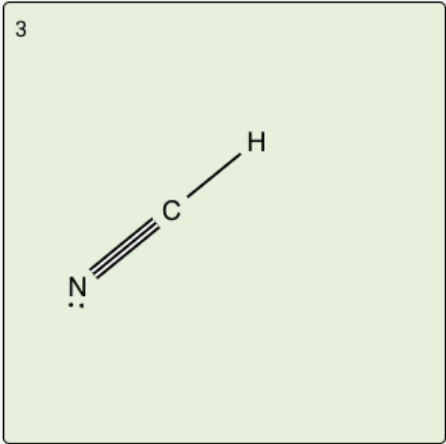
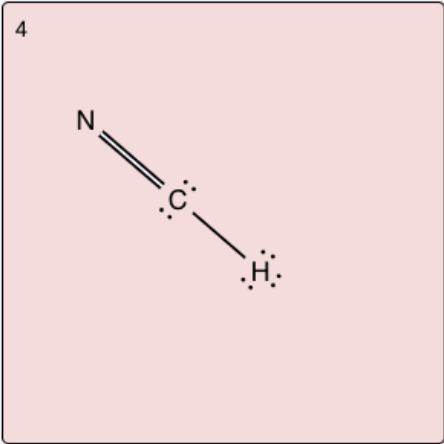
Group: Penrose/Edgeworth → Google Drawings ▾

Domain: Chemistry ▾

## Introduction

Thank you for taking the time to participate in our study! This study will involve creating diagrammatic multiple-choice problems using Google Drawings and Edgeworth, our research prototype tool. This session will last 90-minutes at most. The figure below is a diagrammatic multiple-choice problem, where the prompt is textual and the answer choices are diagrams.

Choose the correct Lewis structure for HCN.

1		2	
3		4	

Your task is to create diagrammatic multiple-choice problems. Problems consist of one correct answer and three incorrect answers.

# Penrose/Edgeworth Tutorial

[Penrose](#) is a diagram making tool in which you write plain-text notation and the system automatically lays out diagrams for you. This section guides you through the process of making diagrammatic answers to a simple geometry problem: “Which of the following diagrams shows the correct Lewis structure of O<sub>2</sub>?”

1. Navigate to the Penrose online editor, which will show an example geometry program:  
<https://penrose.cs.cmu.edu/try/?examples=molecules/sulfuric-acid>
2. Replace the program in the “substance” tab with the following program, which constructs the two atoms in an oxygen molecule (O<sub>2</sub>). Hit “compile” to see the diagram.


Unset

```
Oxygen o1, o2
```

3. Add a **Bond** object and **FourDots** predicates the program to get the full lewis structure of an oxygen molecule:

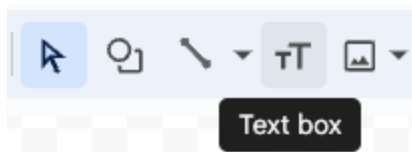
Unset

```
Oxygen o1, o2
Bond b := DoubleBond(o1, o2)
FourDots(o1)
FourDots(o2)
```

4. Click “resample” a few times to see alternate layouts
5. Navigate to the Edgeworth interface:  
<https://penrose.github.io/penrose/edgeworth/chemistry>
6. Copy and paste the Substance program from the Penrose UI into “Input Scenario”
7. Click “Generate Variations”
8. Wait until layout optimization finishes
9. click  on one of the diagrams to see alternate layouts.
10. Click checkboxes to collect diagrams. After each checkbox click, toggle to select whether the diagram is correct. The exact choices don’t matter here.
11. Click the “More Variations” icon to generate another batch of diagrams
12. Select a few more diagrams

# Google Drawings Tutorial

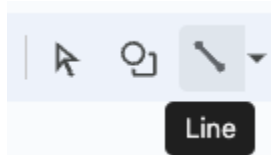
1. Open a new Google Drawings file: <https://docs.google.com/drawings/>
2. Add text labels using “Text box”



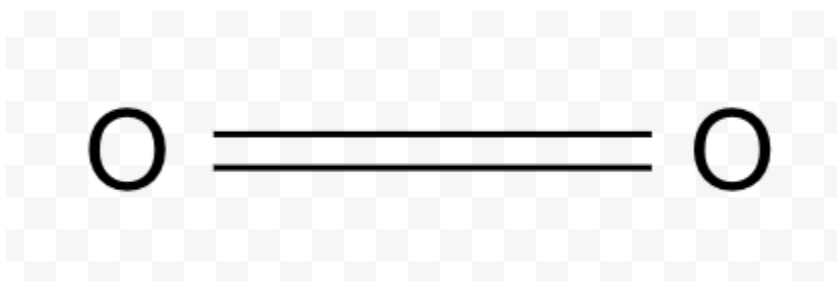
3. Create the oxygen molecules as text labels



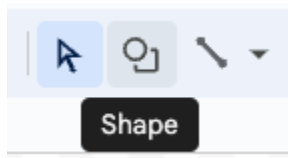
4. Select the "Line" tool



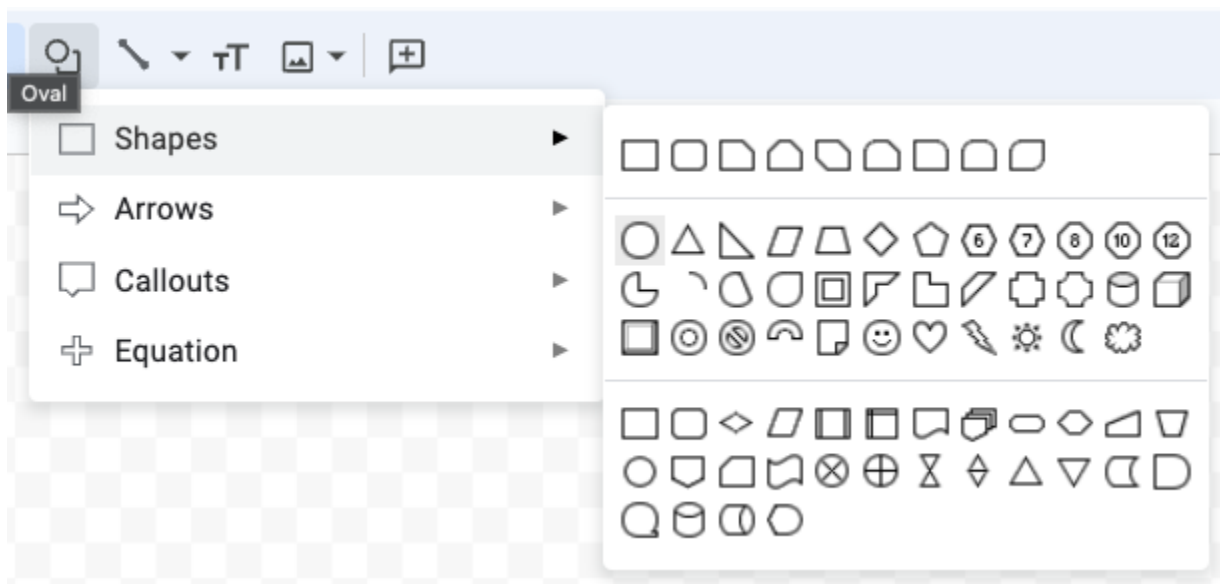
5. Draw lines between the molecules



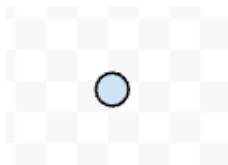
6. Select the shape tool



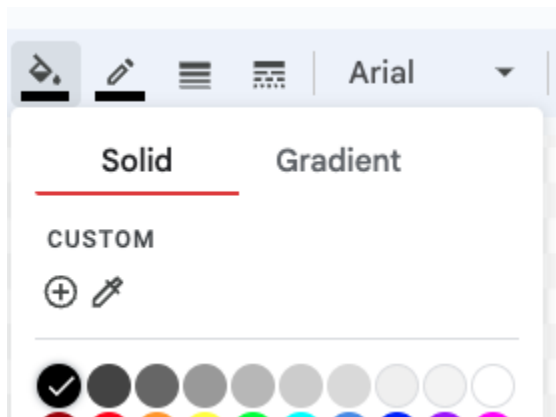
7. Pick the “Oval” shape



8. Hold down the Shift key and drag on the canvas to create a circle



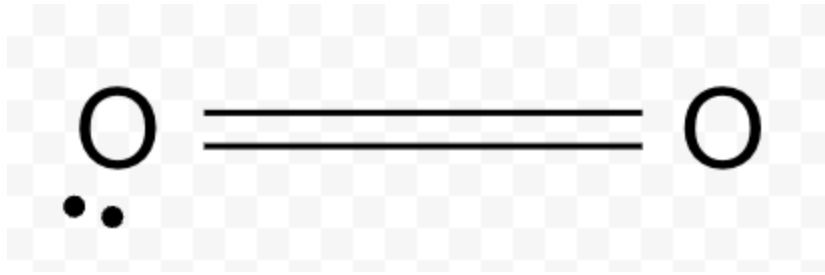
9. Change the fill color to black



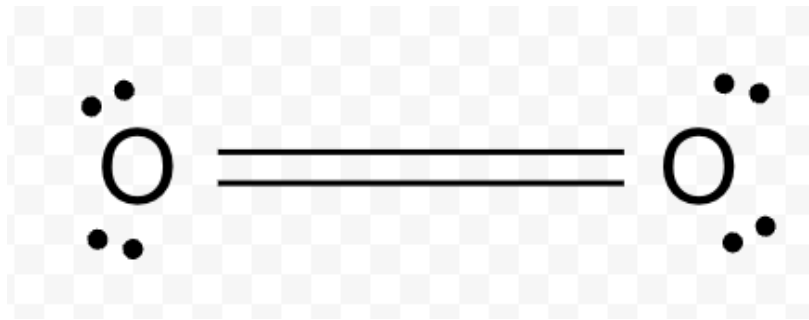
10. Copy and paste four more circles



11. Arrange them to form a lone pair around one of the oxygen molecules



12. Repeat the steps above to create 3 more pairs

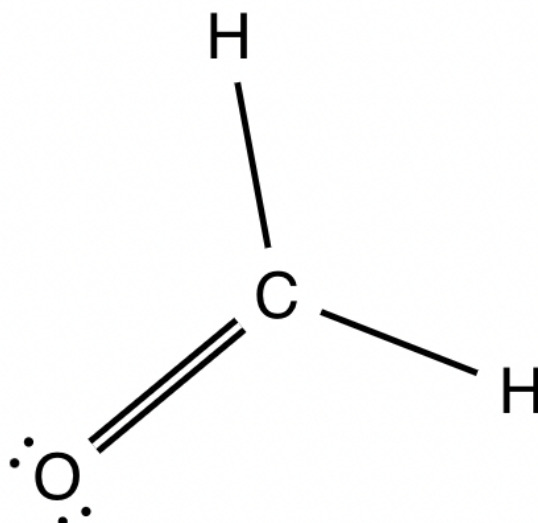


## Tasks

In this section, you will now create diagrammatic multiple-choice problems with both Google Drawings and Penrose/Edgeworth. You will be given two textual prompts and a sample correct diagram. You will make two problems from them by creating corresponding diagrammatic answers.

## Task 1: Penrose/Edgeworth

Prompt 1: Which of the following diagrams shows the correct Lewis structure for  $\text{CH}_2\text{O}$ ?



For this prompt, you will:

- Edit the example program provided below using Penrose to create 1 correct diagram in the first 10 minutes.
  - If you fail to create the diagram, we will provide you with a correct diagram.
- In the next 10 minutes, create up to 10 incorrect diagrams by copying the correct diagram from Penrose to Edgeworth and using Edgeworth to generate the incorrect diagrams. These incorrect diagrams should be distinct from each other and relevant to the prompt.
  - Edgeworth Link: <https://penrose.github.io/penrose/edgeworth/chemistry>
- Make sure all of your diagrams are legible and clear.

Example program

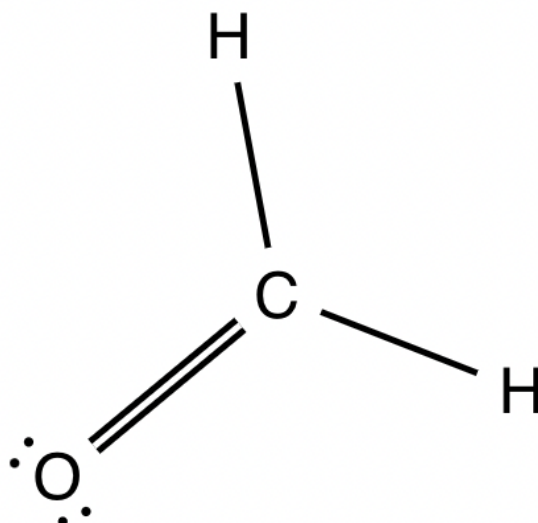
<https://penrose.cs.cmu.edu/try/?examples=molecules/sulfuric-acid>

Survey

[https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp\\_url&entry.276402372=4&entry.633592456=1&entry.1891034286=Edgeworth&entry.315819=Chemistry](https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp_url&entry.276402372=4&entry.633592456=1&entry.1891034286=Edgeworth&entry.315819=Chemistry)

## Task 2: Google Drawings

Prompt 1: Which of the following diagrams shows the correct Lewis structure for CH<sub>2</sub>O?



For this prompt, you will edit the example Google Drawings diagram provided below in Google Drawings to:

- Create 1 correct diagram in the first 10 minutes.
  - If you fail to create the diagram, we will provide you with a correct diagram.
- In the next 10 minutes, create up to 10 incorrect diagrams by editing the correct diagram. These incorrect diagrams should be distinct from each other and relevant to the prompt.
- Make sure all of your diagrams are legible and clear.

### Example drawing

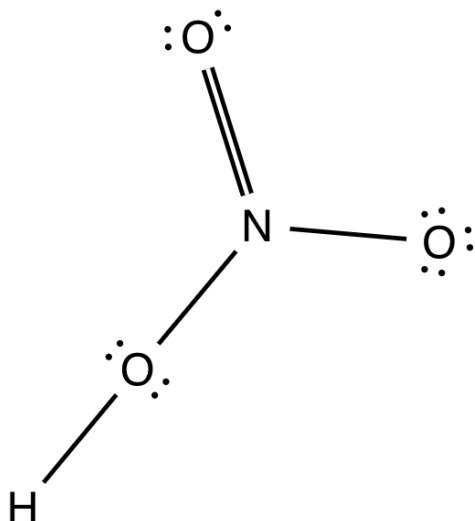
 Edgeworth chemistry task example: h2so4

### Survey

[https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp\\_url&entry.276402372=4&entry.633592456=1&entry.1891034286=Google+Drawings&entry.315819=Chemistry](https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp_url&entry.276402372=4&entry.633592456=1&entry.1891034286=Google+Drawings&entry.315819=Chemistry)

## Task 3: Penrose/Edgeworth

Prompt 2: Which of the following diagrams shows the correct Lewis structure for  $\text{HNO}_3$ ?



For this prompt, you will:

- Edit the example program provided below using Penrose to create 1 correct diagram in the first 10 minutes.
  - If you fail to create the diagram, we will provide you with a correct diagram.
- In the next 10 minutes, create up to 10 incorrect diagrams by copying the correct diagram from Penrose to Edgeworth and using Edgeworth to generate the incorrect diagrams. These incorrect diagrams should be distinct from each other and relevant to the prompt.
  - Edgeworth Link: <https://penrose.github.io/penrose/edgeworth/chemistry>
- Make sure all of your diagrams are legible and clear.

Example program

<https://penrose.cs.cmu.edu/try/?examples=molecules/sulfuric-acid>

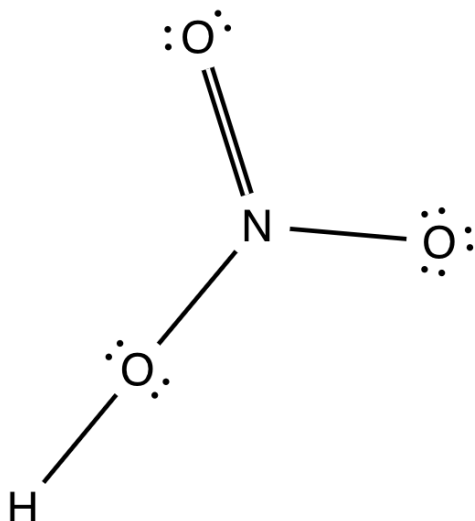
Survey

[https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp\\_url&entry.276402372=4&entry.633592456=2&entry.1891034286=Edgeworth&entry.315819=Chemistry](https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp_url&entry.276402372=4&entry.633592456=2&entry.1891034286=Edgeworth&entry.315819=Chemistry)



## Task 4: Google Drawings

Prompt 2: Which of the following diagrams shows the correct Lewis structure for  $\text{HNO}_3$ ?



For this prompt, you will edit the example Google Drawings diagram provided below in Google Drawings to:

- Create 1 correct diagram in the first 10 minutes.
  - If you fail to create the diagram, we will provide you with a correct diagram.
- In the next 10 minutes, create up to 10 incorrect diagrams by editing the correct diagram. These incorrect diagrams should be distinct from each other and relevant to the prompt.
- Make sure all of your diagrams are legible and clear.

### Example drawing

 Edgeworth chemistry task example: h2so4

### Survey

[https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp\\_url&entry.276402372=4&entry.633592456=2&entry.1891034286=Google+Drawings&entry.315819=Chemistry](https://docs.google.com/forms/d/e/1FAIpQLScTSfb75ZkdFBP6dGnEgSVZRMkGW1pF-nsSLK6aLbDnR0at4g/viewform?usp=pp_url&entry.276402372=4&entry.633592456=2&entry.1891034286=Google+Drawings&entry.315819=Chemistry)