PhET Name	Build a Molecule
PhET Simulation Link	https://phet.colorado.edu/en/simulations/build-a-molecule
Topic Covered using the Simulation	Carbon and its Compounds
Class	10
Learning Focus	Formation of molecules Covalent bonding Carbon's valency Carbon chains Single, double and triple bonds Functional groups Molecular formula and structure Different arrangements of atoms

Single Frame & Multiple Frame :

Task 1: Explore the atoms

Look at the atoms available in the simulation.

On the **right-hand side**, identify the available atoms, such as water, oxygen,hydrogen, carbon dioxide, nitrogen.
Create the molecules according to the task assigned to you.
Observe how the atoms are connected in each molecule.
Identify the type of bond formed between the atoms.
Determine whether the bond is a **single covalent bond**.

Identify the type of bond formed between the atoms. Is it a **single, double, or triple covalent bond**?

Playground Frame

Task 2: Build methane — CH_4

Select one carbon atom.
Add 4 hydrogen atoms.
Arrange them so that all four bonds of carbon are satisfied.
Identify the formula of the molecule.
Record the molecule as CH_4.

Once the compound is formed, an icon appears showing the molecular name and 3D structure.

Click on the 3D to see the bonding structure.

Task 3: Build ethane — C_2H_6

Start with 2 carbon atoms.
Join the two carbon atoms.
Observe the bond between the carbon atoms.
Add hydrogen atoms to satisfy the remaining valencies.
Count the total carbon and hydrogen atoms.
Write the formula: C_2H_6.

Task 4: Explore a carbon chain

Build a molecule with 3 carbon atoms.
Complete the remaining bonds with hydrogen.
Record the formula.
Repeat with 4 carbon atoms.
Compare the molecules.

Carbon atoms	Formula
1	CH_4
2	C_2H_6
3	C_3H_8
4	C_4H_{10}

Task 5 : Explore single, double and triple bonds

Try to construct a molecule containing two carbon atoms.
First explore a structure with a single bond between carbon atoms.
Try a structure with a double bond.
Try a structure with a triple bond.
Compare the number of hydrogen atoms that can be attached in each case.

Task 6 : Explore functional groups

Build a simple chain of methane with carbon and hydrogen
Try to construct a molecule containing an –OH group.
Identify the functional group.
Build another molecule containing oxygen in a different arrangement.
Compare the structures.

Focus on:

Alcohol: –OH
Aldehyde: –CHO
Ketone: >C=O

Carboxylic acid: –COOH

Task 7: Construct ethanol, C_2H_5OH. & ethanoic acid

Select 2 carbon atoms.
Join them.
Add hydrogen atoms to satisfy the carbon valencies.
Add oxygen.
Add hydrogen to oxygen.
Check the final structure.
Identify the –OH functional group.

Start with two carbon atoms.
Connect the carbon atoms.
Add oxygen atoms.
Arrange the atoms to form the –COOH group.
Complete the remaining valencies with hydrogen.
Observe the difference between ethanol and ethanoic acid.

Compare:

Molecule	Formula	Functional group
Ethanol	C_2H_5OH	–OH
Ethanoic acid	CH_3COOH	–COOH

Task to be completed and shared :

1. Create a single, covalent and triple bond structure
2. Which part of the structure determines the prefix, and which part determines the suffix?
3. Construct two molecules with the **same molecular formula but different arrangements of atoms**.
4. Construct two molecules with the **same molecular formula but different arrangements of atoms**.

Challenge : How many different molecules could you create ? Share the screen shots.

Inquiry-Based Classroom Questions

1. **Atoms and Molecules**
   Can atoms combine in any arrangement to form a molecule? Use the simulation to investigate.
   What happens when you try to combine atoms in different arrangements?
   What does this tell you about molecule formation?
2. **Carbon's Valency**

How many hydrogen atoms can one carbon atom bond with? How can you demonstrate this using the simulation?

What happens when you try to attach more hydrogen atoms to carbon? Why do you think this happens?

3. **Carbon–Carbon Bonding**

   Can two carbon atoms bond with each other? Construct a molecule to find out.

   What changes when you add another carbon atom to a carbon-containing molecule?

4. **Carbon Chains**

   Build molecules containing 1, 2, 3 and 4 carbon atoms. What pattern do you observe in the number of hydrogen atoms?

   If a molecule contains five carbon atoms, can you predict its molecular formula before building it? Test your prediction using the simulation.

5. **Single, Double and Triple Bonds**

   What happens to the number of hydrogen atoms when the bond between two carbon atoms changes from single to double to triple?

   Can you construct three molecules that differ only in the type of carbon–carbon bond? What do you observe?

   Why can't the same number of hydrogen atoms be attached in all three structures?

6. **Functional Groups**

   Construct molecules containing –OH, –CHO, >C=O and –COOH. How can you distinguish these functional groups from their structures?

   If oxygen is added to a carbon-containing molecule, does it automatically become an alcohol? Use the simulation to test your prediction.

   What changes when the arrangement of oxygen and hydrogen atoms changes?

7. **Functional Group and Compound Identity**

   Construct two molecules with similar carbon skeletons but different functional groups. Are they the same compound? Explain using evidence from the simulation.

   What happens to the identity of a compound when its functional group changes?

8. **Molecular Formula vs Structure**

   Can two molecules have the **same molecular formula but different arrangements of atoms**? Construct examples using the simulation.

   If two molecules have the same molecular formula, how would you determine whether they have the same structure?

   What does the simulation show us about the limitations of using only a molecular formula to describe a molecule?

9. **Challenge Question**

How many different molecular structures can you construct using the same types and numbers of atoms? What determines whether the structures are different?