**Reaxys**
Structure & Reaction Searching

**Accessing the database:**
A. Go to http://chemistry.library.nd.edu
B. Click the **Reaxys** link
C. If needed, Click on the **New Reaxys** link

Click on the **Query builder** link

Click on the **Structure** link at the top of the page.
Click **Create Structure / Reaction Drawing**

**Helpful Drawing Hints:**
Fusing rings: Put your cursor over the bond that you want both rings to have in common and click.

Joining two atoms: Put your cursor over the atom from which you want to draw a bond and click.

Below are some of the tools you will frequently use to draw your structures:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="tool1" /></td>
<td>Undo, Redo, Cut</td>
</tr>
<tr>
<td><img src="image2" alt="tool2" /></td>
<td>Select</td>
</tr>
<tr>
<td><img src="image3" alt="tool3" /></td>
<td>Erase</td>
</tr>
<tr>
<td><img src="image4" alt="tool4" /></td>
<td>Bonds</td>
</tr>
<tr>
<td><img src="image5" alt="tool5" /></td>
<td>Chain</td>
</tr>
<tr>
<td><img src="image6" alt="tool6" /></td>
<td>Uncommon Elements, Common Elements</td>
</tr>
<tr>
<td><img src="image7" alt="tool7" /></td>
<td>Ring templates</td>
</tr>
</tbody>
</table>
Substance Search: Fusing Rings, Changing Bonds, Changing Atoms

Draw the structure.

Select the **As Drawn** option on the right side of the screen.

Click the **Transfer Query** button.

Click **Substances** button at the top of the page

**A.** Did you get a result in Reaxys? Yes  or  No

(Hint: Look at the upper right corner of the screen, under the Sign in link. Does it say Reaxys or something else.)

Why did it leave Reaxys to give you a result?
The system hates giving you a zero for an answer, so it does a series of searches in order to find an answer for you.

**B.** To expand your search: Click on the **Query Builder** link. Click on **As Drawn** under the structure. Select **As Substructure – On all atoms**. Click **Apply**. Click the **Substructure** button.

How many substances did you get?  
(You should get 100-150 substances.)

What you drew is in Blue.

These options surrounding the structure should look familiar to you.

- **Commercial availability** – where can I buy this compound?
- **Zoom**: Enlarge the structure and rotate in 3D
- **Create synthesis plan** – to create a synthesis plan for the compound
- **Options** – for copying the structure or to do a similarity search

Click on the **Query builder** link at the top of the page.

Click on the **Delete all**.
Substance Search: Allowing Ring Fusion, Substitution & Property searching

2. Click on the Structure link. Click on the Create Structure / Reaction Drawing link.

![Chemical Structure](image)

A. Substance Search As Drawn. How many substances did you get? __________
   (You should get fewer than 10 substances.)

B. Modify the search parameters – As Substructure on heteroatoms.
   How many substances did you get? __________
   (You should get fewer than 20 and more than the previous question.)

C. Modify the search parameters – As Substructure on all atoms.
   How many substances did you get? __________
   (You should get 28,000-29,000 substances.)

D. Click the Query builder link. Click Find search fields and forms
   How many substances with the above substructure have a melting point between 95 and 100 in ethanol?
   How many substances did you get? __________
   (You should get 40-50 substances?)

Query builder then Delete all
Substance Search: Limiting Substitution

3. Draw the structure.

A. Search Substructure on all atoms

How many substances did you get? ______
(You should get 1,100-1,200 substances.)

Look at hits 1-15. Notice the shorter chain ends in something other than CH₃ about half of the time.

B. You really want the shorter chain that ends in a carbon to always be a methyl. There are two ways to do this. Here is the first way.

Put your cursor over the carbon atom. A green circle will appear. Right click on the atom. Select Atom Properties. The Atom Properties pop-up window will appear. Select the Advanced tab. At the Substitution(s) drop-down menu, select as drawn. Click OK. An (s*) will appear on your structure.

Search. Substructure on all atoms. How many substances did you get? ______
(You should get 350-450 substances.)

C. Look at the first 15 answers.
Is there any substitution on the carbon on the shorter chain? Yes or No
Substance Search: Generic Groups and R-Groups

4. Draw the structure. Use \( \text{for the multi-bond chain.} \)

Creating a Generic Group

1. Go to the top of the list of common atoms.
2. Click the triangle. You will see the available generics.

Creating an R group

1. Draw your atom fragments to the right of your structure – (ignore the hydrogens unless the chain is attached to the hydrogen and don’t draw the chain ending in a squiggle).

2. Click the Smart R-group icon
3. Click on the R1 location of the parent structure
4. Still using the Smart R-group icon, select all the fragments

5. Click on the R-group Attachment icon
6. Click the atom in each fragment that will attach to the parent structure

A. Substance Search As Drawn. How many substances did you get? ________________

(You should get fewer than 10.)
Substance Search: Creating R-groups & Limiting Substitution

5. Draw the compound

Creating an R group

1. Draw your fragments to the right of your structure – (ignore the chain ending in a squiggle)

2. Click the Smart R-group icon
3. Click on the R1 location of the parent structure
4. Still using the Smart R-group icon, select all the fragments

5. Click on the R-group Attachment icon
6. Click the atom in each fragment that will attach to the parent structure

A. Substance Search - Substructure on all atoms.
   How many substances did you get?
   (You should get 5-15 substances.)

   25+ You didn’t limit substitution. See 3B for instructions.
Substance Search: Generic Group – multiple attachment points

6. Draw the structure and draw the four fragments for R1.

Before you search for substances you need to tell the system which atom on the fragment attaches to the main structure. Your finished product will look like this.

A. Substance Search As Drawn. How many substances did you get?
   (You should get 5-15 substances.)

You have just done two tasks that are impossible in SciFinder
1. drawing non-standard fragments in an R-Group
2. attaching the R-Group in the middle of a chain.
**Reaction Search: Filters**

**Templates & Reactions**

7. First, draw the structures. To attach two rings at a common atom – select a ring, click anywhere in the structure editor, hold, and drag toward the shared atom.

![Diagram of a reaction]

Select the Reaction Arrow button

Draw from the reactant to the product.

Click the Transfer to Query button, then the Reactions button

**A. Reaction Search As Drawn.** You should get one reaction. What is the yield of the one reaction you got? _____

(You should get 85% - 95%.)

What is the reaction ID for this reaction? ________________

(The number will have 7 digits and end with 250.)

**B. Reaction Search Substructure on all atoms.**

How many reactions did you get? ________________

(You should get 4,000-5,000 reactions.)

**C. Now you want to know how many of those reactions have a yield greater than 80%?** Hint: Filter data on left side of results.

How many reactions did you get? ____________

(You should get 300-400 reactions)
Reaction Search: - Retrosynthesis

8. Your boss says the product in this reaction is needed but there is no money to purchase it. The lab has plenty of the reactant. Find a reaction path from the reactant to the product.

To find a functional group, select and type the functional group you want, click ok then click on the structure to attach the functional group.

A. Reaction Search As Drawn.

The system ran three searches and told you that it didn’t find a result:

As a result you will have to do a retrosynthesis.

B. Eliminate the reactant and search for the product.

How many reactions did you get? __________
(You should get 35-45 reactions)

1. Look at the list of reactions. Find a reactant that gets you close to the desired reactant. (hint: look for yields of 56%, 71%, and 70%)

2. Click the Synthesize link next to the Reaction ID.

3. This will take you to the Synthesis Planner

4. Click the Synthesize link under the reactant then select manually

   This turns the reactant into a product and does a search.

5. Look at the list of reactions. Find a reactant that gets you close to the desired reactant, (you may need to click the Load more button to see the next 10 reactions.)

6. Repeat steps 2-6 until you have selected your desired reactant

7. If you run into a brick wall then click the three vertical dots and select Remove preparation. Or you can trash the whole plan by clicking the Edit link in the upper left and then clicking the trash can.

C. How many steps are in your synthesis plan? ______
(You should have fewer than 5 steps)
**Reaction Search: Atom to Atom mapping and Marking bonds**

You are looking for a particular set of reactions. You want the bond with the double lines to be formed and you want the Sulfur in the reactant to be the Sulfur in the product.

9. Draw the structures.

Marking Bonds:
- Right click on the desired bond
- Bond Properties
- Reacting Center
- Make or Break

Atom to Atom mapping:
- Select the Reaction Arrow button
- Click on the atom in the reactant
- Drag to the atom in the product

**A. Substructure on all atoms Search.** How many reactions did you get? ____________
(You should get 15-35 reactions)
**Substance Search: Using Generic Groups**

You are looking to do one structure search that will have the following five structures in the search results.

![Chemical structures]

10a. Draw the structure that is common to all the structures above.

10b. Draw the compound you drew in 10a in Reaxys. Use the Reaxys Generics on the right side of the editor to search for all of the structures. Select the Heterocyclic generic.

(Hint: CHC can’t be in a ring because it can have only one attachment point.)

How many results did you get? ______
(You should get between 25-50 substances not reactions.)

Did you get the five structures drawn above? Yes or No
More Practice Problems:

11. Draw the structure.

\[
\begin{align*}
\text{R1} &= \text{any element} \\
\text{R2} &= \text{any element except Hydrogen}
\end{align*}
\]

No substitution allowed on the ring and the ring is isolated

A. How many structures do you find?

B. How many reactions have this structure as a product?

12. Find a pathway for the following reaction. How many one-step reactions are there?

\[
\begin{align*}
\text{OAc} & \quad \text{N} \\
\text{O} & \quad \text{R}_1 \\
\text{OAc} & \quad \text{R}_2
\end{align*}
\]