The irYdium Project

http://ir.chem.cmu.edu/

A User's Guide
for the
Virtual Laboratory

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- 10M HNO₃
- 1M HCl
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- 3M HClO₄
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Strong-bases
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H₂O

10 Molar Hydrochloric Acid **Solution Description**

Stockroom Explorer

Workbench 1

Retrieve

Click to retrieve a solution from the stockroom.

Obtain Glassware

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Tab Workbench 1

Solution Info

1M NaOH **Source**

250mL **Recipient**

Buffer Solution

250mL **Empty Flask**

250mL Erlenmeyer Flask

Transfer Field

Transfer amount (mL):

Solution Info...

Name: Buffer Solution
Volume: 109.0 mL

● Aqueous ○ Solid ○ Gas

Concentration Graph

0	
-5	
-10	

Concentration Viewer

Species	Molarity
H⁺	6.977e-5
OH⁻	1.963e-10
Cl⁻	7.339e-1
CH₃COO⁻	4.594e-2
Na⁺	7.798e-1

29.09 **Thermometer**

pH Meter

4.15

pH Meter

Pour from 1M NaOH to Buffer Solution

Transfer Bar (Precise)

Accessing the Virtual Lab

1. Launch a web browser application.

2. Load the IrYdium website:
        http://ir.chem.cmu.edu/irProject/applets/virtualLab/

    You may receive a new URL from your professor.

3. In the list located on the left side of the window, click the "applet" link.

    If the applet does not run initially, you may need to download additional components for your browser. Refer to the online instructions for platform-specific procedures.

Run the **applet**.

Loading Homework

Note: You may want to begin with the Demonstration problem (in the Local Repository) and the accompanying handout for a brief overview of features.

1. In the File menu, select the *Load Homework...* option.

    A *Load Homework* dialogue box will appear.

2. Double click to select your class from the available repositories in the left panel.

    After connecting to the repository, a list of available problems will be displayed in the right panel.
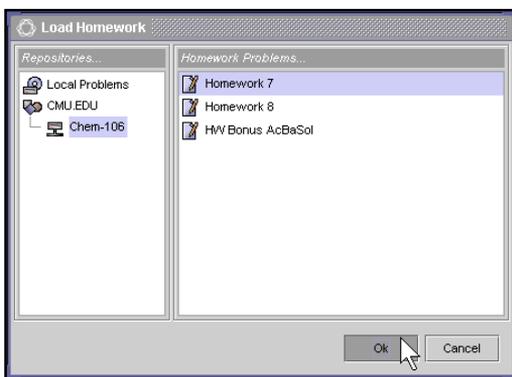

3. Select your homework problem and click *Ok*.

    The dialogue box will disappear and you will see a new cabinet in the *Stockroom Explorer* window on the left of the workbench. A problem description and all the relevant solutions for that problem will appear in the new cabinet.

Obtaining Glassware

1. In the action bar on the left side of the workbench, click the *Obtain Glassware* button.

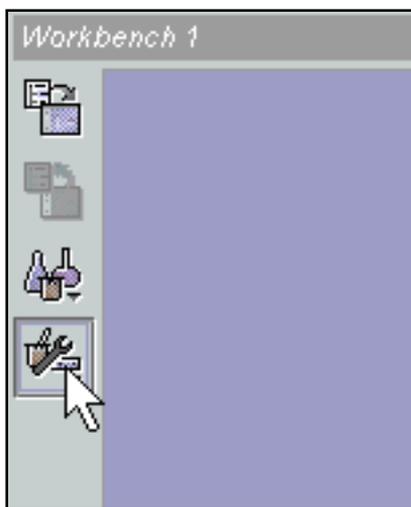   A menu of glassware options will be displayed.
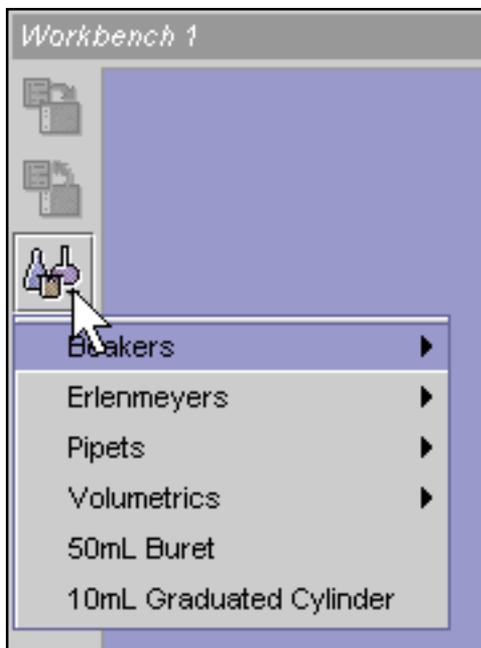
2. Drag the pointer down to the type of glassware you want and single click.

    The menu will disappear and the new glassware will appear on the workbench.

Obtaining a Bunsen Burner

1. On the action bar located on the left side of the workbench, click the *Obtain Tools* button.

   A menu of tool options will be displayed.

2. Select *Bunsen Burner* from the menu.

   A Bunsen burner will appear on your workbench.

Obtaining a Solution

1. In the *Stockroom Explorer* window, double click on the *IrYdium Solutions* cabinet to open it.

    A list of cabinets containing solutions will be displayed. Double click on the cabinet from which you want to retrieve a solution.
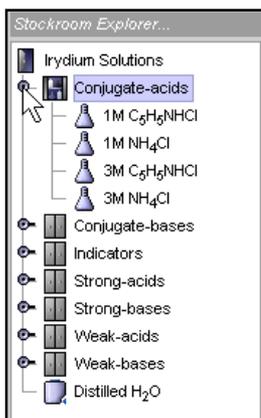
2. Double click on the solution you want to add to your workbench.

    An Erlenmeyer flask containing 100 mL will appear on your workbench, labeled with the name of the solution.
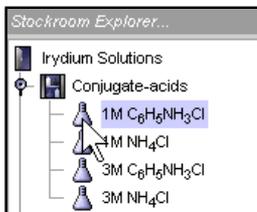
Selecting a Transfer Mode

Note: You should use realistic transfer mode to simulate the precision possible in an actual lab, and precise mode to check calculations.

1. In the *Tools* menu, drag the pointer down to *Transfer Bar.*

    A submenu will appear.

2. Select either *Precise Transfer* or *Realistic Transfer.*

    The submenu will disappear, and the transfer bar below the workbench will reflect the selected transfer mode.
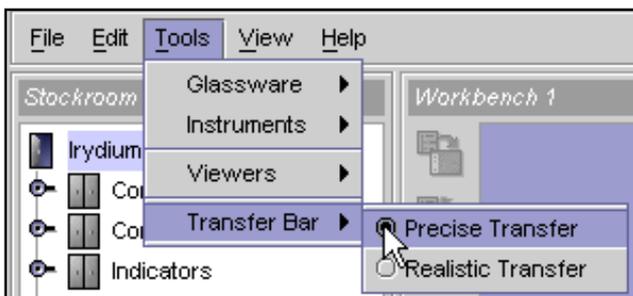
Precise transfer mode includes a *Transfer Field* where you can type a number with several significant figures.

Realistic transfer mode includes a button that pours only when the button is held down.

Note: Solutions pour faster from larger glassware. The *Realistic Transfer Bars* have marks to show how fast the transfer is occurring. Only 0.02mL is transferred when the purple bar stays within the "drop" range, marked on the left of the transfer bar when using a pipette or buret.

Pouring a Solution

Note: Use this method to transfer solutions using flasks, beakers, and burets.

Realistic Transfer:

1. Click the flask you want to pour from (your source solution).

   The name of the flask will become highlighted.

2. Drag the source solution on top of the flask you want to pour the solution into (your recipient flask) so that the pieces of glassware overlap.

   The source solution will become tilted above the recipient flask and the name of the recipient flask will become highlighted.
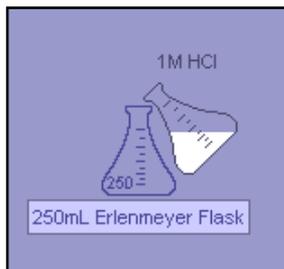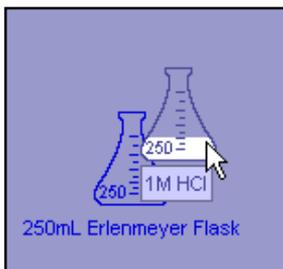
3. In the *Transfer Bar* below the workbench, click and hold the *Pour* button for as long as you wish to pour source solution into the recipient flask.

As you hold the *Pour* button, the amount of source solution actually poured is shown in the bar to the left of the *Pour* button. This counter resets itself each time you click on the *Pour* button. Refer to the *Solution Information* window to determine the total amount of solution in the recipient flask or click on the source solution and refer to the *Solution Information* window to determine the remaining amount of solution in the source flask. All changes in the concentration or pH are updated after releasing the *Pour* button.

| 0 | 50 | 100 | 150 | 200 | 250 | Pour | from H_2O | to 250mL Erlenm... |

Precise Transfer:

Follow Steps 1 and 2 for Realistic Transfer, but instead of holding down the *Pour* button, type in the volume and click on the *Pour* button once.

3. In the *Transfer Field* below the workbench, type the amount of source solution (in mL) you want to pour into the recipient flask and press Enter.

In the *Solution Information* window, the volume of the recipient flask will increase to reflect its new volume. If you single click on the source flask, you can see an equivalent decrease in the volume of the source solution. All changes in the concentration or pH are updated after you click the *Pour* button.
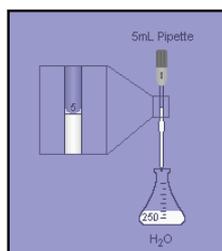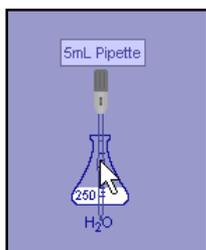
| Transfer amount (mL): 50 | Pour | from H_2O | to 250mL Erlenm... |
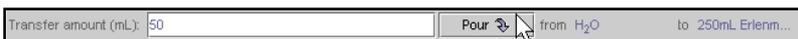
Transferring with a Pipette

Realistic Transfer:

1. Click and drag the flask you want to draw solution from (your source solution) on top of the pipette so the pieces of glassware overlap.

    The detailed view of the pipette will appear.

2. In the *Transfer Bar field* located beneath the workbench, click the *Withdraw* button for as long as you wish to withdraw solution from the source flask into the pipette.

    In the *Solution Information* window, the volume of the pipette will increase to reflect its new volume. If you single click on the source flask, you can see an equivalent decrease in the volume of the source solution. All changes in the concentration or pH are updated after you release the *Withdraw* button.

3. Single click and drag the pipette on top of the flask you want to add the solution to (the recipient flask).

    The detailed view will still be shown.
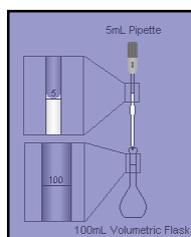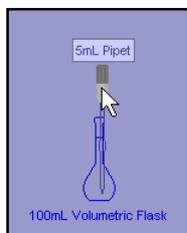
4.   In the *Transfer Field* below the workbench, click the *Pour* button for as long as you wish to release solution from the pipette into the recipient flask.

> In the *Solution Information* window, the volume of the pipette will decrease to reflect its new volume. If you single click on the recipient flask, you can see an equivalent increase in the volume of the recipient solution. All changes in the concentration and pH are updated after releasing the *Pour* button.

| 0.02 | | 5 | 🔁 Withdraw | Pour 🜄 ▷ | from 5mL Pipet | to 100mL Volume... |

Precise Transfer:

> Follow steps 1 and 3 for Realistic Transfer but instead of holding down the *Pour* button, follow the steps below:

2.   In the *Transfer Bar* below the workbench, type the amount of source solution (in mL) you want to withdraw with the pipette and press Enter.

| Transfer amount (mL): 3 | 🔁 Withdraw | Pour 🜄 | from 5mL Pipette | to H_2O |

4.   In the *Transfer Bar* below the workbench, type the total volume of the pipette to transfer its contents to the recipient flask and press Enter.

| Transfer amount (mL): 3 | 🔁 Withdraw | Pour 🜄 ▷ | from 5mL Pipette | to 100mL Volume... |

> Note: The detailed view of pipettes and burets automatically displayed during a transfer can be viewed any time by right clicking on the glassware and selecting *Detail View* from the pop-up menu.

Obtaining Solution Information

1. Click on the solution about which you want to obtain information.

   > The flask will become highlighted. The *Solution Info* panel to the right of the workbench will show the name, volume, concentration, temperature, and pH of the selected solution.

   > Your instructor may disable some of the features in the *Solution Info* panel for certain assignments.

2. In the *Solution Info* panel to the right of the workbench, click on the circle next to the state of species (aqueous, solid, gas) you wish to view.

   > The concentration viewer, located beneath the circles, will show the amounts of each element in the solution.

   > Note: At present, the Virtual Lab does not simulate gases.
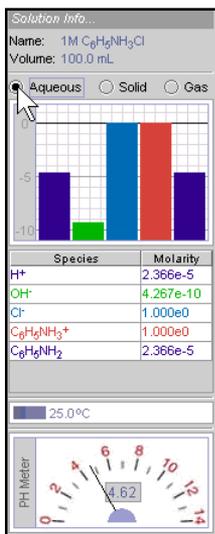
Removing Equipment

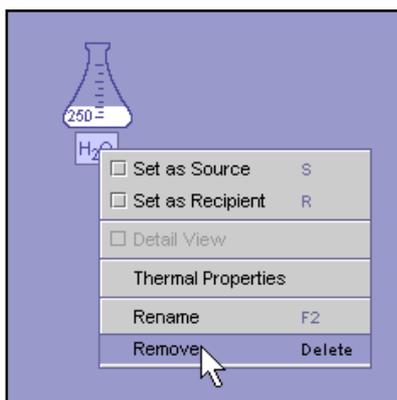1. Click on the equipment you want to remove.

   The name of the glassware or tool will become highlighted.

2. Press Delete or Backspace.

   The equipment will disappear.

   You can also right click on the object and select *Remove* from the pop-up menu.

   Note: At present, there is no *Undo* function. To clear a work area without
   removing equipment, see *Adding a Workbench* on page 16.

Heating with a Bunsen Burner

1. Click and drag the solution you want to heat on top of the Bunsen
    burner until the glassware and burner overlap.

    > The flask will become centered above the flame, and the temperature will
    > begin to rise on the thermometer, on the right side of the workbench.

2. To adjust the height of the flame, click on the *Up* or *Down* arrows.

    > Click and hold the *Up* arrow to increase the flame. Click and hold the
    > *Down* arrow to decrease the flame.

    > To remove heat, click and hold the *Down* arrow until the flame
    > disappears.
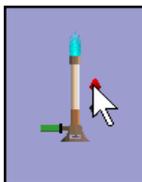
Adjusting Thermal Properties

Note: Adjust thermal properties for cooling or for a constant temperature.

1. Right click on the solution for which you want to adjust thermal properties.

   The name of the flask will become highlighted and a pop-up menu will be displayed.

   Mac Users: You can access the menu by pressing the Control key on your keyboard and single clicking the solution.

2. Drag the pointer down to the *Thermal Properties* option and single click.

   A *Thermal Properties* dialogue box will appear.

3. Type the new temperature for your solution and click *Ok*.

   The dialogue box will disappear and the thermometer to the right of the workbench will display the new temperature. The solution will either cool or heat depending on the temperature of its environment.

   Select the *Insulated from Surroundings* option in the *Thermal Properties* dialogue box for the solution to hold its new temperature.

   Note: The maximum temperature for aqueous solutions is 99º C. At present, the Virtual Lab does not simulate boiling.
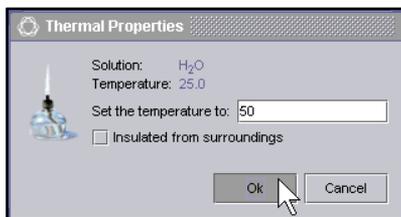
Adding a Workbench

1. In the *File* menu, select *New Workbench*.

    Another tab will appear on the bottom of your workbench area, but
    your current workbench will stay visible, initially. Single click on the
    new tab to make it the active workbench as shown on page 17.
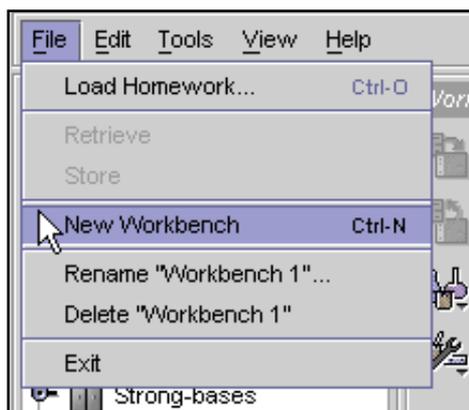
Selecting a Workbench

1. At the bottom of the workbench area, single click on a tab.

    That workbench or problem description will move in front of the other tabs and become the active workbench or display the problem description.
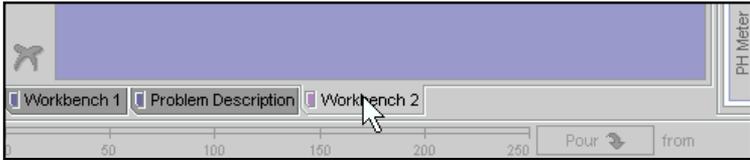
Relabeling Glassware

Note: You may want to relabel a flask to reflect its new contents each time you carry out a reaction.

1. Right click on the glassware you want to rename.

   The name of the glassware will become highlighted and a pop-up menu will be displayed.

   Mac Users: You can access the Relabel option by pressing the F2 key on your keyboard.

2. Drag the pointer down and click on the *Rename* option.

   A *Relabel Solution* dialogue box will appear.

3. Type the new label for the glassware and click *Ok*.

   The dialogue box will disappear and the glassware will bear the new label.

Relabeling a Tab

Note: You may want to relabel your tabs when you are working on several
different workbenches or have a problem description open.

1. Right click on the tab you want to rename.

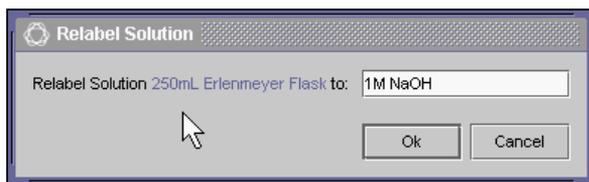   A pop-up menu will be displayed.

    Mac Users: You can access the Relabel option by pressing the F2 key on your keyboard.

2. Drag the pointer down and click on the *Rename* option.

    A *Relabel Tab* dialogue box will appear.

3. Type the new label for the tab and click *Ok*.

    The dialogue box will disappear and the tab will bear the new label.

Additional Help

1. Check the user guide online:

   http://ir.chem.cmu.edu/irProject/applets/virtuallab/UserGuide.pdf

2. Ask your instructor or TA for the step-by-step demonstration handout, or download it:

   http://ir.chem.cmu.edu/irProject/applets/virtuallab/walkthrough.pdf

3. Email any questions or comments to:

   feedback@ir.chem.cmu.edu

About the IrYdium Project

The IrYdium Project develops educational software that can be integrated smoothly into introductory chemistry courses nationwide and used easily over the web. Where paper-and-pencil homework typically emphasizes applying formulas—a process that can become routine and disconnected from the reality and fun of doing chemistry—interactive, simulation-based exercises offer new ways to promote learning and motivation. Interactive exercises can allow students to explore and reinforce fundamental concepts in contexts that are increasingly complex, realistic, and engaging. Our goal is to create flexible, interactive learning environments where college and high school students can approach chemistry more like practicing scientists.

The Virtual Lab is intended as a flexible teaching and learning tool. It can be used for in-class discussions, pre-lab activities, or novel types of homework problems. We view enhancing homework as a particularly important method of increasing student learning and motivation. Also, by introducing the Virtual Lab in homework assignments, we believe that instructors can try this new technology-enhancing approach with only minor adjustments in their course planning.

The IrYdium project began in 1997 and so far has involved two faculty members, two software engineers, an instructional designer, eleven undergraduate programmers, and three technical writing interns. We are continuing to add new features to the Virtual Lab and are now developing tools to help instructors author interesting assignments that build on the Virtual Lab and other simulations. We welcome your comments and suggestions for future versions of our software at feedback@ir.chem.cmu.edu.

IrYdium Development Team

Current Project Members:

David Yaron, Ph.D.

Rea Freeland, Ph.D.   Donovan Lange

D. Jeff Milton   Mike Karabinos

Emma Rehm   Giancarlo Dozzi

Past Project Members:

Rohith Ashok   Aaron Rockoff

Jason Chalecki   Jon Sung

Greg Hamlin   John Tunison

Joshua Horan   Stephen Ulrich

Vincent Leung   Jean Vettel

Jason McKesson   Agnes Wong

Email any questions/comments to:
feedback@ir.chem.cmu.edu