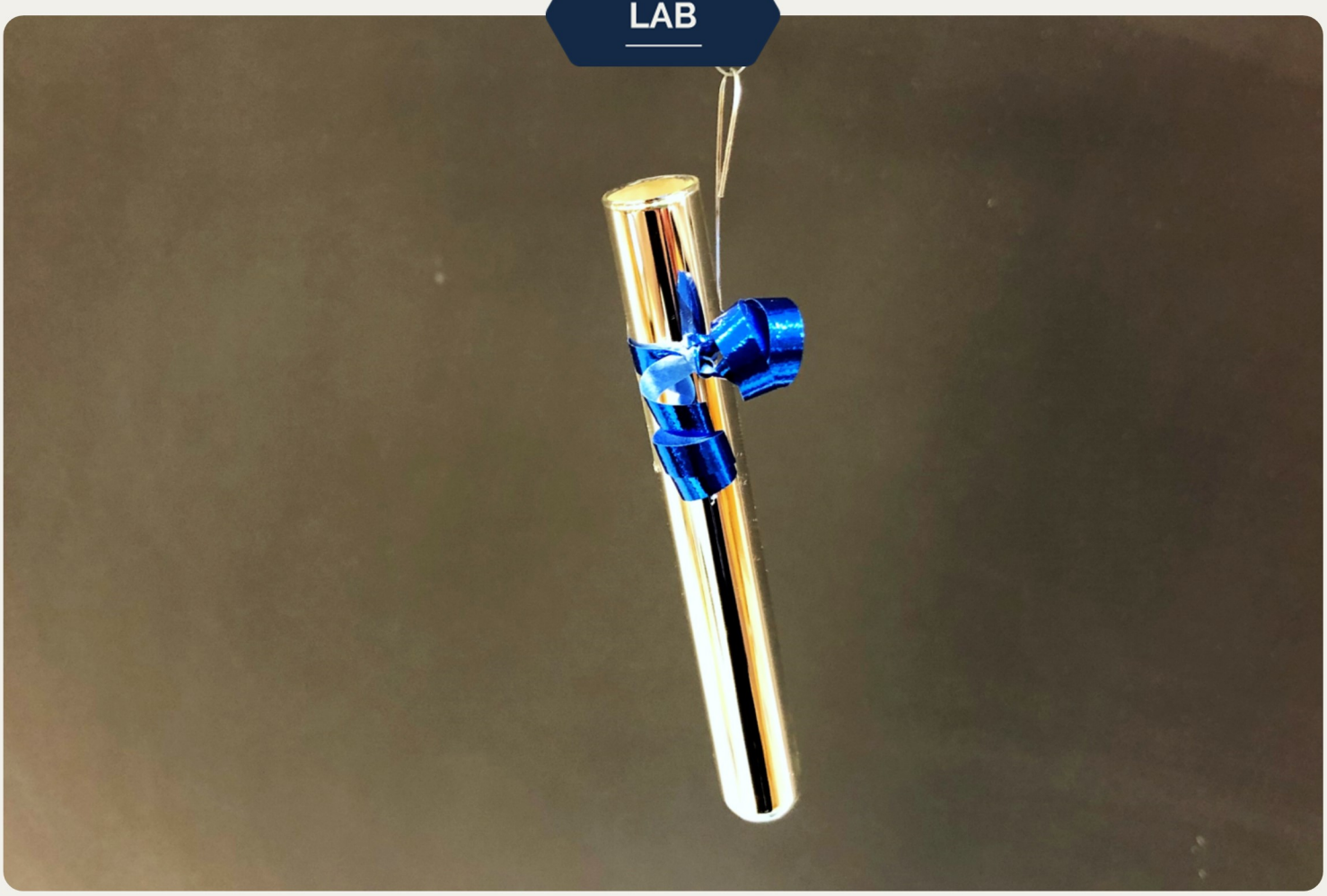
Redox Silver Glassware

LAB



ChemKate

Silver Glassware Lab

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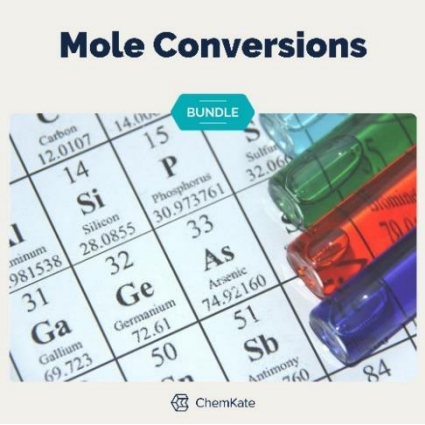

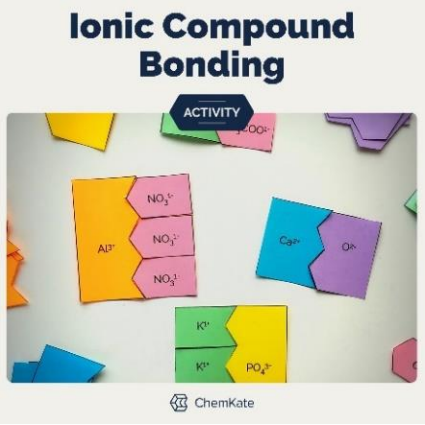

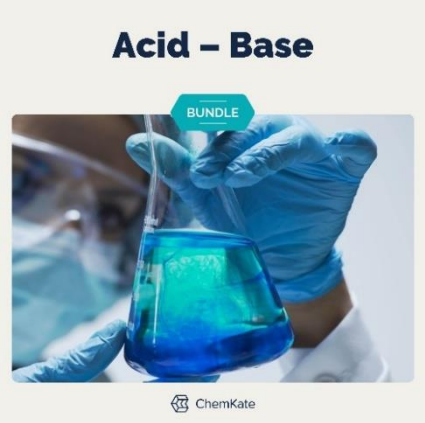

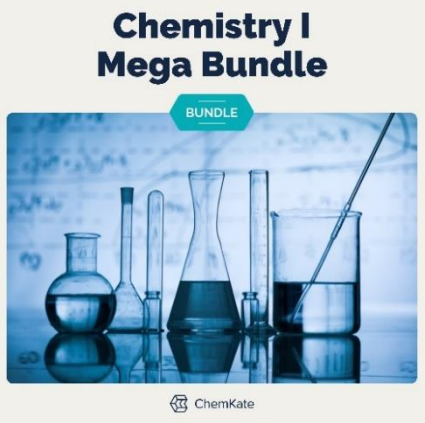

Teaching redox reactions in chemistry? Silver glassware in this *easy to follow, favorite* redox lab. Plate silver onto test tubes (or any glass) with lab procedures written in three versions: words-only, alongside photos, or alongside lab equipment images. Great for an end of semester chemistry celebration or any time of the year!

✦ This is available in my *costs-savings* Redox Bundle, the Chemistry I Lab Bundle, and *save time and assurance* with all the activities found in this Chemistry I MEGA Activity Bundle - Visit this to see a wide variety of many *no-prep, print and digital inquiry activities, graphic organizers and application* ✦

Materials List:
0.20 M $AgNO_3$ (3.4 g per 100 mL H_2O)
0.80 M NaOH (3.2 g per 100 mL H2O)
0.25 M dextrose (4.5 g per 100 mL H_2O)
Distilled Water
14.8M $NH_4OH(aq)$
Test tubes; one per
10-mL and 50-mL graduated cylinders
Droppers
100-mL or 150-mL beakers
Hooks and ribbons for hanging test tubes

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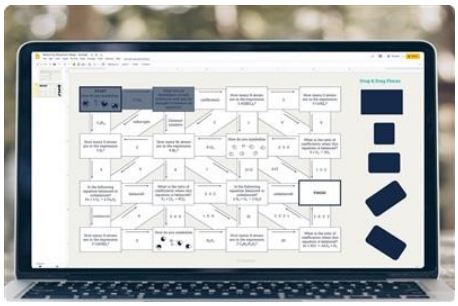

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Silver Glassware Lab cont.

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Thank you!

Silver Glassware Lab Teacher Tips

This lab can be used at any time of the year. Even though we haven't covered electrochemistry by the time we do this lab in the school year, I use this lab to preview what it means for a metal to be reduced, from a $Ag^{+1}(aq)$ oxidation state to a $Ag^{0}(s)$ oxidation state. I ask them many times throughout the lab, "What did we do to the silver?" And they respond, "We reduced it!"

This lab can be used after redox reactions have been introduced as verification of plating out metals by reducing them, or before it has even been taught. After completing this lab, anytime redox reactions come up again throughout the year, I use that opportunity to ask the same question above: “What did we do to the silver?”. I tell them why I keep asking - I want them to associate the reduction of metals to plating them out. I want them to have a visual reminder that the reduction of metal cations to their neutral charge means that solid metal is produced. This is an important step in our discussion of galvanic cells and what happens at the cathode as a battery runs. The use of test tubes keeps supplies to a minimal need.

Caveats:

Glassware:
The cleaner the glassware, the better the silver will plate out. I have used older glassware that I’ve tried to clean with concentrated nitric acid, then acetone, but the silver still did not adhere to the glass as well. This will give the glassware a “vintage” look.

Overtime, a container of 14.8 M NH_4OH may dilute by the escape of NH_3.

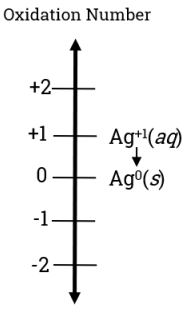
Once complete, you can protect the silver by coating it with clear varnish or paint. Closing the test tubes with a stopper also helps slow the silver oxidation process. Do not add any additional liquids to the test tubes, as it will remove the silver from the glass.

Solutions:
The Tollens’ reagent, the product of the $AgNO_3$, the NaOH and the NH_4OH mixture, should be prepared fresh and not stored. Upon standing, the solution may form an explosive mixture of silver nitride.

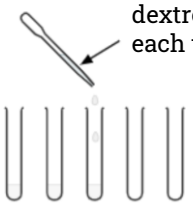
Students should dispose of excess product solution immediately into a waste beaker with copious amounts of water. As their instructor, you should acidify the waste by adding 1M HCl until all AgCl has precipitated out. The AgCl can be collected via filtration and contained for landfill disposal or used for another lab. The remaining solution can be diluted further and washed down the sink with plenty of water. As with all labs, instructors should review current Safety Data Sheets for additional safety, handling and disposal information.

Since the product solution cannot be stored, I allow students to bring in their own glassware to be silvered with any leftover solution, with the above caution that it might coat as well as in our new test tubes. This past year, I use this same lab procedure and quantities as described in this lab, mixed the solutions in a test tube and immediately emptied them into a cola bottle and found that the same microscale quantities are still enough to silver a larger cola bottle.

Silver Glassware Lab

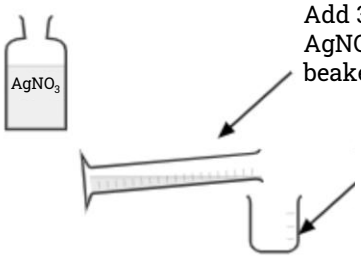


1. Add 1 mL dextrose to each test tube.



2. Add 30-mL $AgNO_3$ to a beaker

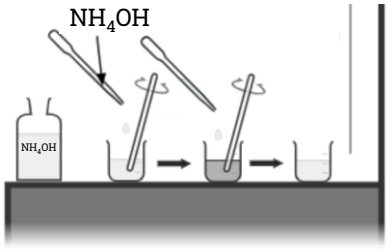
100-mL or 150-mL beaker



Steps 3-7 take place in a well-ventilated area.

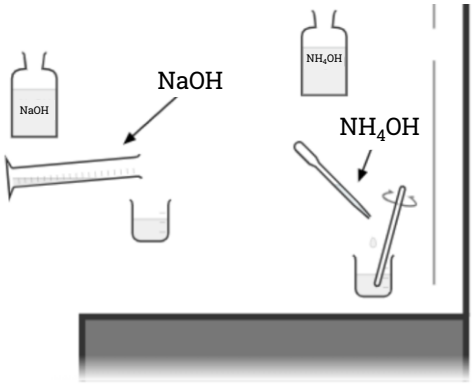
3. While stirring continuously, add NH_4OH dropwise until a precipitate forms.

4. Continue adding NH_4OH dropwise while stirring until the solution becomes clear again.

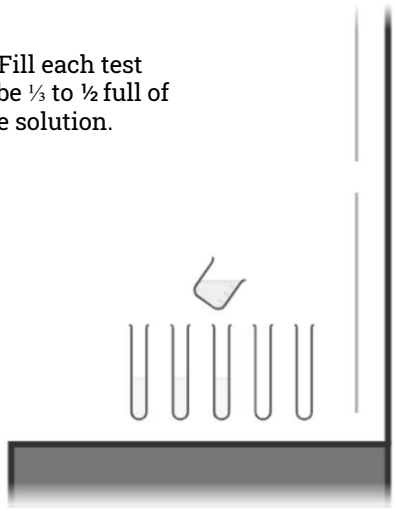


5. Add 15-mL NaOH to the beaker.

6. If a precipitates forms again, while stirring, add enough NH_4OH dropwise until the solution is clear again.

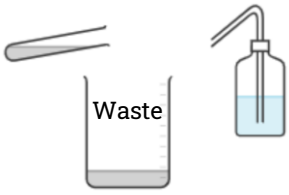


7. Fill each test tube ⅓ to ½ full of the solution.

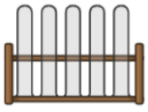


8. Cover each test tube with stopper or gloved finger and begin gently tilting it back and forth so that the solution meets the entire surface.

9. Within about 5 minutes of continually tilting, the glass should be coated with reduced silver and achieve a mirrored surface.

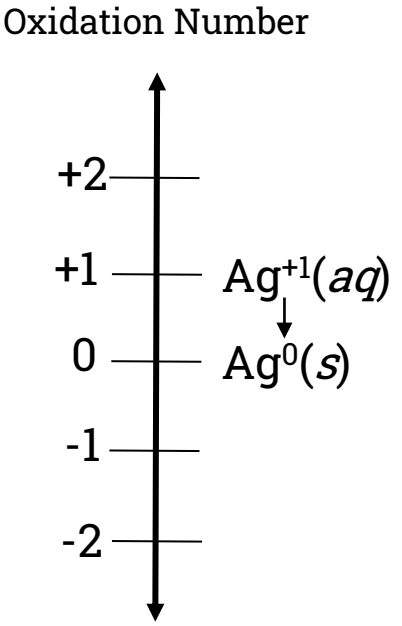


10. Pour excess solution into a waste container and gently rinse the test tube with distilled water. The test tube may be rinsed with acetone to facilitate drying.



11. Allow test tubes to dry for at least 2 days. Clean your area and wash your hands.

Silver Glassware Lab



<u>Teacher materials for 3 solutions</u>: (enough for 30 students below)
- 0.20 M $AgNO_3$ (3.4 g per 100 mL H_2O)
- 0.80 M NaOH (3.2 g per 100 mL H_2O)
- 0.25 M dextrose (4.5 g per 100 mL H_2O)
- 14.8 M $NH_4OH(aq)$ (kept in fume hood or well-ventilated area)
- Distilled water

<u>Student Supplies:</u>
Test tube: 1 per student (13 x 100 mm)
Goggles, apron and gloves
100- or 150-mL beaker: one per group of 5-7
Glass stir rod, graduated cylinders (10-mL and 50-mL), droppers, and stoppers (optional)

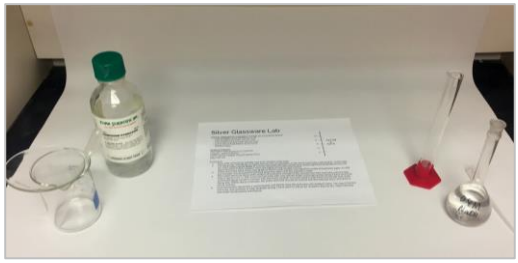
Procedure:
1. Add 1 mL of dextrose solution into each student's test tube.
2. Per lab group, add 30 mL of $AgNO_3(aq)$ into the small beaker. In the fume hood or well-ventilated area with a lab partner, continually stir while adding 15-20 drops of concentrated $NH_4OH(aq)$ until the gray-black $AgOH(s)$ precipitate forms *and then becomes a clear solution* when the $[Ag(NH_3)_2]^+(aq)$ complex forms.
3. Add 15 mL of NaOH to the beaker. The $AgOH(s)$ usually precipitates again, so add just enough concentrated $NH_4OH(aq)$ dropwise again until the solution is clear while stirring.
4. Still under the fume hood or well-ventilated area, each student should pour enough of the solution into their test tube until the test tube is about ⅓ to ½ -full. Cover the test tube with your gloved finger or a stopper and begin gently tilting it back and forth so that the liquid meets the entire surface. Carefully walk back into the lab area or station while doing this. Within about 5 minutes, the entire test tube should be coated with the reduced silver and show a mirror surface.
5. Pour the excess liquid into a waste beaker and gently rinse the test tube with distilled water. The test tube may be rinsed with acetone to help facilitate drying, otherwise, leave the test tubes open to the air for at least 2 days to dry. Clean your area and wash your hands.

$$CH_2OH(CHOH)_4CHO(aq) + 2[Ag(NH_3)_2]^+(aq) + 3\ OH^-(aq) \rightarrow 2\ Ag(s) + CH_2OH(CHOH)_4COO^-(aq) + 4\ NH_3(aq) + 2\ H_2O(l)$$

Silver Glassware Procedure with Pictures

Procedure:

1. Pour **1** mL of dextrose solution into each student's test tube.
2. Per lab group, add **30** mL of $AgNO_3(aq)$ into the small beaker. In the fume hood or well-ventilated area with a lab partner, continually stir while adding **15-20** drops of concentrated $NH_4OH(aq)$ until the gray-black $AgOH(s)$ precipitate forms and then becomes a clear solution when the $[Ag(NH_3)_2]^+(aq)$ complex forms.



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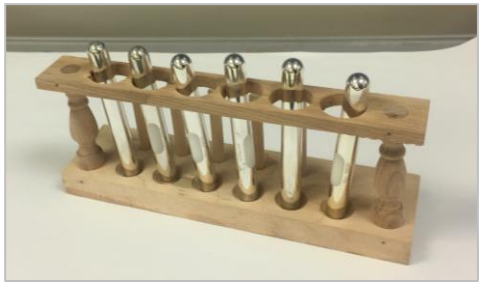

5. Pour the excess liquid into a waste beaker and gently rinse the test tube with distilled water. You may rinse the test tube with acetone to help facilitate drying. Leave open to the air for at least 2 days to dry. Clean lab area and wash hands before leaving the lab.

6. After the test tubes are dry, add hooks and string (held with tape if there is no lip on the test tube), before taking them home.

$$CH_2OH(CHOH)_4CHO(aq) + 2[Ag(NH_3)_2]^+(aq) + 3\ OH^-(aq) \rightarrow 2\ Ag(s) + CH_2OH(CHOH)_4COO^-(aq) + 4\ NH_3(aq) + 2\ H_2O(l)$$