

## Gold standards for sensing (preparation details for teachers and technicians)

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### SAFETY

#### Ethanol

H225 Highly flammable liquid and vapour

H319 Causes serious eye irritation

P210 Keep away from heat/sparks/open flames

P280 Wear eye protection

#### Dodecanethiol

H314 Causes severe skin burns and eye damage

H410 Very toxic to aquatic life with long lasting effects

P273 Avoid release to the environment

P280 Wear protective gloves/ clothing/ eye protection

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P501 Dispose of contents/ container to an approved waste disposal plant

#### KOH (s)

H290 May be corrosive to metals

H302 Harmful if swallowed

H314 Causes severe skin burns and eye damage

P280 Wear protective gloves/clothing/eye protection

#### AgNO<sub>3</sub> (s)

H272: May intensify fire; oxidizer.

H314: Causes severe skin burns and eye damage

H410: Very toxic to aquatic life with long lasting effects

210: Keep away from heat.

P221: Take any precaution to avoid mixing with combustibles, heavy-metal compounds, acids and alkalis.

P273: Avoid release to the environment.

P280: Wear protective gloves/ clothing/ eye protection

P301 + P330 + P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

#### 30% NH<sub>4</sub>OH (aq)

H302: Harmful if swallowed

H314: Causes severe skin burns and eye damage

H400: Very toxic to aquatic life

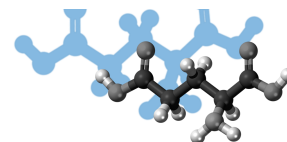
P260: Do not breathe mist, spray, vapours

P264: Wash exposed skin thoroughly after handling

P273: Avoid release to the environment

P280: Wear eye protection, protective clothing, protective gloves

P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately



all contaminated clothing. Rinse skin with water/shower  
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing  
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing, if present and easy to do. Continue rinsing.

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## TO BUY

**Glass microscope slides:** Rectangular standard glass microscope slides purchased from VWR were used in this experiment.

**Dodecanethiol solution:** Purchase 1-dodecanethiol from a chemical supplier, such as Sigma Aldrich. (100 mL is ca. £20, and will last for many experiments).

**Glucose:** D-glucose (dextrose) was purchased from a chemical supplier.

**30% Ammonium hydroxide solution:** This is standard ammonia solution purchased for labs. The reaction may work with 10% ammonia, just with more needed to be added to see the colour changes required.

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## TO PREPARE IN ADVANCE

**0.1 mM Ethanolic dodecanethiol solution:** Dissolve 0.2 g (or 240 microlitres, if you have a pipette to do this) in 10 mL of ethanol. Take 1 mL of this solution, and dissolve it up to 10 mL of ethanol, and then take 1 mL of this, and dissolve it up in 100 mL with ethanol.

**0.3 M Glucose solution:** Dissolve 1 g of dextrose (D-glucose) in 20 mL of deionised water.

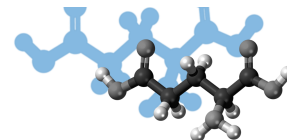
**0.8 M KOH (aq) solution:** Dissolve 1.4 g KOH (s) in 30 mL deionised water. *Always add base to water, and not the other way around, to prevent excessive heating.*

**Tollens' Solution:** **This must be made up as soon as the practical is to be done, and discarded within half an hour of preparation**, by washing it down the sink with a large amount of water, to prevent the formation of a deposit of silver fulminate, *a dangerously explosive substance*. Discard the solution within half an hour of preparation by washing it down a sink, followed by a large amount of water. For pre-16 students it may be easier and safer to prepare the glass slides for them.

Dissolve 0.25 g of  $\text{AgNO}_3$  in 15 mL of deionised water, and stir until dissolved, to give a 0.1 M solution. In a fume hood, or a well ventilated area, add 3 drops of 30 % ammonia solution ( $\text{NH}_4\text{OH}$  (aq)) to this, from a plastic pipette. The solution will go brown and then colourless. Add 8 mL of 0.8 M KOH solution, and the solution will go dark brown. Add a few (3) drops of ammonia solution, until the solution goes colourless. This is now ready.

*(It is also possible to make up the silvered slides in advance for the class, and they keep for several weeks – see over page)*

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## To prepare the silvered slides in advance for students:

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If your glass slide is fresh out of a new packet, use it as is, being careful to handle it by the edge so as not to get grease on the surface. Otherwise, wash your slide with soap and water, and dry with a paper towel. Wash with ethanol, and dry.

Place 2 glass slides into separate petri dishes/ large beakers/ onto watch glasses, so that they can lie flat. Using a plastic pipette, drop ~4 drops of glucose solution onto each glass slide, followed by ~12 drops of the Tollens' solution, and agitate for 3-5 min - You should see a silver mirror forming on the glass.

Pick the slide up with tweezers, and carefully wash off the solution with deionised water, followed by ethanol, and place onto a paper towel (silver side up), to dry.

Wash out your petri dishes, and wash all the Tollens' waste down the sink with plenty of water.

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## STUDENTS WILL NEED

- (Tollen's solution)
- (0.3 M glucose (aq) solution)
- (glass microscope slides, 2 per group) – or 2 pre-silvered slides per group
- 1 petri dish / watch glass/ large beaker, big enough to fit slide in
- 0.1 mM ethanolic dodecanethiol (DDT) solution (~ 0.5 mL per group)
- paper towels
- ethanol
- plastic pipettes
- deionised water, in squeezey bottle
- tweezers