**How to Make Chemical Solutions**

**Often you will need to dissolve solid chemicals in water to make a solution of the particular strength needed for your experiment. Plan one hour for every 2-4 solutions you need to prepare. You will need a [balance](https://www.homesciencetools.com/product/triple-beam-balance-2610-g/" \t "_blank) to weigh out the solid chemical (or solute) and a**[**graduated cylinder**](https://www.homesciencetools.com/product/graduated-cylinder-glass-100-ml)**to measure the water (or solvent).**

**First, determine the concentration (weight percent or Molarity, see below) and amount (milliliters) of solution you need from your lab procedure. Second, calculate the amount of solid chemical needed in grams, using one of the formulas given below. Next, weigh out the solid chemical and add it to a mixing beaker. Finally, measure the volume of water needed in milliliters with a graduated cylinder and add it to the [beaker](https://www.homesciencetools.com/product/pyrex-beaker-griffin-low-form-1000-ml" \t "_blank). Stir the solution until all of the chemical dissolves.**

**Break up hard lumps of chemical with a [mortar and pestle](https://www.homesciencetools.com/product/mortar-and-pestle-80-ml" \t "_blank) or by careful crushing in a plastic bag with a hammer. Chemicals dissolve more quickly by gently heating the solution and stirring.**

**You might consider scaling down when experiments call for large amounts of chemical. Scaling down reduces safety hazards, chemical cost, and waste disposal.**

**Most experiments can be scaled down by dividing all chemical and water amounts by a factor of your choosing. If an experiment calls for 50 g of chemical and 250 ml of water, and you only want to use 5 g of chemical, scale down all quantities and volumes by a factor of 10 (i.e., use 25 ml of water). Use smaller beakers, test tubes, etc. with the reduced chemical amounts if necessary.**

**When making chemical solutions, always use the appropriate**[**safety equipment**](https://www.homesciencetools.com/chemistry/safety-equipment)**.**

**Making Molar Solutions**

**Molar (M) solutions are based on the number of moles of chemical in 1 liter of solution. A mole consists of 6.02×1023 molecules or atoms. Molecular weight (MW) is the weight of one mole of a chemical. Determine MW using a periodic table by adding the atomic mass of each atom in the chemical formula. Example: For the MW of CaCl2, add the atomic mass of Ca (40.01) to that of two Cl (2 x 35.45) to get 110.91 g/mole. Therefore, a 1M solution of CaCl2 consists of 110.91 g of CaCl2dissolved in enough water to make one liter of solution.**

**Once the molecular weight of a chemical is known, the weight of chemical to dissolve in a solution for a molar solution less than 1M is calculated by the formula:**

**grams of chemical = (molarity of solution in mole/liter) x (MW of chemical in g/mole) x (ml of solution) ÷ 1000 ml/liter**

**For example, to make 100 ml of 0.1 M CaCl2 solution, use the previous formula to find out how much CaCl2 you need:**

**grams of CaCl2 = (0.1) x (110.91) x (100) ÷ (1000) = 1.11 g**

**Now you can make your solution: dissolve 1.11 g of CaCl2 in sufficient water to make 100 ml of solution. The amount of water needed will be slightly less than 100 ml.**

**A**[**balance**](https://www.homesciencetools.com/product/triple-beam-balance-2610-g)**and a**[**volumetric flask**](https://www.homesciencetools.com/product/volumetric-flask-100-ml)**are used to make molar solutions. A procedure for making a molar solution with a 100 ml volumetric flask is as follows:**

1. **Calculate the weight of chemical needed to make 100ml of solution using the above formula.**
2. **Weigh out amount of chemical needed using a balance.**
3. **Transfer the weighed out chemical to a clean, dry 100ml volumetric flask.**
4. **Slowly add distilled water to the volumetric flask. Wash all the chemical into the bottom of the flask as you do so. Keep adding water until you reach the 100ml mark on the neck of the flask.**
5. **Place the stopper in the flask and gently swirl the flask until all the chemical is dissolved.**

**If you don’t have a volumetric flask you can use a 100ml graduated cylinder instead. Just add the chemical to the graduated cylinder and then add distilled water until you reach the 100ml mark in the side of the cylinder.**

**Making Weight Percent (Wt%) Solutions**

**One common solution is based on weight percent. The weight percent of a solution is the weight of chemical divided by the total weight of the solution (chemical + water) and multiplied by 100. Since the density of water is 1 g/ml, the formula to calculate the amount of chemical that must be mixed for a wt% solution is:**

**grams of chemical = (wt% solution) x (ml of water) ÷ (100 – wt% solution)**

**As an example, to make 100 ml of 10% NaCl (table salt) solution, use the previous formula to find out how much NaCl you need:**

**grams of NaCl = (10) x (100) ÷ (100 – 10) = 11.1 g**

**Now you can make your solution: dissolve 11.1 g NaCl in 100 ml of water.**