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FLINN SCIENTIFIC "Your Safer Source for Science"

Vol. 16–3 Chemistry Edition

Supersaturated Solution

Sodium Acetate Demonstration

See the Free Video at www.flinnsci.com/supersaturated

Introduction

Snap your fingers over a clear solution and, presto, the solution instantaneously crystallizes. The flask can immediately be turned upside down without spilling a drop. The solution is easy to make and can be used over and over again.

Concepts

• Supersaturated solutions
• Crystallization • Exothermic

Safety Precautions

Sodium acetate is slightly toxic by ingestion, inhalation, and skin absorption. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wear heat-resistant gloves or use tongs when handling the hot flask. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Materials (for each demonstration)

Sodium acetate, trihydrate, $CH_3CO_2Na{\bullet}3H_2O$, 160 g
Water, distilled or deionized, 30 mL
Balance
Flask, Erlenmeyer or Florence, 500-mL, Borosilicate Glass
Graduated cylinder, 100-mL or 50-mL
Heat-resistant gloves or tongs
Hot plate or Bunsen burner
Parafilm M® or 100-mL beaker, to cover the flask
Ring stand set-up, if using a Bunsen burner
Stirring rod, glass
Washing bottle filled with distilled water

Preparation

1. Weigh out 160 g of sodium acetate trihydrate in a 500-mL Erlenmeyer flask.
2. Using a graduated cylinder, measure out 30 mL of distilled water, and add it to the flask of sodium acetate trihydrate.
3. Heat the mixture on a hot plate or over a Bunsen burner, stirring occasionally until all of the solid is dissolved. (This may take 15 minutes or so.) Make sure the sides of the flask are free of solid sodium acetate. To remove crystals from the sides of the flask, rinse them down with small squirts of water from the washing bottle.

Continued on page 4

Laboratory Ventilation

Reducing Chemical Exposure

One of the most important steps in maintaining a safe laboratory environment is to ensure that the laboratory is properly and adequately ventilated. Unfortunately, architects, engineers and administrators who make the design decisions when planning a new or renovated laboratory frequently leave out plans for proper laboratory ventilation in an effort to save money. Good ventilation is important to protect everyone who uses the laboratory from short-term exposure to toxic substances. Ventilation is equally important for protecting the teacher from the hazardous effects of long-term exposure to hazardous chemical vapors, aerosols and fumes. This article is intended to provide guidelines on how to solve the problem of poor ventilation in your laboratories and preparation/storage areas. We hope that you and your administration will follow these guidelines in order to provide a safer working and learning environment for teachers and students at your school.

Fume Hoods

Fume hoods are an important feature in any laboratory using hazardous chemicals. Fume hoods provide a location for the dispensing and use of hazardous chemicals that are likely to form a vapor or aerosol that could be inhaled by the user of the chemical or others in the lab-

Continued on page 2

What's Inside

Laboratory Ventilation—Continued from page 1

oratory. It is a common misconception that fume hoods provide adequate room ventilation in a school science laboratory. Fume hoods are not designed for room ventilation. Fume hoods are only designed to ventilate the activity taking place in the fume hood itself and to prevent the release of hazardous chemicals into the general laboratory environment.

When functioning properly, a fume hood should have a face velocity of 80–120 feet per minute (fpm).[1] This is a measurement of the amount of air moving across the front opening of the hood and can be measured using a device called a velometer (Catalog No. SE4055) available from Flinn Scientific. In order to work efficiently, a fume hood should be located more than 10 feet from any doorway or window and should not be located near major traffic areas. Fume hoods should be checked periodically to make sure that they are working properly and efficiently. The fume hood ductwork should be checked annually to make sure that it is in good condition and venting directly to the out-of-doors, away from building air intakes. Fume hoods should be checked using a velometer or a small smoke generator which will allow you to test the effectiveness of your hood as well as its exhaust location at the exterior of the building. Simply turning the fume hood on and hearing the motor run does not constitute a thorough fume hood test.

A fume hood should never be used as storage space for chemicals or other items. Doing so not only decreases the efficiency of the hood, but also creates an unsafe situation for the user(s) of the hood. When items are stored in the hood they will prevent proper airflow, which decreases the hood's efficiency. Additionally, items stored in the hood force the users to perform their tasks closer to the front of the hood, which increases the possibility that the products or fumes from their activity will enter the general laboratory environment.

Fume hoods generally function most efficiently when used with the individual blower provided with the hood. Connecting multiple fume hoods to common ductwork and using a single, large blower is not recommended as the rate of air exhaust is usually insufficient to provide a face velocity in the acceptable range. Also, ensuring the proper amount of draw from each hood is difficult when using more than one hood at the same time.

Laboratory Ventilation

Good laboratory ventilation is the single most important ingredient in maintaining a safe laboratory environment. The ability to quickly provide a complete air change in science laboratories will greatly minimize the potential for chemical exposure. Good laboratory ventilation will allow teachers and administrators to feel safe and comfortable in doing all of the experiments and activities needed to provide an outstanding laboratory experience for their students. Adequate ventilation will also decrease the risks of long-term exposure to chemicals for teachers and other laboratory personnel. Unfortunately, architects, engineers and administrators often get so concerned about conserving energy, money and HVAC (heating, ventilation and air-conditioning) costs, that they ignore the need for proper ventilation of the science laboratory. It is up to the science teacher to ensure that all key decision-makers are aware of the need for good ventilation.

Auxiliary Ventilation

So, how much ventilation is enough? The OSHA Laboratory Standard 1910 states that "4 to 12 room air changes per hour is normally adequate general ventilation."[2] Air that is exhausted from the laboratory should always be vented to the out-of-doors and should never be recirculated. This will prevent laboratory air from being drawn back into the school building. Ideally, the ventilation system should provide a minimum of six complete air changes per hour.[3]

Six complete air changes per hour are needed when conducting experiments that generate hazardous vapors or to remove particularly strong or long-lasting odors. An exchange rate of six or more air changes per hour can be most easily achieved using an auxiliary ventilation system such as a purge fan or ceiling ventilator. Whichever type is chosen, the system must move a large enough volume of air in cubic feet per minute (CFM) to provide the desired rate of air exchange.

With any auxiliary ventilation system, it may be necessary to open the laboratory doors in order to provide enough make-up air to allow the system to provide the required air change. Make-up air is the air required from outside the room (for example, a hallway) to replace the air being removed from the laboratory by the ventilation system.

Other Thoughts

While it is true that ventilation is a large problem in many, if not most, schools, several steps can be taken to minimize chemical exposure in addition to adequate ventilation. The most important step that can be taken to limit exposure to hazardous chemicals is to store and use minimum quantities. This can be accomplished by purchasing and storing only those chemicals that are used by the school in a short amount of time. Flinn Scientific recommends that no more than a one- to three-year supply of any hazardous chemical be stored in a school's chemical storeroom. This not only assures a safe environment, but also prevents inaccurate results in experiments due to old, stale chemicals and saves valuable budget dollars that are wasted on excess chemical purchases.

Also, the amount of chemicals needed for use can be greatly reduced by using microscale techniques whenever hazardous chemicals are used. Finally, exposure to hazardous chemicals can be limited by choosing lab activities that use chemicals that are less hazardous to teach the same concepts as more hazardous chemicals.

For more information and tips about laboratory ventilation, view our free video at www.flinnsci.com/ventilation

Materials discussed in *Laboratory Ventilation* are available from Flinn Scientific

Catalog No.	Description	
SE4055	Valometer	
SE5010	Smoke Generator, Package of 2 30-seconds, 4,000 ft^3 of smoke, within lab or fume hood	
SE5011	Smoke Generator, Package of 2 3-minute, 40,000 ft^3 of smoke, from lab exhaust or fume hood to remote outdoor roof stack	

[1]ANSI/AIHA Z9.5-1992, p 13

[2]OSHA Part 1910.1450 Appendix A

[3]OSHA Part 1910.106 (d)(4)(iv)

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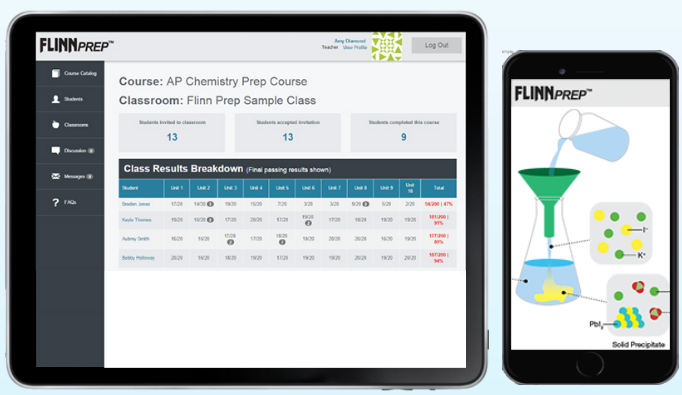

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Supersaturated Solution—Continued from page 1

4. Cover the flask with Parafilm or with a 100-mL beaker. Allow the solution to cool to room temperature undisturbed or, to speed up the cooling process, run cool water over the sides of the flask making sure no tap water gets into and contaminates the solution. The flask can now sit undisturbed until you are ready for the presentation. Take care not to disturb the solution as even slight movement may cause crystallization to occur before you're ready.

Procedure

1. While holding a single sodium acetate trihydrate crystal over the open mouth of the flask, snap your fingers and allow the crystal to drop into the flask. You might want to say some magic words like "abracadabra presto" as you snap your fingers. The single crystal should start a chain reaction of crystallization.
2. Immediately turn the flask upside down as crystallization occurs. The crystallized sodium acetate will not fall out.
3. Feel the sides of the flask. The flask will be warm since this is an exothermic process.
4. The solution may be used over again by reheating it to redissolve the sodium acetate.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The sodium acetate solution may be re-used or flushed down the drain with excess water.

Tips

- Use caution if substituting a non-Pyrex® hydrometer cylinder for the flask in this demo. The temperature differential may crack the cylinder. Use a Pyrex cylinder instead or allow the supersaturated solution to cool slightly before pouring it into the cylinder.
- The addition of too much water will result in leftover liquid after recrystallization.
- This demonstration can be performed for a larger audience by using 640 g sodium acetate trihydrate and 120 mL water.
- Topics of discussion may include saturated solutions, supersaturated solutions, crystallization, and exothermic processes.
- Uses for supersaturated sodium acetate solutions include hot packs and hand warmers.
- Variations of this demonstration include performing the crystallization in a 500-mL graduated cylinder or placing a single crystal in a shallow container and pouring the solution onto the crystal. A buret may also be used to release the solution onto the crystal. These two variations can produce fairly tall columns of the recrystallizing sodium acetate.
- Use a stereo microscope with a Celestron Digital Microscope Imager (Catalog No. MS1116) or other video projection device to provide a close-up view of the crystallization process.

Discussion

A supersaturated solution of sodium acetate trihydrate (the clear solution) will recrystallize by the addition of a single crystal of the solid. A supersaturated solution is a solution which contains a greater amount of dissolved substance than is present in a saturated solution at the same temperature. A saturated solution is a solution that contains the maximum amount of a dissolved substance at a given temperature.

A supersaturated solution can be made by gradually cooling a saturated solution without agitation so that crystals do not form. Supersaturated solutions are extremely unstable and will precipitate, or crystallize, upon addition of just one crystal of the solute. Even slight shaking or agitation may be enough to cause crystallization to begin.

Materials for *Supersaturated Solution* are available from Flinn Scientific

Catalog No.	Description	
S0036	Sodium Acetate, Trihydrate, 100 g	
S0037	Sodium Acetate, Trihydrate, 500 g	
GP3050	Flask, Erlenmeyer, 500-mL	
GP3090	Flask, Florence, 500-mL	
AP1933	The Heat Solution Instant Handwarmer	
AP8087	Supersaturation Flask—Chemical Demonstration Kit	

Molar Mass Mystery

An Engaging Activity for Mole Day

Introduction

Challenge your students to identify the mystery compounds in six "mole baggies" by calculating the molar mass of each compound and then determining its identity from a list of possibilities.

Concepts

- Mole
- Molar Mass

Materials

Balances, centigram precision (0.01-g)
Periodic table
Permanent markers
Zipper-lock plastic bags, quart size, 6 (with labels)
White crystalline compounds (calcium acetate, potassium sulfate, sodium acetate, sodium carbonate, sodium chloride, zinc oxide), 1–8 g each (see Table 1)

Safety Precautions

The safety hazards depend on the materials chosen. Keep the zipper-locked bags sealed throughout this activity. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

Table 1 gives suggestions for six mole baggies, enough for a class of 24 students working in groups of four. Samples may be repeated with different letter codes to accommodate the number of desired unknowns.

1. Obtain a set of zipper-lock plastic bags, equal in number to the number of student groups that will be working independently.
2. Measure the mass of each empty zipper-lock plastic bag and record the mass on the bag label.
3. Fill the bags with the appropriate amount of each compound, as shown in Table 1. Label the sample bags with the unknown label code and number of moles. DO NOT identify the compound, formula, molar mass or the mass.
4. Prepare a list of the names of possible compounds that you will give to students. Do not include the formulas or molar masses of the compounds. This can be written on the board or distributed on a worksheet.

Procedure

1. Instruct students to use the information on the label and their periodic tables to identify the substance inside the baggie, based on a prescribed list of possibilities.
2. Students may not open the sample baggies to identify the compounds.
3. Each group should turn in an answer sheet that gives the unknown letter, the name of the compound, and its molar mass, including detailed calculations for the latter.

   For example, with Unknown A, the molar mass is calculated by dividing the mass of the sample by the number of moles. 2.93g/0.050 mol = 58.6g/mol

   The only molar mass of the compounds that is close to 58.6g/mol is sodium chloride (58.45 g/mol).

Tips

- Quart-size freezer-style plastic bags with a zipper locks are recommended—they are sturdy enough to withstand repeated use and usually have a label printed on the plastic. Write on the labels using permanent markers.
- To simplify the activity, in addition to giving the compound names, you could also provide chemical formulas.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing disposal. Store the mole baggies for future use in larger containers that are labeled with the names of the substances and their specific hazard warnings.

Materials for *Molar Mass Mystery* are available from Flinn Scientific

Catalog No.	Description	
C0262	Calcium Acetate, 100 g	
P0087	Potassium Sulfate, 100 g	
S0036	Sodium Acetate Trihydrate, 100 g	
S0052	Sodium Carbonate, 500 g	
S0063	Sodium Chloride, 500 g	
Z0013	Zinc Oxide, 500 g	
AP9020	Flinn Periodic Table, Notebook Size, Package of 50	

Table 1.

Labeled on Bag for Student		Information for Teacher			
Unknown Label	Number of Moles	Compound Name	Formula	Mass of Sample for Bag	Molar Mass g/mol
A	0.050	Sodium Chloride	$NaCl$	2.93 g	58.45
B	0.020	Potassium Sulfate	K_2SO_4	3.48 g	174.27
C	0.035	Sodium Carbonate	Na_2CO_3	3.71 g	105.99
D	0.015	Calcium Acetate	$Ca(C_2H_3O_2)_2$	2.37 g	158.19
E	0.025	Zinc Oxide	ZnO	2.04 g	81.38
F	0.045	Sodium Acetate Trihydrate	$NaC_2H_3O_2 \cdot 3H_2O$	6.12 g	136.08

Celebrate Mole Day October 23

Visit www.moleday.org

Product Spotlight

Quantum Periodic Table

New

Does What Wall Charts Can't

Science, art and imagination overlap in this beautiful folding periodic table. Colorful atomic icons show the repeating patterns in atomic structure that lie at the heart of periodic law. Accordion folds expand and collapse to show hidden patterns that can't be seen in textbooks and wall charts. Ideal for students, teachers, scientists or anyone wishing to explore the mysteries of chemistry. Unfolded, 18" x 6". Folded, 4" x 6".

Catalog No.	Description	
AP8093	Quantum Periodic Table, Foldable, Package of 15	

Generating and Detecting Ozone

Chemical Demonstration Kit

A very topical demonstration that highlights ozone's unique role in environmental chemistry! Investigate the formation and properties of ozone with this novel, small-scale gas-generating kit. Ozone is produced as a byproduct of the electrolysis of sulfuric acid solution. A modified transfer pipet serves as the reaction vessel and delivery tube. The reactions of ozone with unsaturated organic compounds are illustrated. Watch as ozone causes a balloon to burst, a rubber band to snap, and decolorizes food dyes and pigments. *Note:* Perform this demonstration in a fume hood or well-ventilated lab.

Catalog No.	Description	
AP7249	Generating and Detecting Ozone—Chemical Demonstration Kit	

Visit ozonewatch.gsfc.nasa.gov for ozone facts, maps, and activities.

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Catalog No.	OB1054	OB2150
Ohaus Model No.	SKX421	PA84
Capacity (g)	420	85
Precision/Readability (g)	0.1	0.0001

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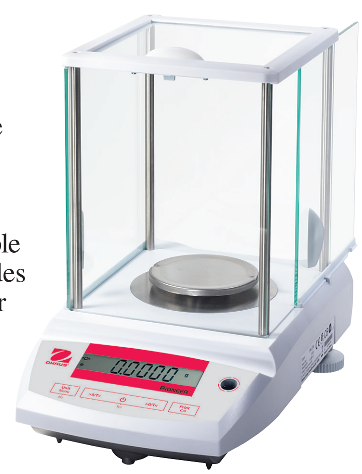

Here's a quality analytical balance with readability of 0.0001 grams at an affordable price. All operations are easy, using the clearly-identified three-button touch control, large digital display, and simple calibration. Draft shield provides stable weighing results. 2-year warranty. This balance is the perfect choice if you teach AP Chemistry or use microscale techniques. Catalog No. OB2150.

Splash Goggles

Popular Safety Eyewear

These chemical splash goggles provide comfort, protection and durability. The soft vinyl flange gently conforms to facial contours. Clear lenses are made of 2–mm thick polycarbonate. Ventilation is provided through the covered lens channel and four covered vents. Non-vented goggles are also available. (Some eye-care professionals say wearers of contact lenses should wear a non-vented goggle when organic solvent fumes are present.)

Goggles are sized to fit over most eyeglasses. Replacement lenses, elastic head bands and vent covers are listed in our catalog. AP3306 and AP3309 meet ANSI Z87+D3 standards. SE1049 meets Z87+D3, D4, D5 standards.

See our complete selection of eye and face protection products and accessories on pages 1190–1194 in the *2016 Flinn Scientific Catalog/Reference Manual.*

Catalog No.	Description			
AP3306	Standard Vented Goggle			
AP3309	Standard Vented Goggle with fog-free lens			
SE1049	Non-Vented Goggle with fog-free lens			

Adopt a firm goggle policy:

"Any time chemicals, glassware or heat is used, students and teachers will wear their goggles. No exceptions!"

Chemystery of Halloween

Multi-Demo Kit

This popular Halloween seasonal chemical demonstration kit includes enough chemicals to do all seven demos seven times.

- "Evil spirits" erupt from a jack-o'-lantern.
- Concoct a fluorescent "slime monster."
- An "amorphous monster" foams up and out of a cup.
- Concoct a Silly Putty–type material.
- Vaporous "ghosts and goblins" appear out of a pop bottle.
- Eerie lights are given off by both a mysterious solution and ordinary candy.

Order now for Halloween!

See all of our seasonal demonstration kits including "A Christmas of Chemistry—Multi-Demonstration Kit" (AP6281) on pages 393–398 in the *2016 Flinn Scientific Catalog/Reference Manual* or by searching keyword "seasonal" at flinnsci.com.

Catalog No.	Description	
AP2102	Chemystery of Halloween—Multi-Demonstration Kit	

Hot Plates and Stirrer/Hot Plates

New

Perfect for Solution Prep

When solution making calls for heating and/or stirring, the new Flinn Hot Plates and Magnetic Stirrer/Hot Plates make the job easier. These instruments feature state-of-the-art ceramic tops that offer high-impact strength, remarkable chemical resistance, and a bright white surface for better visibility when monitoring color changes in solutions.

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Catalog No.	Description	Size of Top	
AP8182	Hot Plate, Flinn	4" × 4"	
AP8183	Hot Plate, Flinn	7" × 7"	
AP8180	Magnetic Stirrer/Hot Plate, Flinn	4" × 4"	
AP8181	Magnetic Stirrer/Hot Plate, Flinn	7" × 7"	

Magnetic Stirrer/Hot Plate, Flinn, 4" × 4" AP8180

Magnetic Stirrer/Hot Plate, Flinn, 7" × 7" AP8181

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NEW!

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See page 3

FLINN FAX! Bulletin Board

What Teachers Say

"You guys are the best. The service and assistance I have received from you has been excellent every time I call—and I have been calling for a long time. I feel like you are an extension of my classroom. Thank you!"
—Renee Fredrickson, Northwest School, WA

"Great products—Great labs! Everything I need in one location—one source at the best prices!"
—David Rogers, Wayne Technical and Career Center, NY

"Excellent service and fast shipping. I will definitely be ordering from you again!"
—Chris Foster, Southeastern Jr Sr High School, IL

Flinn Workshops at NSTA Conferences

Attend Flinn's workshops if you are going to a National Science Teacher Association (NSTA) Regional Conference this fall. Check your conference program for workshop times and locations. Visit the Flinn booth and enter drawings to win an electronic balance or microscope. Learn more about the conferences at www.nsta.org/conferences.

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Take control of your laboratory design project with Flinn's free UDesign™—an online science lab design tool. UDesign™ enables teachers to plan and design a customized floor plan for a new laboratory space for new construction, renovation, classroom conversion, or a new STEM lab.

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