

Chemical Stockroom Management:

Lessons Learned Ten Years In



Diane Arbus' Child with Toy Hand Grenade in Central Park, New York City (1962)

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Appalachian
STATE UNIVERSITY



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Boone NC

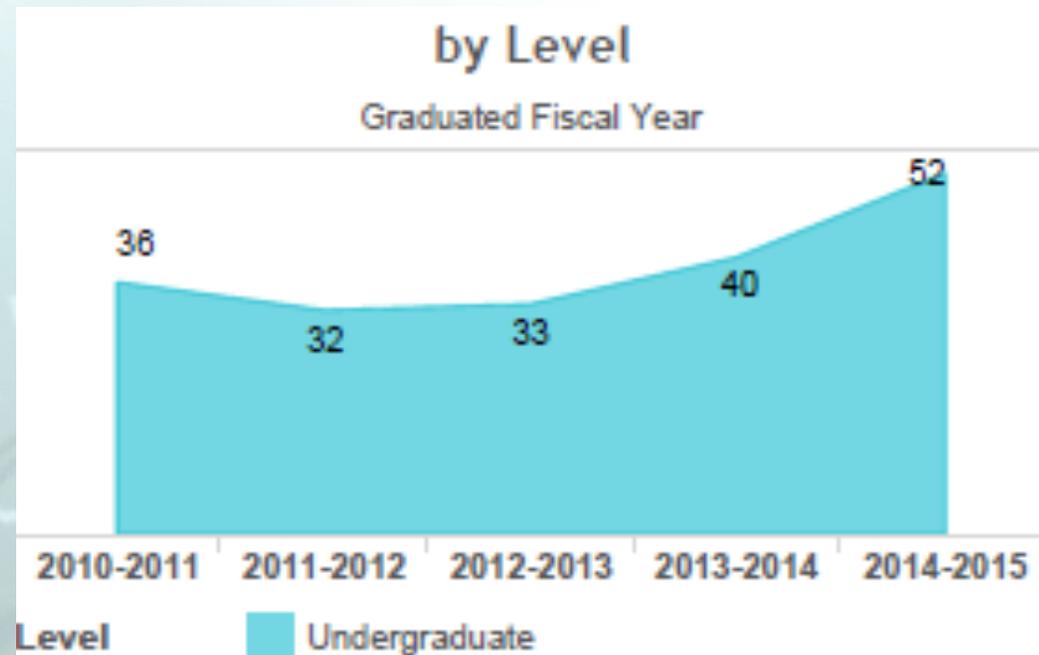


Our Students

Undergraduate Program

- ~340 Declared majors in 12 concentrations
- ~50 to 70 Students performing undergraduate research with 13 faculty members

Degrees Awarded



Stockroom Mission

- To service
 - ~1200 students/semester in the Intro Chemistry labs (40 to 50 sections)
 - ~400 students/semester in the Organic Chemistry labs (20 sections)
 - assist with all other teaching labs as needed
- To manage 2000 – 2500 chemical containers safely at any given time
- To provide instructional mentoring for 3-6 students per term
- To support research faculty and undergraduate research

Safe operation of a chemical stockroom that supports teaching and undergraduate research involves managing various “assets” using a variety of “tools”

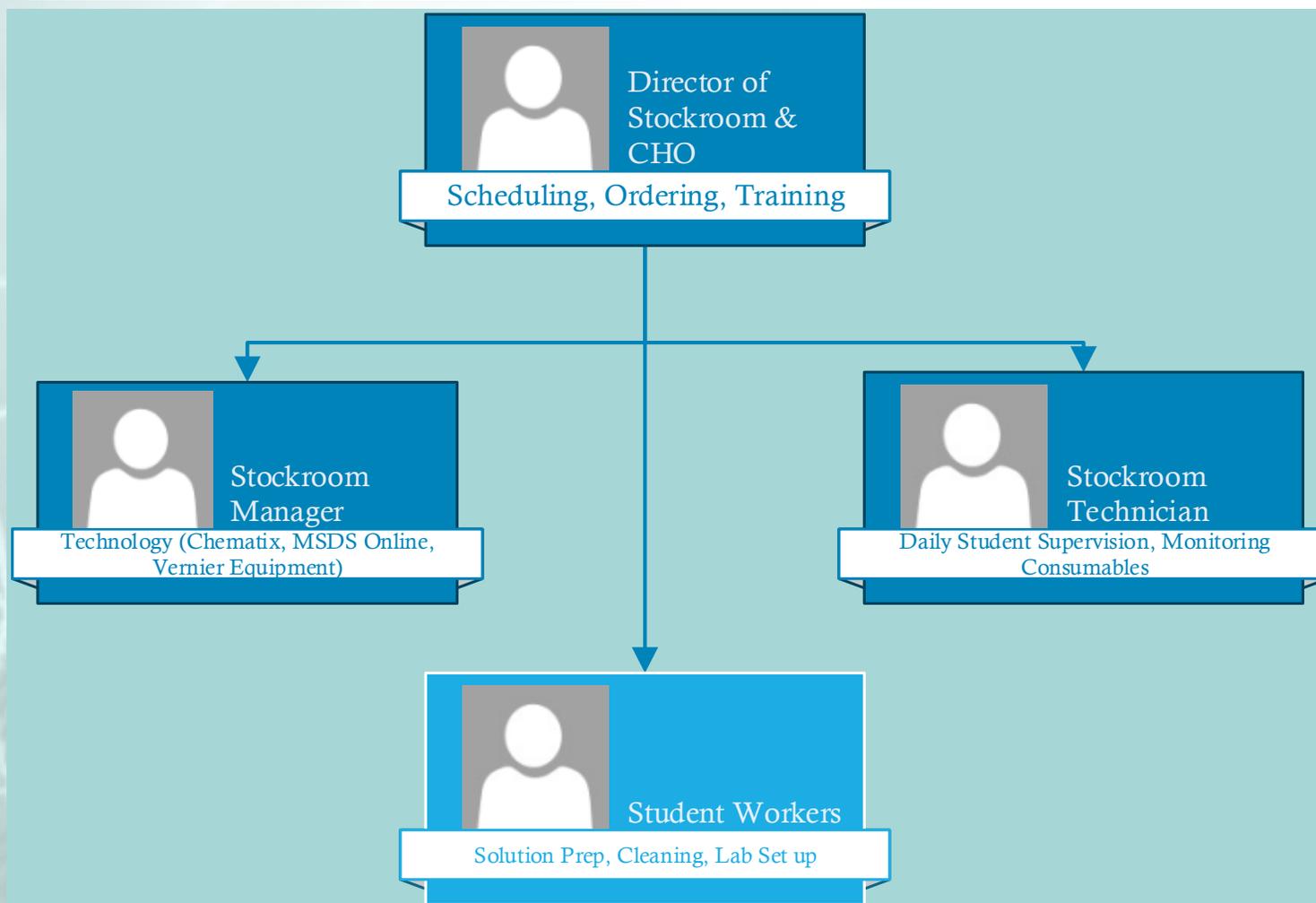
Assets & Tools

- People
- Space
- Technology (Hi tech and Lo tech)
- Time
- Specialized equipment

What is Involved in the Safe Daily Operation of a Chemical Stockroom?

- Managing operations:
 - Tools & Assets: chemicals, equipment, people, technology, & time
- Managing chemicals & equipment:
 - Tools & Assets: people, technology, space, & time
- Managing personnel:
 - Tools & Assets: people, time, & technology

Our Personnel

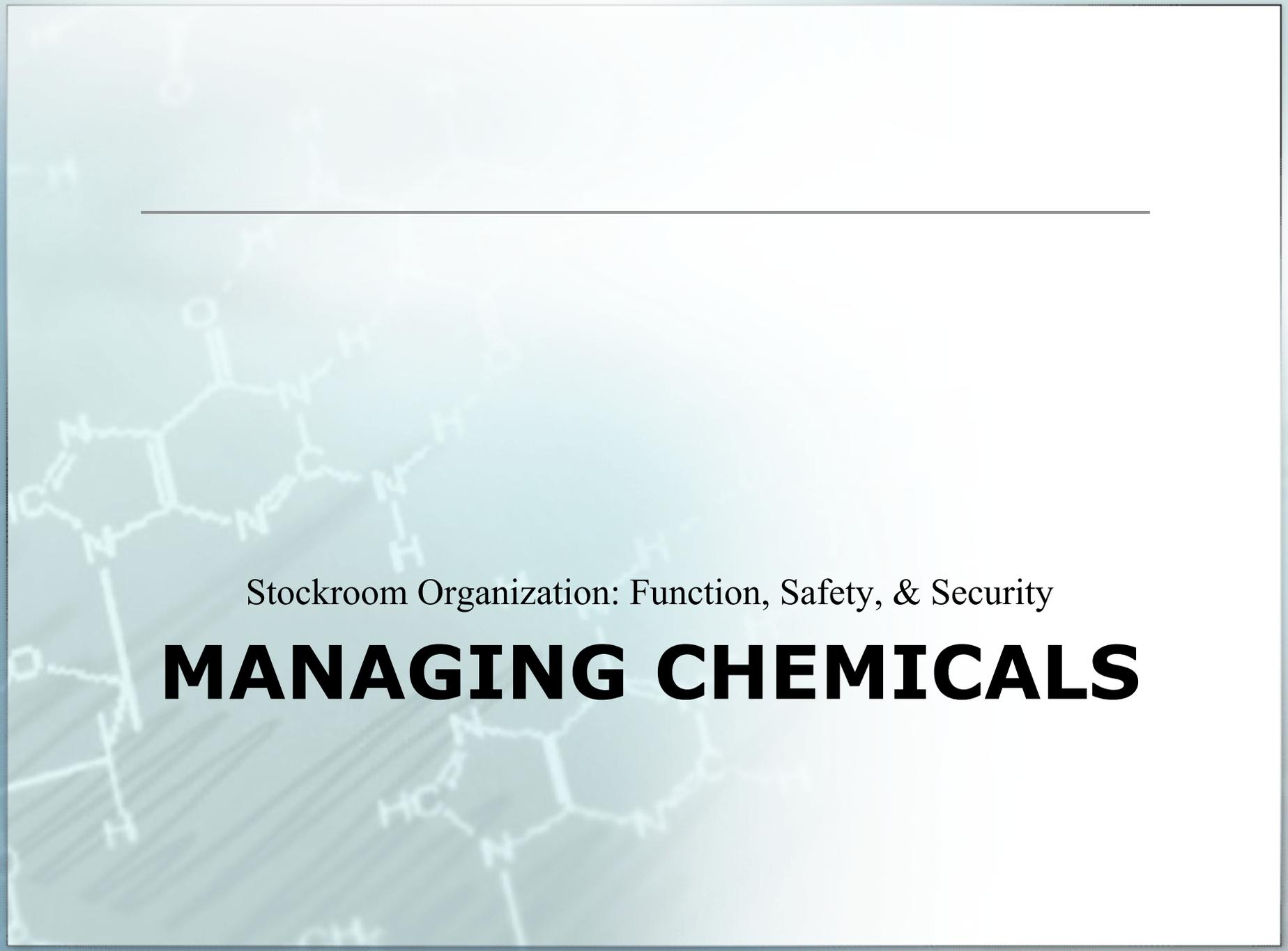


Our Time

- Director is full time 12 month faculty. Stockroom time is typically 30 hours per week.
- Manager is full time staff with $\frac{1}{2}$ time teaching assignment. Time is, “until the job is done”, typically 40 hours/week
- Technician is full time staff, strict 40 hours/week
- We typically have 30 hours/semester of student help

Our Space

- Main Stockroom ~ 1800 sq ft, 3rd floor
- Satellite Accumulation Area ~ 60 sq ft for Organic labs, 4th floor
- Three closet/storage areas ~ 60 sq ft ea, 3rd floor
- 180 day storage hood in the stockroom
- Blowout Room – 180 day storage & compressed gas cylinder storage ~ 200 sq ft, 1st floor
- No service elevator

The background of the slide features several faint, light blue chemical structures, including what appears to be a nucleotide base and a peptide chain, overlaid on a light blue gradient. A thin horizontal line is positioned above the subtitle.

Stockroom Organization: Function, Safety, & Security

MANAGING CHEMICALS

Inventory System (Technology)

- Chematix w/ Intermec barcode printer
- MSDS Online
- Several scanners w/ tablets for users to reconcile

Log In

Edit Memory

Help Centre

Appalachian State University

MSDSonline
— a Velocity® solution —

MSDS Search

MSDS Search

Search by Product Name, Manufacturer, CAS#, and/or Product Code or search by indexed fields, Ingredient, Ingredient CAS#, UN/NA#, Dc

Locations:

Select Location

Product Status:

Active

Groups:

Grignard Reaction with an Aldehyde (24)

- EPA (0)
- Equilibrium (8)
- Extraction of Trimyristin from Nutmeg (7)
- Extremely Hazardous Substance (EHS) (0)
- Formula of a Hydrate (37)
- Freezing point Depression (23)
- Fundamentals Lab (78)

Grignard Reaction with an Aldehyde (24)

- Hamburger Research Lab (506)
- Hazardous Air Pollutants (HAP) (0)
- Hydrolysis of Unknown Ester (27)
- ID of Unknown Organic Liquid (21)
- Inorganic (56)
- Iron by Permanganate Titration (10)
- Kinetics (17)
- ksp (21)

Product Data:

Select Product Data

Product name starts with: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0-9 #+=

MSDS Search

Search by Product Name, Manufacturer, CAS#, and/or Product Code or search by indexed fields, Ingredient, Ingredient CAS#, UN/NA#, Dc

Product name starts with: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0-9 #+=

48 Products x 4640 Chemicals

Export Sort By: Last Added

Narrow Results		Product	Revision Date	Product CAS #	Product Co
- By Manufacturer	1	Mercury(II) sulfate Mercuric sulfate Manufacturer: Sigma-Aldrich Corporation	12/28/2015	7783-35-9	10029
<input type="checkbox"/> Acros Organics N.V. (2)	2	Iron(III) chloride hexahydrate Ferric chloride Manufacturer: Sigma-Aldrich Corporation	12/10/2015	10025-77-1	31232
<input type="checkbox"/> ALFA AESAR (2)	3	Ammonium hydroxide solution Manufacturer: Sigma-Aldrich Corporation	12/02/2015	1336-21-6	221228
<input type="checkbox"/> Avantor Performa... (5)	4	Pyridine Manufacturer: Sigma-Aldrich Corporation	10/23/2015	110-86-1	270970
<input type="checkbox"/> High-Purity Stand... (2)	5	Acetaldehyde Ethanal Manufacturer: Sigma-Aldrich Corporation	07/10/2015	75-07-0	402788
<input type="checkbox"/> Millipore Corporat... (5)					
<input type="checkbox"/> PHARMCO-AAPER (1)					
<input type="checkbox"/> Poly Scientific R ... (1)					
- By Language					
<input type="checkbox"/> English (52)					

Inventory Systems

- People are in charge of any inventory system and in my experience an inventory system is only as good as the people entering the data and using it
- While an inventory system can tell you what the hazards are, and where a container is, it cannot tell you the container condition or if it is being stored correctly

Ordering (People, Time, Technology)

- Could be the most important part of managing chemicals
- Consideration for safe storage and use should be given *prior to ordering*
- *Taking advantage of promotions/discount memberships (NAOSMM)*
- Time:
 - Determining need/obtaining quotes/price comparison/follow-up/talking to reps
- People:
 - receiving/entering/storing/notifying or delivering/scanning packing slips
- Technology:
 - Inventory control, SDSs

Space Pre-Renovation

- 3000 to 4000 chemical containers
- Chemicals were stored with very little segregation on very questionable shelving wooden “library shelving” or in flammable cabinets
- There was very little capability to segregate solvents from general storage
- Function was hampered by poor organization
- Security was non-existent
- All faculty had key access to the space

Space Post-Renovation

- Chemical inventory was dropped to ~2000 – 2300 containers
- Chemicals have low visibility from outside
- Chemicals are now stored with physical segregation based on correct hazard classes
- Solvents are in a 2 hour solvent room
- Organization that optimizes function
- Security measures in place (card reader /camera surveillance/locking cages)
- Only faculty with need (and training) have access to the space

Before

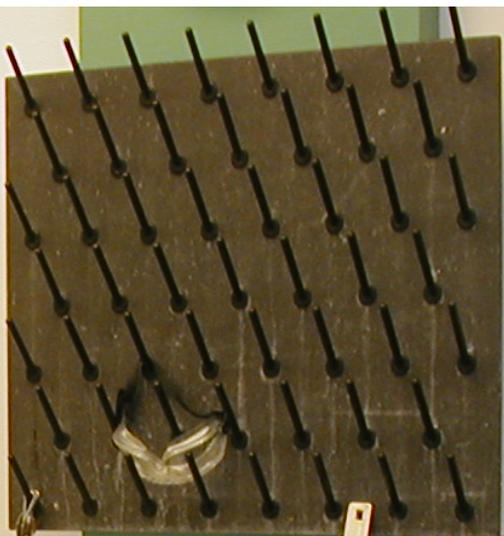


After

FIVE
(5)



After





Before

MAY 18 2007

Before



MAY 18 2007

After



MSDSs

After



After



INORGANIC
LAB

ALUMINUM
PVC
PLASTIC
GLASS
BINDER
BINDER
STORAGE
PINE

THREE
(3)

After

OXIDIZER
STORAGE



After





Before

MAY 18 2007



After



After



Secure Niches for Various Things



Small, secure cabinets for reactive acids

The background of the slide features several faint, overlapping chemical structures. These include a complex heterocyclic ring system with multiple nitrogen and oxygen atoms, and a long-chain polymer-like structure with repeating units containing nitrogen and oxygen. The structures are rendered in a light, semi-transparent style, allowing the text to remain the primary focus.

LESSONS LEARNED

The Person in Charge of Operations

- This person must –
 - Be someone that has, or is willing to develop a vested interest in operations
 - Have strong organizational skills and be very detail oriented
 - Understand chemistry and chemical hygiene
 - Be able to communicate with various stakeholders
 - Take responsibility when things go wrong
 - Have well-developed problem solving skills
 - Be able to keep personnel working in goal time on important tasks to keep operational flow proactive

Ordering

- Currently, I do all the ordering of items <\$1500
- Just in time ordering requires more time
- Ordering should be assigned to someone
 - with a chemistry background and strong chemical hygiene knowledge
 - that has basic accounting skills
 - with strong scientific communication skills
 - with some institutional knowledge of the department
 - who can constantly balance need/use/space vs. hoarding/want/cost

Managing people is more
difficult than managing
time, space, equipment,
technology or chemicals

Security features have to be
engaged or operational to
be of any use

Student Workers

- We require potential workers to submit their resume and interview for a position – we always have a waiting list (and it is not for the pay!)
- Students are trained to HAZCOM for stockroom work as opposed to the Lab Standard that they train to for work in the research lab
- They are very closely monitored and mentored. We assign tasks that are simple at first, and allow them more challenging assignments as they learn about the operations
- They are required to use a card reader to monitor their time and fill out bi monthly timesheets
- They are required to log their daily activities in a lab notebook

Through stockroom work I gained a lot of knowledge that wasn't taught in other laboratories or classes

Although a lot of specific safety information necessary for a position is acquired through job training, it is still important to have a solid background. Understanding safety regulations not only helps with job duties, but also in securing a job.

Questions regarding a candidate's knowledge of safety arises in applications where it is used to weed out unqualified applicants; it is also integral in interviews where candidates are asked to explain what safety regulations, equipment, etc. they have experience with.

The stockroom also taught me how to store chemicals, which wasn't something that was really taught but learned while working.

I think it is important for chemical storage to be taught because it can help prevent incidents from ignorance.

For example storing nitric acid separately from other acids, keeping ammonia out of hoods used to store [broken]Hg thermometers, or how acetone can dissolve certain plastics.

Some Thoughts on Time & Technology

Goal Time & Tool Time

- Tool time is the time one spends on a task using technology that does not increase the quality of the result. Think of it as time spent working, but to no apparent benefit (decreased efficiency)
- Goal time is the time one spends in direct pursuit of the specific end product or goal. Goal time always improves the quality of the result (increased effectiveness)

Technology Should



Goal
Time



Tool
Time

Example – Secondary Labels

Hexanes
110-54-3

Danger
Highly flammable liquid and vapor

May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
Suspected of damaging fertility or the unborn child
May cause damage to organs through prolonged or repeated exposure

Hexanes
110-54-3

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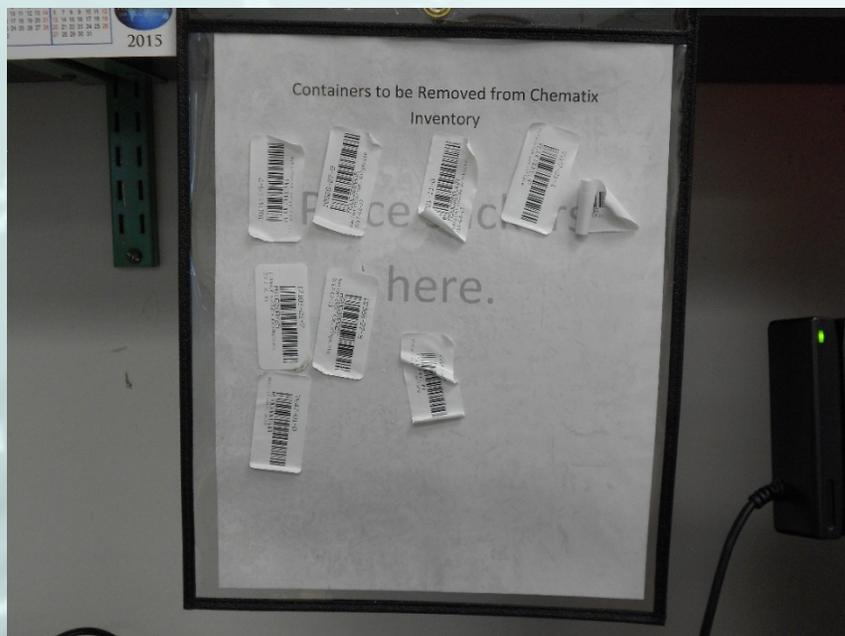
DANGER

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Technology that facilitates operations in goal time improves operational effectiveness (the right things are being done) and efficiency (they are being done correctly)

Saving Time (Technology)

Save time by batch scanning
empty barcode labels (higher tech)



Experiments by week at a glance
(low tech)

4 1110-Nickel 1120-Ksp 2203-Alcohol II	5 1110-Nickel 1120-Ksp 2203-Alcohol II 2204-Watig I Biochem	6 1110-Nickel 1120-Ksp 2204-Watig I Quant	7 1110-Nickel 1120-Ksp 2204-Watig I Quant	8 1120-Ksp 2102-Fruity Ester Quant
11 1110-Calciumhydroxide 1120-Elektrochem 2203-Alkyl halide I	12 1110-Calciumhydroxide 1120-Elektrochem 2203-Alkyl halide I 2204-Watig II Biochem	13 1110-Calciumhydroxide 1120-Elektrochem 2204-Watig II Quant	14 1110-Calciumhydroxide 1120-Elektrochem 2204-Watig II Quant	15 1120-Elektrochem 2102-Makeup Quant
16 1110-Makeup 1120-Makeup 2203-Alkyl Halide I	19 1110-Makeup 1120-Makeup 2203-Alkyl halide I Biochem	20 1110-Makeup 1120-Makeup Quant	21 1110-Makeup 1120-Makeup Quant	22 1120-Makeup Quant
25	26 2204-Makeup	27 2204-Makeup	28 2204-Makeup	29

Great jobs for student workers

Understand the Difference Between Urgent Tasks & Important Tasks

- **Urgent tasks require immediate attention (Reactive)**

Obviously, things such as spills fall in this category. More commonly – not having a needed chemical, incorrectly numbered unknowns, or full hazardous waste containers, etc.

- **Important tasks contribute to the operational mission of the unit (Proactive)**

Important tasks in the stockroom involve monitoring the integrity of chemicals on a schedule, ordering, washing glassware, preparing solutions and unknowns, and maintaining equipment.

Urgent Tasks vs. Important Tasks

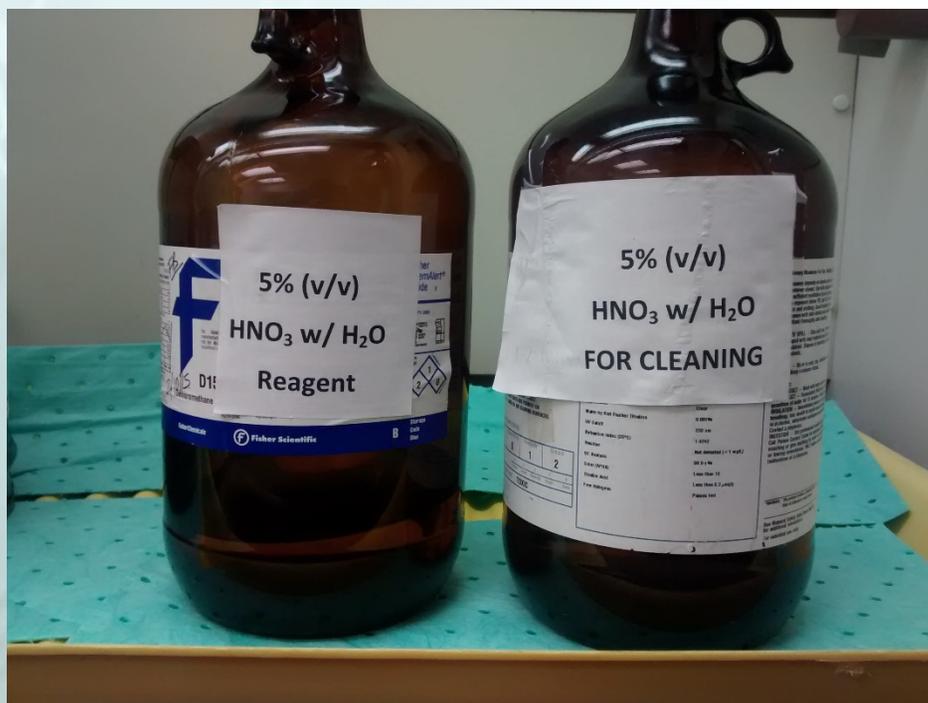
“What is important is seldom urgent and what is urgent is seldom important.” – Dwight D. Eisenhower



Eisenhower Decision Matrix

Operations where people are working proactively on important tasks with tools that improve product or service quality (goal time) are both effective and efficient

Never Overlook An Opportunity to Teach



Transporting Chemicals Through Doorways



Things I would not want to live without and worth paying for!

ESSENTIAL TOOLS (REAL)

Tote Storage Unit

Organization
value added =
time saved!

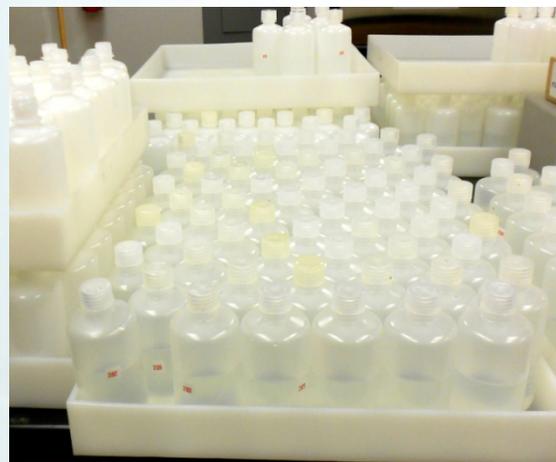


Secondary Containment & Segregation

Features Include:

- Acid resistant
- One-piece polyethylene construction
- 1", 1.5", or 2" containment lip
- Coved corners
- Impact resistant
- Dishwasher safe
- Over 250 sizes

- Protect chemical shelves while segregating
- In laboratory use for protecting counters and containing spills
- Organizing student samples



Scientific Plastics, Inc.

Labeling System

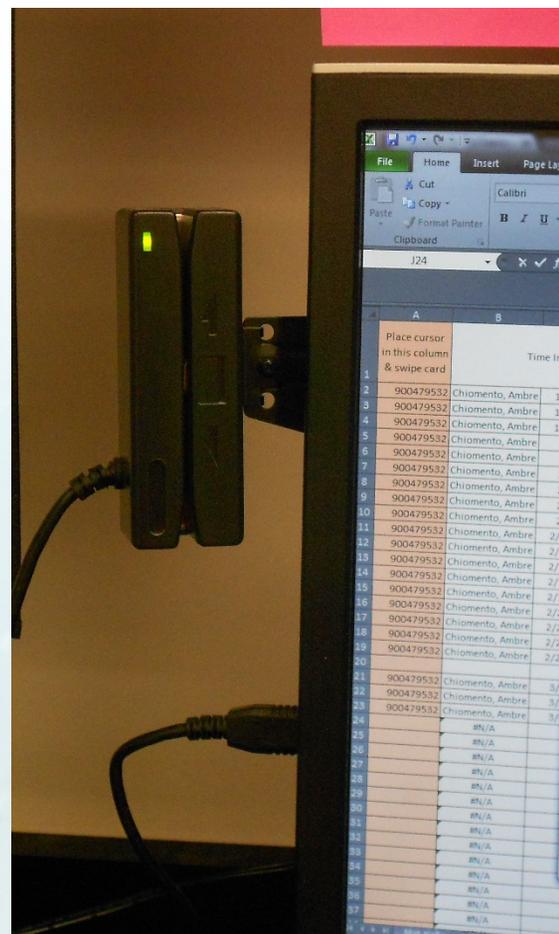
- Labels can be printed in numerical series quickly
- Labels are easy to remove and re-stick
- Multiple tape sizes and colors
- Chemical resistant label material
- Operates w/ or w/out PC connection

Brother P-Touch Printer



Card Reader

- Track employee or student worker time
- Enter student breakage charges as they occur



Ecofunnels

EPA approved,
but not student
proof.

(Signage is
required to get
them not to
dump on the lid)





Summarizing

- For operations to be both effective and efficient, it is critical to have the right person in doing the right job
- The person ordering chemicals needs to be closely tied to the operations
- For safe operations, the space must be able to accommodate the required chemicals and operations
- There must be enough personnel to keep operations in flow
- Students are learning and should be taught (not just labor)
- Chemical containers cannot move themselves