

Communicating Chemistry for Public Understanding

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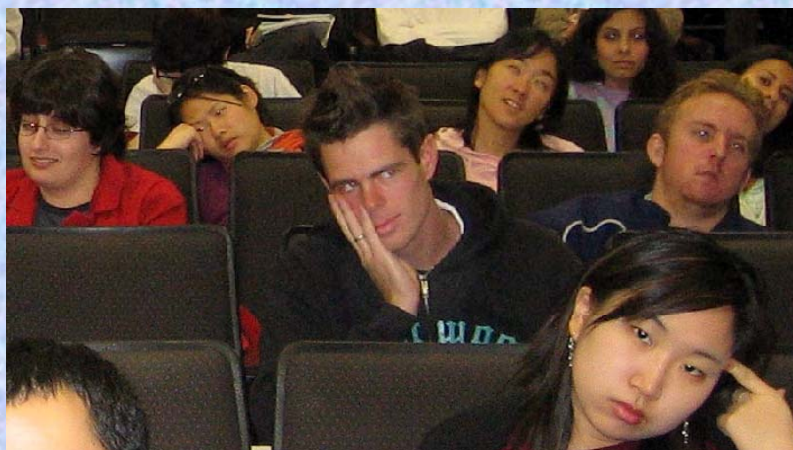
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Why?

- **Poor public appreciation of chemistry (or science)**
- **Poorly equipped schools**
- **Teachers have limited science background**
- **Science should be fun!**



Where?

- Schools
- Museums
- Public libraries
- Hotels
- Restaurants
- Fire houses
- Parks
- Radio/Television studios
- U.S. and around the world



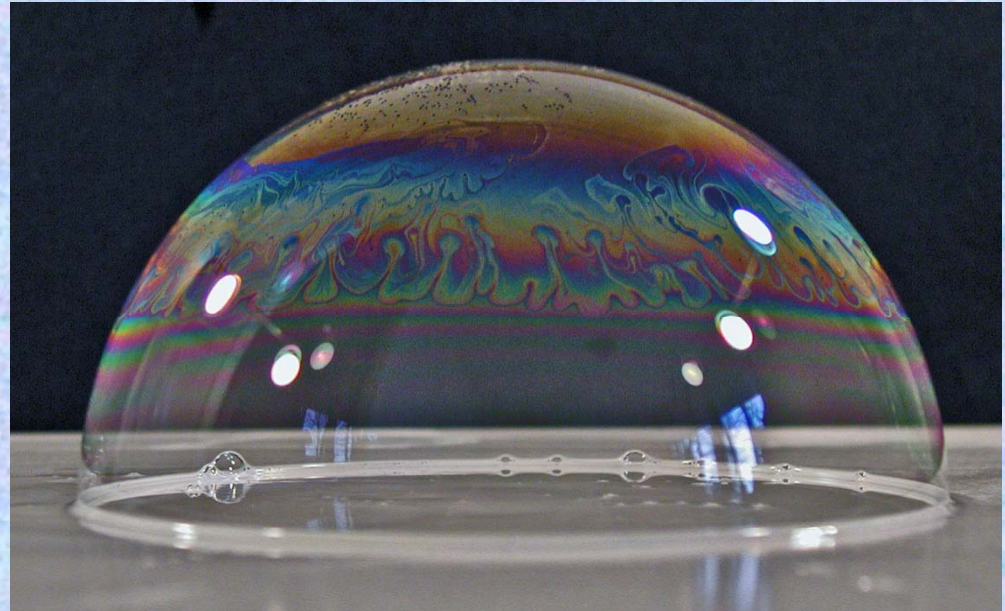
What?

- **Chemistry in the Toy Store**
 - **The chemistry behind:**
 - Rubber
 - Shrinky Dinks (shrinking plastic)
 - Slime
 - Gak
 - Silly Putty
 - Play Doh
 - Crystal “Trees”
 - Magic Sand
 - Other common “chemical” toys

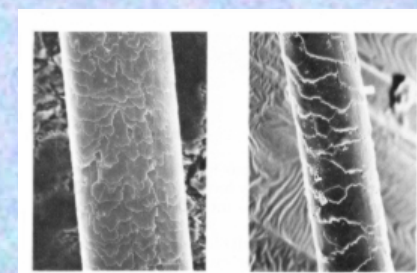
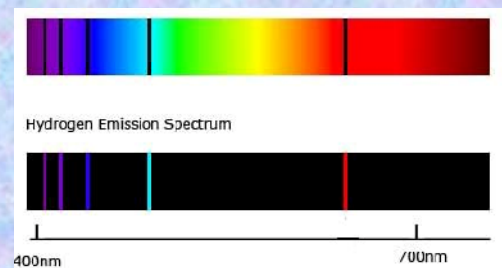


The Chemistry, and a Little Physics, of Soap Bubbles

- Bubble demonstrations
- Bubble workshops
- School programs



- **Polymers**
- **Magic into Science**
- **Chemistry in Your Home**
- **Cooking With Chemistry**
- **Light and Color**
- **Sound and Motion**
- **Atmospheric and Earth chemistry**
- **Forensics (started in 1993)**
- **Earth Day activities**
- **National Chemistry Week activities**



The best learning is hands-on multi-sensory learning

- **Start with demonstrations**
- **Elementary, but not simple or dumbed down, science**
- **Visuals – identify with common products**
- **Hands-on activities**

The best learning is hands-on multi-sensory learning

- **Go beyond the public to teachers**
- **One must teach educators, both pre-service and in-service, techniques when:**
 - **There are limited resources**
 - **Limited science preparation**
- **For effective teacher pre- or in-service programs, one must model techniques as well as teach them.**

Modes of Operation

- **School programs**
 - Pre-K thru college
 - Special education
- **Family programs**
 - In schools
 - In science museums
 - In parks or community centers
- **Methods courses for pre-service teachers**
 - For-credit one-semester
 - One-day (CEU's)

Modes of Operation

- **In-service workshops**
 - Undergraduate/graduate courses
 - One-day programs
 - Specific topics
 - Make-it and take-it projects
 - Multi-week programs (Grant funded, Industry funded, or Local Section ACS funded)
 - Project labs (Rohm & Haas Co.)
 - ICE (Institute for Chemical Education)
 - Other programs (Monthly or quarterly workshops)
 - Columbia College (Grant funded)
 - Workshops for teachers
 - Workshops for parents

Strategies

- **Develop concepts**
- **Visualization**
- **Hands-on activities**
- **Get “volunteers” to assist in the presentation**
- **Get family involvement**
- **Low cost materials to take home (provide containers)**
- **Summer “camp” for local youngsters**
- **Lending library of demonstrations and activities for local teachers**
- **Follow-up requirement for teachers after workshops**
- **After-program refreshments**

Safety

- **Avoid fire, smoke, and explosions**
- **All chemicals must be low toxicity, low vapor, non-irritating**
- **Goggles/safety glasses for chemical activities**
- **Gloves for hand protection**
 - **Be aware of latex allergies**
- **No food near chemicals or activities**
- **Supervision at work stations**

Develop Concepts

- **This is informal education, not a rigorous science class**
- **Teach concepts, not details**
 - **Appropriate to grade level**
 - **Provide reading/background materials/Internet links**
 - **Develop a dialogue with audience**
 - **Demonstrate**
 - **Hands-on activities**
 - **Discussion**
- **Model the teaching of the concept**
- **Humor**

Visualization

- **Chemistry concepts hard to visualize**
 - **Models**
 - **Manipulatives**
 - **Diagrams**
 - **Toys**
 - **Use “volunteers” to act out reactions/processes**
 - **Dance**
 - **Animations**

Hands-on activities

- **Small-scale activities**
- **Set up activities at work stations in advance.**
 - **Volunteers/assistants at work stations**
 - **Do not give out and collect supplies**
- **Enough work stations to minimize long lines**
- **Small containers of chemicals**
 - **Multiple containers for participant activities**
 - **Refill as needed**
- **Encourage measurement**
 - **Use teaspoons, tablespoons, cups, etc...**
 - **Graduated containers for liquids**
 - **Make a dark line at the proper volume**

Hands-on activities

- **Directions in large print at work stations**
 - Printed directions with explanations to take home
 - Extension activities for home
- **Direct participants to read the directions through interactive questions**
- **Demonstrate! (no short cuts)**
- **Disposable apparatus**
 - Paper cups, popsicle sticks, plastic bags, paper towels, etc...
- **Sufficient trash containers**
- **Safety**

Hands-on activities in a Classroom Setting

- **Appropriate for age group**
- **Small-scale classroom activities – no lab required:**
 - **Mystery powders**
 - **Elements**
 - **Physical properties**
 - **Chemical properties/reactions**
 - **CO₂ with baking soda and vinegar**
 - **O₂ using H₂O₂ and yeast**
 - **Kinetics using Alka Seltzer, lightsticks, etc.**
 - **Equilibrium using water**
 - **Acids, bases and indicators (red cabbage indicator)**

Hands-on activities in a Classroom Setting

- **Light and color activities**
 - Spectra
 - Fluorescence/phosphorescence
 - RGB lights
- **Heat and energy**
 - Heat of solution/reaction
 - Hot packs/cold packs
 - Zip-lock bag reactions
 - Chemiluminescence
 - Batteries
- **Forensics**
 - Fingerprinting
 - Hair and fiber analysis
 - Handwriting and ink analysis

Peer presentations in teacher workshops

- **Teachers generally are comfortable in front of their students.**
- **Get teachers to present to their peers**
 - **Concepts**
 - **Demonstrations**
 - **Activities**
- **Groups of teachers present together**
- **Evaluate with constructive feedback**

Summer “camp” for local youngsters

- **University of Pennsylvania Gifted Student Programs**
 - The Chemistry Lab in Your Home (one week)
 - Waves, Light, Sound and Motion: Working with the Tools of Physics (one week)
- **ICE Chem Camp (one week – half day)**
 - Group of teachers present pre-lab to students for day’s activities
 - Teachers assist/supervise activities
 - Experience “new” activities in classroom setting
 - Group of teachers summarize and expand on day’s activities in a post-lab presentation to students and parents

Lending library of demonstrations and activities

- **Assemble demonstrations and activities in labeled boxes with set of instructions**
- **Use common, everyday materials when possible**
- **Local teachers and field service students who participated in classes/workshops may borrow demonstrations for their classroom**
- **We restock materials, not the teachers**

Follow-up requirement

- **Teachers must present a program to their peers or to parents within 6 months**
 - **Show parents/peers their classroom activities**
 - **Demonstration program**
 - **Hands-on activities**
- **Encouraged to present, singly or in groups, at local, regional, or national meeting (ACS, NSTA, AAPT, etc.) within one year (Group presentation = a teacher reunion)**
- **Written report to workshop leaders**

Get parents involved

- Involved parents work with their children
- Regularly scheduled workshops for parents
 - At local school
 - At central location
- An unexpected result:
 - Parents put on a workshop for their children (Columbia College, Chicago, IL U.S.A.)
 - Workshop leader acted as advisor only

Those who DO NOT
have science education



Those who DO
have science education

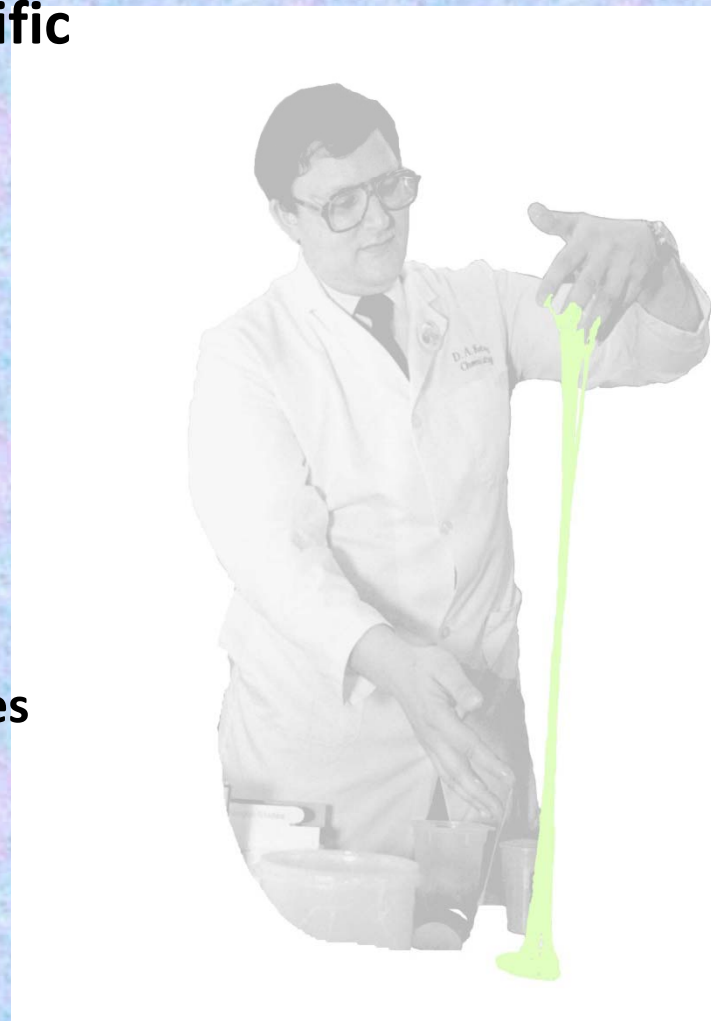


Low cost materials to take home

- Do not allow a participant to leave a program without written information, list of recipes, and/or materials they can use at home (or in a classroom) immediately
 - Formula cards
 - Molecular models
 - Spectroscopes
 - Lenses and/or prisms
 - Sample containers of chemicals/materials (Lightsticks, PVA plastic sheets, litmus paper, pH paper, etc... Must be SAFE)
 - Sign: Please be considerate of others TAKE ONLY ONE
 - Working models
 - Toys (Magic Trees, grow creatures, Silly Putty, Magic Sand, Bubble blowers & solution, etc...)
- Do not let the science end with the presentation

Some long-term results

- **First teacher kit with Flinn Scientific**
- **Burning book**
- **Slime/Gak/Silly Putty**
- **Disappearing ink**
- **Polymers**
 - **Needle/skewer through balloon**
 - **Magic Sand**
 - **Oobleck/corn starch**
 - **Sodium polyacrylate/Grow Creatures**
 - **Super/Stupid balls**
 - **Shrinking plastic (Shrinky Dinks)**
- **Soap bubbles**
- **Forensics (not just CSI)**





Why you want to do outreach!

