This resource guide is designed for teachers of introductory college chemistry classes. The topics chosen represent those areas most frequently studied. For each of the 33 topics, the following are included: content errors which have appeared in textbooks, references (primarily paperback), films, teaching aids, selected lecture demonstrations, and black-on-white transparency masters. A comprehensive checklist of minimum design standards for chemistry classrooms is included. (RS)
TOPICS-AIDS
INSTRUCTIONAL RESOURCES
FOR GENERAL CHEMISTRY
TOPICS-AIDS
INSTRUCTIONAL RESOURCES
FOR GENERAL CHEMISTRY

by

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Additional copies of this publication are available free of charge upon request to:

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PREFACE

This collection is designed to help in planning both the content and presentation of an introductory chemistry course. The topics chosen were selected as representing those areas most frequently discussed in both majors and non-majors programs. It is hoped that the individual teacher will add other topics, or expand on those included herein, to make a total collection of value in his own unique teaching situation. If this booklet provides a useful format and a nucleus for a personalized catalog of teaching supplements, the editors will feel well rewarded.

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Harry Zeitlin
Ann Zeitlin
1970
ACKNOWLEDGEMENTS

To Hubert Alyea, Fred Dutton, and Dick Powell - those masters of innovative teaching - for their advice and cooperation in this effort; to Gordon Barrow, Bill Cook, Carroll King, and the Executive Committee of the Advisory Council on College Chemistry for their encouragement and support; to Bob Barnard, Bill Eberhardt, and Tom Lippincott for their magnificent efforts in the *Journal of Chemical Education*; to Mrs. Juanita Maier for her work in assembling this manuscript; to Ken Finan for preparation of the illustrations; to Roger Gymer for shepherding the manuscript through final production; and to the Dee Toner Agency for printing and distribution of the booklet - the warmest thanks from the editors.

Rod O'Connor
Harry Zeitlin
Ann Zeitlin
1970
DEDICATION

To the students in general chemistry courses in colleges and universities.

The future is yours. May we, as teachers, not obstruct your paths.
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**TOPICS-AIDS**

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In spite of numerous efforts to publicize useful criteria for classroom design, it is still common for new construction to include classrooms poorly planned and inadequately equipped for advantageous use of modern teaching aids. The following checklist should be considered as furnishing the minimum requirements for design of new classrooms or renovation of existing facilities for chemistry teaching. Additional features may be added as determined by local requirements and budgets.

**CHECKLIST**

**Minimum Standards for Chemistry Classrooms**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Room Size (Seating Capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>less than 50</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Layout</td>
<td>rectangular</td>
</tr>
<tr>
<td>seats facing shorter wall</td>
<td>seats facing shorter wall</td>
</tr>
<tr>
<td>parallel rows</td>
<td>parallel rows</td>
</tr>
<tr>
<td>side aisles</td>
<td>side aisles + optional</td>
</tr>
<tr>
<td></td>
<td>sloping or stepped floors</td>
</tr>
<tr>
<td></td>
<td>for larger rooms</td>
</tr>
<tr>
<td></td>
<td>high ceiling</td>
</tr>
<tr>
<td><strong>Access</strong></td>
<td></td>
</tr>
<tr>
<td>front and rear</td>
<td>rear for main traffic</td>
</tr>
<tr>
<td>cart access to lecture area</td>
<td>cart access to lecture area</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows</td>
<td>none or A-V drapes</td>
</tr>
<tr>
<td>Lighting</td>
<td>fluorescent or (better) incandescent in rows</td>
</tr>
<tr>
<td></td>
<td>switched parallel to front of room</td>
</tr>
<tr>
<td></td>
<td>switches near door and at lecture area</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td>standard</td>
</tr>
<tr>
<td></td>
<td>optional downdraft hood on lecture bench</td>
</tr>
<tr>
<td><strong>Seating</strong></td>
<td>movable chairs</td>
</tr>
<tr>
<td></td>
<td>fixed tablet arms</td>
</tr>
<tr>
<td></td>
<td>under-seat book storage</td>
</tr>
<tr>
<td></td>
<td>some left-hand tablet arms</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Lecture Area
- Small fixed table
- 110 volt outlets on table and on floor (for overhead projector)
- Lecture Area Control System, convenient location, conduit to projection area
- Fire extinguisher

### Preparation Area
- Access for roll-in cart

### Projection System
- Overhead projector (horizontal stage)
- Pull-down screen (6' x 6') which can be slanted to avoid Keystone effect
- Roll-in cart with 35mm, Super-8, and 16mm projectors (remote controls)
- 110 volt outlets in back of room
- Roll-in TOPS projector optional

### Projection System
- Overhead projector (horizontal stage)
- One fixed screen (8' x 8'), slanted to avoid Keystone effect
- Roll-in cart or roll-in screen (8' x 8')
- 110 volt outlets in back of room
- Roll-in TOPS projector optional

### Lecture Area
- Medium fixed bench with lockable cabinets
- Roll-in table to match bench
- Gas, electricity, water, sink on bench
- 110 volt overhead projector outlet on floor
- P.A. System, wireless
- Fire extinguisher

### Lecture Area Control System
- One-unit, lockable panel for:
  - Lights (banks)
  - Projectors, including remote focus and slide-changer (random-access preferred)

### P.A. System
-Wireless lecture bench TV system optional
- Telephone connection through P.A.

### Response System
- Optional

---

The Journal of Chemical Education frequently contains useful articles related to design and use of instructional facilities. Of particular value to faculty considering renovation or new construction is the series "The Modern Chemistry Classroom", edited by Dr. W. Robert Barnard. The following are highly recommended:

RECOMMENDED GENERAL RESOURCES

1) Lecture Demonstration Booklets

2) Continuing Resources
   A number of excellent publications are available to teachers of chemistry. Chemical and Engineering News frequently contains interesting articles on new advances in research, technology, and education. The British journal Education in Chemistry (published by The Royal Institute of Chemistry, 30 Russell Square, London WC1, England) has numerous useful features, including regular reviews of instructional motion pictures. Many of the publications designed for high school science teachers, such as "The Science Teacher", National Science Teachers Association, 1201 16th Street, N.W., Washington, D.C., often have appropriate materials for introduction college courses.

   Certainly every chemistry teacher should regularly scan the Journal of Chemical Education. In addition to the excellent articles of a subject-matter nature, particular attention should be given to such continuing features as "Textbook Errors" and "Tested Demonstrations". Annual listings of paperback references are published and a wide variety of instructional aids are advertised.

3) Useful Tables of Data
   a. Handbook of Chemistry and Physics (college edition), The Chemical Rubber Company, 2310 Superior Avenue, Cleveland, Ohio 44115, new editions annually.

4) Model Preparation
   b. Atomic, Molecular, and Crystal Models, Edmund Scientific Co., Barrington, N. J. 08007 - $0.50

5) 35mm Color Slides
   b. Color Slides of Chemical Phenomena (1968) - write for descriptive information from KODANSHA Co., Ltd., Bunkyoku, Tokyo, Japan

6) Programmed Instructional Materials (General)
The Format of TOPICS-AIDS

There are as many ways of approaching the subject of chemistry as there are teachers in the field. The sequence of topics in this booklet is selected as representing a fairly conventional format for an introduction to chemistry. For each topic in the sequence the following items are included:

a. Textbook Errors Summary

b. References
   (Primarily current paperbacks).

c. Selected Films
   (16mm sound and Super-8 silent films).

d. Other Teaching Aids
   (Models, apparatus, programmed materials, etc.).

e. Selected Lecture Demonstrations
   (Both unpublished and references to published demonstrations).

f. Transparency Master
   (Back of topic page).

All illustrations included have been drawn specifically for this publication and are free of copyright restriction except that they may not be reproduced for profit. They may be photographed for slides or converted to overhead projector transparencies. Color may be added with colored inks or by use of colored acetates.

All materials included have been arbitrarily selected by the editors who apologize for any errors or omissions.

*All prices quoted on commercial materials are only approximate. Current catalogs should be consulted before ordering. College audiovisual bureaus may help in locating films for rental rather than purchase.
1) ATOMIC STRUCTURE

a. Textbook Errors Summary


In the paddle-wheel Crookes tube the paddle wheel does not move because of the momentum of the electrons striking it. The electron momentum force is found to be far too small to cause motion; rather, the mechanism is the same as that of the radiometer.

b. References

2. Explaining the Atom, Hecht, S., Viking, 256 pp. (1964) - $1.45
3. Focus on Physics - Atomic Physics, Stearns, R. L., Barnes and Noble (1969) - $1.25

c. Selected Films

1. Mass of the Electron - MLA, cat. no. O613, $90. (16mm, B/W, sound, 18 min.)
2. Millikan Experiment - MLA, cat. no. O604, $150. (16mm, B/W, sound, 30 min.)
3. Rutherford Atom - MLA, cat. no. O616, $150. (16mm, B/W, sound, 40 min.)
4. Rutherford Scattering - HR, cat. no. 80-3969, $25. (S-8, color, silent, 4 min.)
5. Thomson Model of the Atom - EAL, cat. no. 80-3977, $23. (S-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - MLA ($1.50 each)
   cat. no. 0955 - Thomson's e/m Experiment
   cat. no. 0964 - Rutherford Scattering
   cat. no. 0965 - Energy Hill Analog
   cat. no. 0966 - Proton-Proton Repulsion

e. Selected Lecture Demonstrations

1. Electrostatics
   Materials: Two pith balls connected by long string, overhead projector, amber or hard rubber rod, glass rod, cat's fur, piece of silk, 10" x 10" acetate, marking pen.
   Procedure: Hang pith balls from head of overhead projector so that shadows of balls are projected onto a screen. Charge balls +, +, -; -, +, +, labeling charges each time on acetate on projector surface.

2. Magnetic Deflection of Electron Beam
   Procedure: Connect tube to display electron beam, darken room, show beam deflection by N and S poles of magnet.

3. Modified Rutherford Experiment
   Materials: Geiger-Muller Counter (suitable for α-detection) with meter display and audio output, swivel clamp for e/m tube, alpha source, lead foil with circular hole, thin gold (or other metal) foil, overhead projector, acetate, two colored marking pens.
   Procedure: Mount α-tube perpendicular to α-beam. Swivel tube at various angles and plot count rate vs. angle on overhead projector. Insert metal foil in α-path and repeat measurements, using new color for plotting data.

f. Transparency Master

"The Nuclear Atom"
2) **NUCLEAR STRUCTURE**

**a. Textbook Errors Summary**


Increase in binding energy is usually given as a criterion of spontaneity in a nuclear reaction. This is correct in certain cases, e.g., α-decay and fission, but incorrect for isobaric decay (β-emission and electron capture). The basic criterion of spontaneity is that there should be a decrease in mass in the reaction.

**b. References**

5. **Nuclei and Radioactivity: Elements of Nuclear Chemistry**, Choppin, Gregory R., Benjamin, 160 pp. (1964) - $2.95

**c. Selected Films**

1. **Exploring the Atomic Nucleus** - CORF, B/W, $75.; color, $150. (16mm, sound, 13 1/2 min.)
2. **The Nuclear Structure** - UEVA, $105. (16mm, B/W, sound, 19 min.)
3. **Radioactive Decay** - HR, cat. no. 80-2009, $19. (8-8, color, silent, 1 min.)
4. **Radioactivity** - HR, cat. no. 80-3346, $25. (8-8, color, silent, 4 min.)

**d. Other Teaching Aids**

1. **Transparencies** - MLA ($1.50 each)
   - cat. no. 0969 - Mass Spectrometer
   - cat. no. 0970 - Cloud Chamber
   - cat. no. 0972 - Plot of Number of Neutrons vs. Number of Protons in Some Atoms
   - cat. no. 0973 - Binding Energy per Nucleon for Natural Isotopes vs. Mass Number
   - cat. no. 0974 - Compound Nuclei
2. **Models of Mass Spectrometers**

**e. Selected Lecture Demonstrations**


**f. Transparency Master**

"Mass Spectrometer"
MASS SPECTROMETER

Collector Assembly

To preamplifier

Collector slit 0.007 in.

Narrow slit 0.030 in.

Push

Analyzer tube

Ions in register

Magnetic field throughout entire assembly.

Ionizing region

Electron beam

Anode

Thermocouple

Focus slit

First accel. slit

Second accel. slit

Ion accelerating region

Monitor filament

Molecular beam

Repeller

Gas beam

Electron beam

Anode

Thermocouple

Collector slit 0.030 in.

Ions in register
3) ELECTRON CONFIGURATION  

a. Textbook Errors Summary


A relative order of stability of atomic orbitals is usually stated. The order of stability will often change with changes in the nuclear charge or number of electrons surrounding the atom.


The shape of a 2p orbital is often represented by a graph of the angular part of the 2p wave function. To show the true shape of an orbital, the total wave function must be used.


Several textbooks assert that there is no way of choosing the five d orbitals so that they have the same shape but differ only in their orientation; and, so far as the writer is aware, no textbook author has written down such a set of d orbitals. Yet, as early as 1940, George E. Kimball, in his classic memoir on the application of group theory to directed valence, pointed out that five equivalent d orbitals could be directed along the slant edges of a pentagonal pyramid.

b. References


c. Selected Films

1. The Hydrogen Atom (As Viewed by Quantum Mechanics) - advanced version, MLA, cat. no. 4149, $150. (16mm, color, sound, 20 min.)

2. Matter Waves - MLA, cat. no. 0423, $150. (16mm, color, sound, 28 min.)

3. Teacher Training Introduction to "The Hydrogen Atom" - MLA, cat. no. 4049, $50. (16mm, B/W, sound, 9 min.)

4. The Principle of Uncertainty - ROB, cat. no. 6, 480. (16mm, B/W, sound, 30 min.)

d. Other Teaching Aids

1. Transparencies - MLA  
cat. no. 0960 - Energy Level Diagram for Hydrogen Atom  
cat. no. 0961 - Bohr Hydrogen Atom  
cat. no. 0962 - Some Common Spectra


e. Selected Lecture Demonstrations

1. Uncertainty  
Materials: Large balloon or lightweight "beach ball", overhead projector, acetate, marking pen, blindfolds for students.

Procedure: Toss ball to students and have them pass it around. Plot "path" on overhead projector. Then have students blindfold each other. Toss ball to group with instructions, "As soon as you touch the ball, hit it away." After appropriate interval, have blindfolds removed and ask students "Who touched it first, second, third, etc.? Well, who touched it sometime?" Plot "probability map" and discuss problem of determining "path".

2. Continuous and Discontinuous Spectra  
Materials: Powerful white light source, prism, materials for flame tests on various salts, gas discharge tubes and power set-up. (Alternative to prism: student spectrosopes - REC, cat. no. 30580, $.30 each.

Procedure: Darken room, compare continuous and discontinuous spectra.

f. Transparency Master  
"Line Spectra"
SOME TYPICAL LINE SPECTRA

VISIBLE REGION ONLY

Hydrogen
(gas discharge tube)

Neon
(gas discharge tube)

Sodium ion
(flame emission)
4) IONIC BONDING

a. Textbook Errors Summary
   None reported

b. References
   1. Atomic Structure and Valency, Stevens, B., Barnes and Noble, 103 pp. (1967) - $1.75
   3. Classics in the Theory of Chemical Combination, Benfey, O. Theodor, Dover, 221 pp., (1963) - $2.50

c. Selected Films
   1. Ionization Energy - MLA, cat. no. 4151, $165. (16mm, color, sound, 22 min.)
   2. Electric Interactions in Chemistry - MLA, cat. no. 4109, $165. (16mm, color, sound, 21 min.)
   3. Ionization - CORF, B/W, $105.; color, $210. (16mm, sound, 18 1/2 min.)

d. Other Teaching Aids
   1. Overhead Projector Transparencies - REC
      cat. no. 21717 - Boundary Contours of Atomic Orbitals - $4.90
      cat. no. 21718 - Atomic Orbitals of the Period 2 Elements - $11.50
      cat. no. 21719 - Electronic Configuration of the Elements in Period 1, 2, and 3 - $1.50
      cat. no. 21721 - Approximate Energy Levels of Electrons - $7.00
      cat. no. 21726 - Ionization-Energies - $4.90
      cat. no. 21727 - Size and Ionization Energy (IA) - $4.90
      cat. no. 21728 - Size and Ionization Energy (IIA) - $4.90
      cat. no. 21730 - Ion Formation - $4.90

e. Selected Lecture Demonstrations

f. Transparency Master
   "Born-Haber Cycle"
BORN-HABER CYCLE

\[
\begin{align*}
\text{Li}_{(s)} & \rightarrow \text{Li}_{(g)} \\
& \text{(requires energy)} \\
\text{Li}_{(g)} & \rightarrow \text{Li}_{(g)}^+ + e^- \\
& \text{(requires energy)} \\
F_{2(g)} & \rightarrow 2F_{(g)} \\
& \text{(requires energy)} \\
F_{(g)} + e^- & \rightarrow F_{(g)}^- \\
& \text{(releases energy)} \\
\text{Li}_{(g)}^+ + F_{(g)}^- & \rightarrow \text{LiF}_{(g)} \\
& \text{(releases energy)} \\
\text{n LiF}_{(g)} & \rightarrow (\text{LiF})_{n\text{(s)}} \\
& \text{(releases energy)}
\end{align*}
\]
5) COVALENT BONDING

a. None reported

b. References
6. From Vital Force to Structural Formulas, Benfey, O. Theodor, Houghton-Mifflin, 115 pp. (1964) - $2.50

c. Selected Films
1. Atomic and Bonding Orbitals - WIL, 8mm $17.; S-8 $19. (color, silent, 4 min.)
2. Chemical Bonding - MLA, cat. no. 4057, $120. (16mm, color, sound, 16 min.)
3. The Properties of a Covalently Bonded Molecule - LOC, cat. no. E/66A, $9. (8mm, color, silent, 3 min.)
4. Simple Molecular Orbitals - HH, $25. (8-8, color, silent, 4 min.)
5. Atoms to Molecules - MHX, (8 Film Series), $180, (8-8, color, silent, 4 min. each)

d. Other Teaching Aids
1. Atomic and Molecular Structure (4 wall charts) - MGHT, $125.
3. New type demonstration and student models - Write for brochure from Science Related Materials, Inc., P. 0. Box 1009, Evanston, Illinois 60204

e. Selected Lecture Demonstrations
1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 36, 37, 39, 42, 47, 48, 107-113, 118.

f. Transparency Master
"sp^3 Hybrids and Tetrahedral Molecules"
sp³ HYBRIDS AND TETRAHEDRAL MOLECULES

Bond angles 109.5°

Methane (CH₄)  Silane (SiH₄)  Germane (GeH₄)

Stannane (SnH₄)  Plumbane (PbH₄)
6) **CHEMICAL PERIODICITY**

a. **Textbook Errors Summary**


Confusion often exists in distinguishing between the terms "element" and "elementary substance".


Since such important chemical properties as ionization energy and electron affinity are related to the size of atoms, it is quite common to see discussions relating atomic radii to nuclear charge in general chemistry textbooks. Briefly, the argument goes that within a given series nuclear charge increases faster than does shielding, hence the effective nuclear charge increases, resulting in shrinkage with increasing atomic number. Unfortunately, such discussions are often accompanied by a chart or table which illustrates the trend but includes values for the noble gases which are obviously out of line.

b. **References**


c. **Selected Films**

1. *Chemical Families* - MLA, cat. no. 4112, $1.65. (16mm, color, sound, 22 min.)
2. *Teacher Training Introduction to "Chemical Families"* - MLA, cat. no. 4012, $4.00. (16mm, B/W, sound, 7 min.)
3. *Electronegativity* - AIM, cat. no. TF-224, $38. (16mm, color, sound, 4 min.)
4. *Melting Points - Determination and Trends* - AIM, cat. no. TF-224, $38. (16mm, color, sound, 9 min.)

d. **Other Teaching Aids**


e. **Selected Lecture Demonstrations**

1. See index for references to individual elements in *Tested Demonstrations in Chemistry*, Alyea and Dutton.

f. **Transparency Master**

"Relative Sizes"
### Relative Sizes

<table>
<thead>
<tr>
<th>Atom</th>
<th>Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>1.2 Å</td>
</tr>
<tr>
<td>Na</td>
<td>1.6 Å</td>
</tr>
<tr>
<td>K</td>
<td>2.0 Å</td>
</tr>
<tr>
<td>Rb</td>
<td>2.2 Å</td>
</tr>
</tbody>
</table>

![Diagram showing relative sizes of Li, Na, K, and Rb ions](image-url)
STOICHIOMETRY

a. Textbook Errors Summary


Molecular weight is a dimensionless number whereas gram molecular weight denotes an amount of material equal to that dimensionless number.

b. References


c. Selected Films

1. Determining a Molecular Formula - MEHT, cat. no. 612008, B/W, $75.; cat. no. 612020, $1.50. (16mm, sound, 12 1/2 min.)
2. Gases and How They Combine - MLA, cat. no. 4103, $1.65. (16mm, color, sound, 22 min.)
3. Model for Weight Relations in Chemical Reactions - AIM, cat. no. YF-253, $1.14. (16mm, silent, 4 min.)
4. On Writing Equations (I) and On Writing Equations (II) - WIL, 8mm, $1.17.; S-8, 1.19. (silent, 4 min. each)

d. Other Teaching Aids

none listed

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 6, 54, 71-73
2. Microchemistry Projected, Alyea - demonstration numbers: 95, 213, 214
3. Films + Data
   (show film, supply typical data for student calculations)
   - S-8
     The Sartorius Balance - WIL, 8mm $1.17.; S-8 $1.19. (color, silent, 4 min.)
     Gravimetric Techniques - HR, $25. (S-8, color, silent, 4 min.)

f. Transparency Master

"Stoichiometry"
Stoichiometry

\[ 4 \text{Zn} + \text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^+ \rightarrow 4 \text{Zn}^{2+} + 2 \text{Cr}^{2+} + 7 \text{H}_2\text{O} \]
8) MOLECULAR GEOMETRY

a. Textbook Errors Summary


Some classes of compounds, such as symmetrical trans-olefins and para-disubstituted benzenes are said to have a zero dipole moment by symmetry. If the attached groups themselves are sufficiently unsymmetrical, the molecule need not possess a center of symmetry, and hence, may have a finite dipole moment. See also Donohue, J. and D. A. Downs, 39, 420 (1962).

LE BEL AND TETRAHEDRAL CARBON, Sementsov, A., Am. Sc., 43, 97 (1955)

Many textbooks credit Le Bel (along with van't Hoff) with originating the tetrahedral theory while in fact both introduced the concept of the unsymmetrical carbon atom, but Le Bel for a long time opposed the tetrahedral model and even tried to disprove it experimentally.


In discussing hydrogen bonding, geometric restrictions on the bond angles and the steric effect of the hydrogen are often neglected. This may lead the student to incorrect conclusions about the structure of compounds.

b. References

4. The Shape of Carbon Compounds, Herz, Werner, Benjamin, 164 pp. (1963) - $2.45

c. Selected Films

1. SHAPES AND POLARITIES OF MOLECULES - MLA, cat. no. 4154, $1.35. (16mm, color, sound, 18 min.)
2. THE STRUCTURE OF A COVALENT MOLECULE - LOCS, cat. no. E/66A, $9. (8mm, color, silent, 3 min.)
3. THE STRUCTURE OF WATER - MGHT, cat. no. 612024, $1.20. (16mm, color, sound, 14 min.)

d. Other Teaching Aids

1. Models (see also Topic 2)
   Construction and Use of Atomic and Molecular Models, Basset, H., Pergamon, 213 pp. (1968) $5.50

e. Selected Lecture Demonstrations

1. Polarities
   Materials: 8 small petri dishes; 10-15 ml each of water, methanol, chloroform, carbon tetrachloride; few mg of iodine crystals, few mg of potassium dichromate, 2 spatulas, 8 small stirring rods, models representing H2O, CH3OH, CHCl3, CO2, I2, K2Cr2O7 (ions), overhead projector, acetate, marking pen.
   Procedure: Mark formulas of the four solvents on acetate on overhead projector; set petri dishes of solvents on top of formulas. Show and discuss models, including I2. Add I2 to each. Repeat with fresh solvents and K2Cr2O7.

2. Relative Boiling Ranges
   Materials: Large shallow petri dish of hot water; 3-50 ml beakers (each containing 2 "boiling chips"); 3 ml each pentane, diethyl ether (CAUTION), 1-butanol; models of the compounds used; overhead projector, acetate, pen.
   Procedure: Write the formulas of the compounds at positions on the overhead projector acetate and set the dish of hot water, containing the three beakers, on top of this so that each beaker is place near a formula. Show and discuss models and have students predict relative boiling ranges. Add 3 ml 1-butanol to one beaker, then 3 ml ether to another, then 3 ml pentane - in rapid succession. Observe boiling.

f. Transparency Master

"EFFECTS OF HYDROGEN-BONDING" - 39 -
EFFECTS OF HYDROGEN-BONDING

Two H₂O molecules
GASES: REAL AND IDEAL

a. Textbook Errors Summary


Some texts show kinetic energy distributions of gas molecules with points of inflection on both sides of the maximum in the curve. There should be no inflection on the low energy side of the maximum.


Several texts maintain that an essential postulate of the kinetic theory of gases is that the mean molecular kinetic energy is proportional to the absolute temperature. This statement is valid as a conclusion of the molecular kinetics but is not necessary as a postulate.


Perfect gas compression problems often contain no explicit statement of reversibility. This leaves the student uncertain how to calculate the work done by the gas. Since work is not a state function, the exact path must be specified by which the process occurs in order to calculate the work.


It is usually thought that increasing the temperature decreases the solubility of a gas in a liquid. This has been found to be untrue in a number of systems.


In a common derivation of the chemical potential for an ideal gas mixture two errors in differentiation cancel and lead to the correct result.

b. References


c. Selected Films

1. Behavior of Gases - MLA, cat. no. 0115, $90. (16mm, B/W, sound, 15 min.)

2. Gas Laws and Their Applications - EBF, cat. no. 779, $86. (16mm, B/W, sound, 13 min.)

3. Kinetic Theory (6 film set) - HR, cat. no. 89-2810, $150. for 6 films (8-8, color, silent, each film 4 min.)

4. Molecular Motion - HR, $25. (8-8, color, silent, 4 min.)

5. Absolute Zero - MLA, cat. no. 4001, $18.50 (8-8, B/W, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projection Transparencies - MLA ($1.50 each) cat. no. 0909 - Elastic Collision cat. no. 0910 - Inelastic Collision cat. no. 0911 - Momentum in Inelastic Collision cat. no. 0916 - Kinetic Theory of Gases

2. Molecular Motion Demonstrator (for overhead projection)

   Educational Materials and Equipment Company
   Box 63
   Bronxville, N. Y. 10708

   $49.

e. Selected Lecture Demonstrations


2. Mechanical Gas Model - $11. - REC, cat. no. 30470

3. Elasticity of Gases Apparatus - $3. - REC, cat. no. 30220
   (can be used with "ideal" or non-ideal (e.g., NH₃ vapor or H₂O vapor) gases)

4. Specific Heat of Gas Apparatus - $15. - REC, cat. no. 4700

f. Transparency Master

   "Particles in Motion" - 21 -
PARTICLES IN MOTION

Translation

Simple Rotation

Internal Rotation

Symmetric Vibration

Asymmetric Vibration

Bending Vibration
10) **SOLIDS**

a. **Textbook Errors Summary**


Glass does not flow measurably at room temperature as a viscous liquid under stress but does accept a non-permanent deformation, returning to its original shape slowly after the stress is removed. This deformation may be mistaken for viscous flow.

b. **References**


c. **Selected Films**

1. *Thermal Expansion of Solids* - EAL, cat. no. 80-3296, $23. (8-8, color, silent, 4 min.)
2. *Most Solids Melt* - ICF, cat. no. 13015, $20. (8-8, color, silent, 4 min.)
3. *Identifying Solids by Density* - HR, cat. no. 80-3262, $25. (8-8, color, silent, 4 min.)

d. **Other Teaching Aids**

Send for booklet describing construction of many types of models:
"Atomic, Molecular, and Crystal Models"
Edmund Scientific Co., Barrington, N.J., 08007
cat. no. 9076, 50 cents

e. **Selected Lecture Demonstrations**

1. **Cleavage of Crystals vs. Amorphous Solids**

   **Materials:** Several large crystals of rock salt and rock candy, regular and irregular pieces of thick plexiglas, small cutting board, lump of modeling clay, sharp paring knife, small hammer, overhead projector. Styrofoam models.

   **Procedure:** Display crystals and plexiglas pieces on stage of overhead projector. Cleave crystals and plexiglas pieces (imbedded in clay on cutting board). Show possibilities of planar cleavage of crystals and irregular fracture of plexiglas. Show styrofoam models of crystalline and amorphous solids to explain cleavage behavior.

2. **Melting Behavior of Crystals vs. Amorphous Solids**

   **Materials:** Crystals of phenylacetic acid, small pieces of paraffin, large petri dish, hot (80-90°C) water, 2 - 50 ml beakers, overhead projector. Styrofoam models.

   **Procedure:** Set beakers in large petri dish on overhead projector. Place a few crystals of phenylacetic acid in one beaker and a few pieces of paraffin in the other. Pour hot (80-90°C) water into petri dish. Observe sharp melting range of phenylacetic acid and broad softening range of paraffin. Remove beakers from hot water, remove petri dish, set beakers on overhead projector and observe differences in solidification behavior. Show models.

f. **Transparency Master:**

"Order and Motion"
ORDER AND MOTION

Gas
- little order
- rapid motions

Liquid
- more ordered
- slower motions

Crystalline solid
- highly ordered
- little motion

Ionic crystal

Amorphous solid

Liquid crystal
11) CRYSTAL STRUCTURE

a. Textbook Errors Summary

The classification of crystals into crystal systems on the basis of the length and direction of
the crystal axes can lead to errors. The symmetry of the crystal in all of its properties must
confirm a correct classification.

The low friction and wear of graphite surfaces are due to the presence of adsorbed gases or
vapors and not to the laminar structure of graphite.

b. References

   $1.75
2. In Introduction to Crystal Chemistry, Evans, R. C., Cambridge, 410 pp. (1964) - $2.95
   $2.25
4. Introduction to Crystallography, Sands, D. E., Benjamin, 192 pp. (1969) - Approx. $3.95

c. Selected Films

1. Crystals - MLA, cat. no. 0116, $135. (16mm, color, sound, 25 min.)
2. Krystallos - STER, free loan (16mm, color, sound, 11 min.)
3. Close-Packing of Spheres - HR, cat. no. 04-96331, $25. (8-8, color, silent, 4 min.)
4. Crystal Growth - HR, cat. no. 04-96299, $25. (8-8, color, silent, 4 min.)
   (8-8, B/W, silent, 2 min.)
   (8-8, B/W, silent, 3 min.)
7. Crystals and X-Ray Diffraction - MLA, cat. no. 04006, $21. (8-8, B/W, silent, 4 min.)

d. Other Teaching Aids

Send for booklet describing construction of many types of models:
"Atomic, Molecular, and Crystal Models"
Edmund Scientific Co., Barrington, New Jersey 05007
   cat. no. 9076, 50 cents

e. Selected Lecture Demonstrations

Closest-Packing Arrangements
Materials: About 50 spherical balloons in each of three different colors (~150 total), roll
of double-surface scotch tape, overhead projector, acetate, marking pens to match
balloon colors.

Procedure: Draw staggered rows of large circles (~2" diameter) on acetate on overhead pro-
jector. Print a in center of each circle in one color. Label b and c positions
in other colors (at alternate rows of staggered "vacant" positions). Build a
layer of one color balloons in 4 staggered rows of fours (16 balloons), connecting
balloons with small pieces of double-surface tape. Make four such "planes" of
balloons in three different colors, having two sets alike (same color as a on acetate).
Show that these layers could be most efficiently stacked in aba or abca patterns.
Display previously prepared balloon models of hexagonal closest-packed, cubic
closest-packed, and body-centered cubic unit cell models (using balloons of appro-
riate a, b, c colors). Discuss: Metals having such unit cell patterns, assignment
of particles to "within" cell boundaries, relative density considerations, holes in
packing arrays as possible sites for small ions in crystalline salts. (See Film #3
in "Selected Films" above.)

f. Transparency Master

"Three Simple Unit Cells"
THREE SIMPLE UNIT CELLS

Body-centered Cubic

Cubic Closest-packed
(Face-centered Cubic)

Hexagonal Closest-packed
12) CHANGE OF STATE

a. Textbook Errors Summary

Three-phase regions on ternary diagrams are frequently mislabeled as two-phase regions.

Eutectics are often erroneously represented as separate phases on phase diagrams whereas in fact they are always two phase mixtures.

In discussing the change of vapor pressure with temperature, the effects of the molar volume of the liquid and the total external pressure often are ignored.

The triple point of water has now been chosen as the basic fixed point on both Practical and Thermodynamic Scales as 273.16° Kelvin (or +0.01° Celsius).

b. References

Selected Films
1. Explaining Matter: Molecules in Motion - EBF, cat no. 1675, $1.95. (16mm, color, sound, 11 min.)
2. Phase Change (Change of State) - EBF, cat. no. 08061, $22. (8-8, color, silent, 4 min.)
3. Molecular Motion in Condensed Phases - MLA, cat. no. 04010, $21. (8-8, color, silent, 4 min.)
4. Critical Temperature - HR, cat. no. 80-2058, $25. (8-8, color, silent, 4 min.)
5. Boiling Point and Pressure - HR, cat. no. 80-3403, $25. (8-8, color, silent, 4 min.)
6. A Model of the Kinetic-Molecular Concept - WIL, $19. (8-8, color, silent, 4 min.)

d. Other Teaching Aids
Molecular Motion Demonstrator (for overhead projection)
  Educational Materials and Equipment Company
  Box 63
  Bronxville, N. Y. 10708

$49.

e. Selected Lecture Demonstrations

f. Transparency Master
"Solid, Liquid, and Gas"
SOLID, LIQUID, AND GAS

HEAT

HEAT

HEAT
LIQUIDS

a. Textbook Errors Summary


The difference between $C_p$ and $C_v$ for condensed phases is usually dismissed as negligible. In some cases this is not true, for example in CS$_2$, $C_p$ is 35% larger than $C_v$.

b. References
4. Liquids and Solutions, Dreisbach, Dale, Houghton-Mifflin, 208 pp. (1966) - $2.95

c. Selected Films
1. Identifying Liquids by Density - HR, cat. no. 80-3270, $25. (S-8, color, silent, 4 min.)
2. Thermal Expansion of Liquids - HR, cat. no. 80-3304, $25. (S-8, color, silent, 4 min.)
3. Liquids Evaporate - IUF, cat. no. 13085, $20. (S-8, color, silent, 4 min.)

d. Other Teaching Aids
Molecular Motion Demonstrator (for overhead projection)
Educational Materials and Equipment Company
Box 63
Bronxville, N. Y. 10708

$49.

e. Selected Lecture Demonstrations

f. Transparency Master
"Vapor Pressure"
VAPOR PRESSURE

SOLUTION

PURE LIQUID
14) AQUEOUS SOLUTIONS

a. Textbook Errors Summary

The mole fraction of a solute is a function of the molecular weight of the solvent; however, this molecular weight need never be that of the associating liquid but is either arbitrary or has to be that of the vapor phase.

Restriction of the rate of evaporation by solvent molecules in the surface of a solution has been used to explain Raoult's Law. This explanation is shown to be incorrect.

b. References
3. Ionic Processes in Solution, Gurney, Ronald W., Dover, 284 pp. (1962) - $1.85
4. The Solubility of Nonelectrolytes, Hildebrand, Joel H. and Robert L. Scott, Dover, 462 pp. (1964) - $3.00

c. Selected Films
1. Solutions - CORF, $180. (16mm, color, sound, 16 min.)
2. Dynamics of Solution - MGHT, cat. no. 612017, $170. (16mm, color, sound, 14 min.)
3. Liquids in Solution - MGHT, cat. no. 612014, $160. (16mm, color, sound, 11 min.)

d. Other Teaching Aids
None listed

e. Selected Lecture Demonstrations
1. Solubility, Solution Rate, and Particle Size
Materials: Large crystals, small crystals, fine powder of CuSO₄·5H₂O; triple-beam balance; 3 petri dishes, distilled water; 16 styrofoam models of simple cubic unit cells; double-surface tape; overhead projector; quantitative solubility data.
Procedure: Place water in petri dishes on overhead projector. Weigh large crystal, then weigh same amounts of small crystals and powder. Place solids in dishes of water and observe rate of color formation as solids dissolve. Stack 16 unit cells in large cubic pattern (using pieces of double-surface tape); count spheres at surface. Break model up into 8 smaller cubes and count surface spheres. Finally, break up into 16 "unit cells" and count surface spheres. Discuss surface area and rate of dissolving. Display previously obtained quantitative data on concentrations of saturated solutions from large crystals, small crystals, and powder and discuss.

2. Colligative Properties
f. Transparency Master
"Ion Collisions in Solution"
ION COLLISIONS
in solution

Ineffective collision

Effective collision
SOLUBILITY EQUILIBRIA

a. Textbook Errors Summary


Indirect methods for determination of solubility product constants are discussed. The thermodynamic method is cited as an often neglected but highly reliable method for determining solubility products. Solubility product data for metallic sulfides are cited as often being unreliable.


Acetate salts, thought always to be soluble in water, show many instances of low solubility.

b. References

1. Introduction to Solution Equilibrium, Guyon, John C. and Berwyn E. Jones, Allyn and Bacon, Inc., 165 pp. (1968) - $3.25

c. Selected Films

1. Solubility Product - AIM, $67. (16mm, color, sound, 7 min.)
2. Cation Analysis - Wet Chemical Methods - HR, cat. no. 04-96398 (reel - 04-966), $25. (3-5, color, silent, 6 min.)

d. Other Teaching Aids

None listed

e. Selected Lecture Demonstrations

1. Alternative Routes to Saturation
   Materials: 0.50 M SrCl₂, 0.50 M Na₂CrO₄, 0.50 M NaCl, powdered SrCrO₄, 100 ml "tall-form" beakers, overhead projector, 2 magnetic stirrers, 2 filtration set-ups, Spectronic-20 (or equivalent) cuvettes.
   Procedure: At beginning of lecture, set 2 beakers on overhead projector. In one, place 50 ml 0.50 M NaCl, then add powdered SrCrO₄. In other, place 25 ml 0.50 M SrCl₂ and 25 ml 0.50 M Na₂CrO₄. Observe, then transfer beakers to stirring set-ups and stir for about 30 minutes. Filter both solutions and compare color intensities of filtrates qualitatively in beakers on overhead projector and quantitatively with Spectronic-20. Discuss reason for using the 0.50 M NaCl "solvent" for comparison rather than pure water.

2. Le Chatelier's Principle
   Materials: Saturated SrCrO₄ (in contact with solid), saturated Na₂CrO₄, saturated SrCl₂, 50 ml beakers, overhead projector, filtration set-up, stirring rods.
   Procedure: Display on overhead projector beaker containing saturated SrCrO₄ in contact with solid SrCrO₄. Filter and divide filtrate into three parts. Display three beakers of filtrate. To first, add 10 ml saturated Na₂CrO₄. To second, add 10 ml saturated SrCl₂. Compare and discuss.

e. Transparency Master

"Saturated Solution"
SATURATED SOLUTION

Rate of escape from crystal equals the rate of return to crystal.
16) COLLOIDS

a. Textbook Errors Summary


Brown did not observe the motion of pollen grains in suspension. The particles for which the motion was observed were from within the pollen grains, probably cytoplasmic granules.


Brownian motion can account for the stability of only the smallest colloidal dispersions. For larger particle sizes, thermal convection currents and slow rates of sedimentation are controlling factors.

b. References


c. Selected Films

1. Colloids - EBF, cat. no. 201, $70 (16mm, B/W, sound, 11 min.)
2. The Colloidal State - CORF, $180 (16mm, color, sound, 16 min.)
3. Brownian Motion - ICF, cat. no. 15225, $19. (8-8, color, silent, 3 min.)

d. Other Teaching Aids

"Relevance":

Take 35mm slides of industrial smoke, automobile exhaust, foam on polluted water supplies, etc.

Discuss roles of colloids in environmental pollution and aspects of colloid chemistry now available as possible solutions to some environmental problems.

e. Selected Lecture Demonstrations


f. Transparency Master

"Stabilized Sols"
STABILIZED SOLS

IRON (III) OXIDE SOL
(Stabilized by adsorbed cations)

ARSENIC (III) SULFIDE SOL
(Stabilized by adsorbed anions)
CHEMICAL THERMODYNAMICS

a. Textbook Errors Summary


Only for isothermal processes is reversible work always greater than irreversible work. The restriction of constant temperature is often ignored.


In some texts and laboratory manuals the student is instructed to "plot the integral heat of solution of potassium nitrate against molality and extrapolate to m = 0, to obtain the integral heat of solution at infinite dilution. The slope of the curve should be zero at m = 0". In fact the slope will be positively infinite at m = 0!


It is frequently assumed that deviations from Raoul t's Law must be always either positive or negative for a binary mixture. There is no thermodynamic restriction of this sort and examples where deviations change sign are known.


Raoult's Law and the thermodynamic definition of ideal mixing are usually said to be equivalent if the vapors behave as ideal gases. This is shown to be untrue, the error arising from neglect of the effect of pressure on the chemical potential of the liquid phase.

b. References

2. Basic Chemical Thermodynamics, Waer, Jurg, Benjamin, 296 pp. (1966) - $3.95
4. Problems in Chemical Thermodynamics, Bearman, Richard J. and Benjamin Chu, Addison-Wesley, 240 pp. (1967) - $4.95

c. Selected Films

1. Energy Conversion - HR, cat. no. 80-3437, $25. (S-8, color, silent, 4 min.)
2. The Bomb Calorimeter - ADM, cat. no. YF-623, $46. (16mm, color, sound, 9 min.)
3. Carnot Cycle - NHT, cat. no. 626509, $60. (16mm, B/W, sound, 8 min.)
4. Heat of Fusion, HR, cat. no. 80-3429, $25. (S-8, color, silent, 4 min.)
5. Energy Cycles - WIL, $19. (S-8, color, silent, 4 min.)
6. Molecules in Motion - ROB, $180 (16mm, B/W, sound, 30 min.)
7. Molecules at Work - ROB, $180. (16mm, B/W, sound, 30 min.)
8. The Second Law - ROB, $180. (16mm, B/W, sound, 30 min.)
9. Entropy - ROB, $180. (16mm, B/W, sound, 30 min.)

d. Other Teaching Aids


e. Selected Lecture Demonstrations


f. Transparency Master

"Electrical Energy from Chemical Change"
ELECTRICAL ENERGY FROM CHEMICAL CHANGE

\[ \text{Zn} \rightarrow \text{Zn}^{2+} + 2e^- \]

\[ 2e^- + \text{Cu}^{2+} \rightarrow \text{Cu} \]
CHEMICAL EQUILIBRIA

a. Textbook Errors Summary


The form of an equilibrium constant is often derived from rate laws based on the overall reaction equation. These rate laws often do not reflect the actual reaction mechanism but the derivation is still valid since the position of equilibrium does not depend on the mechanism of reaction.


The kinetic behavior of a reaction cannot be predicted from the stoichiometry of the reaction; it must be determined experimentally. Guldberg and Waage were not the first to note the relationship between the quantitative expression for the equilibrium constant and the stoichiometric reaction equation.


The system cupric sulfate-water is frequently used to illustrate phase equilibria. The data generally quoted are not in agreement with the most reliable values reported, particularly for the CuSO₄-11H₂O-CuSO₄ equilibrium.

b. References


c. Selected Films

1. Equilibrium - the Limit of Disorder - ROB, $180. (16mm, B/W, sound, 30 min.)

2. Equilibrium - MLA, cat. no. 4124, $1.50. (16mm, color, sound, 24 min.)

d. Other Teaching Aids

Teacher Training Introduction to "Equilibrium" - MLA, cat. no. 4024, $40. (16mm, B/W, sound, 7 min.)

e. Selected Lecture Demonstrations

Numerous excellent demonstrations are listed in: Tested Demonstrations in Chemistry, Alyea and Dutton and Microchemistry Projected, Alyea

f. Transparency Master

"Dynamic Equilibrium"
Dynamic Equilibrium

Radioisotopes in Liquid-Vapor Equilibrium
ACID-BASE SYSTEMS

a. Textbook Errors Summary

In formulating the ionization constant of water, the activity of the water is usually ignored. This can lead to appreciable errors in calculations involving concentrated solutions.

Sulfuric acid may be thought to be relatively weak due to the small second ionization constant. Actually, the acid strength of concentrated sulfuric acid is comparable with perchloric acid.

Contrary to some texts, phenol is soluble in sodium carbonate solution, being a stronger acid than the bicarbonate ion.

b. References

2. Acids and Bases - McRae, Russell S. and Nicholas A. Matwiyoff, Raytheon Education Co. 128 pp. (1968) - $2.50

c. Selected Films

1. Ionization and Ionic Equilibrium - INDU, cat. no. FSC - 427, $150. (16mm, color, sound, 15 min.)
2. Acid-Base Indicators - MLA, cat. no. 4130, $150. (16mm, color, sound, 19 min.)
3. Acid-Base Indicators - MLA, cat. no. 4002, $21 (8-8, color, silent, 4 min.)
4. The pH Meter - WIL, $19. (8-8, color, silent, 4 min.)
5. pH Meter - HR, cat. no. 04-96396, $25. (8-8, color, silent, 4 min.)
6. Buffer Solutions - HR, cat. no. 04-96372, $25. (8-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - NEC
cat. no. 21748 - "Neutralization" - $4.00
cat. no. 21749 - "Chart of Acid and Base Strengths" - $3.80
cat. no. 21750 - "Protonic Exchange Reactions" - $2.70

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 11-12, 61-62, 120, 128, 144, 147, 155, 162, 167, 194
2. Microchemistry Projected, Alyea Demonstration Numbers: 1-16

f. Transparency Master

"Acid-Base Def'initions"
ACID-BASE DEFINITION

ARRHENIUS:

ACID— $H^+$ Source in water
BASE— $OH^-$ Source in water
e.g. (Neutralization)

\[
HBr_{(aq)} + NaOH_{(aq)} \rightarrow NaBr_{(aq)} + H_2O
\]
(acid) (base) (salt) (water)

BRONSTED-LOWRY:

ACID— $H^+$ Donor
BASE— $H^+$ Acceptor
e.g. (Competition for proton)

\[
NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+
\]
(acid) (base) (acid)

LEWIS:

ACID— Electron-pair acceptor
BASE— Electron-pair donor
e.g. (Competition for electron-pair)

\[
\begin{align*}
:Cl: & \quad :Cl: \\
\text{Al:Cl: + :Cl:Cl:} & \rightarrow \text{Cl:Al:Cl: + Cl:} \\
:Cl: & \quad :Cl:
\end{align*}
\]
20) OXIDATION-REDUCTION AND ELECTROCHEMISTRY

a. Textbook Errors Summary


The absolute magnitude of the standard electrode potential for the silver-silver bromide electrode relative to the standard hydrogen electrode is erroneously listed in several textbooks as 0.095.


The role of the $\text{MnO}_2$ in the Leclanche dry cell is not simply to scavenge the hydrogen produced at the anode. The emf for reduction of the $\text{MnO}_2$ makes a contribution to the total emf of the cell, and $\text{ZnO}_2$ is an important end product.


The common definition of transference numbers in terms of fraction of total current has an operational meaning only in simplest systems. The advantage of an operational definition in terms of ion constituents is discussed.

b. References

2. Introduction to Electrochemistry, Lyons, Ernest H., Jr., Raytheon Education Co., 128 pp. (1967) - $2.95
5. Potentiometry (Handbook of Analytical Chemistry), Meites, Louis, McGraw-Hill (1963)

b. Selected Films

1. Oxidation-Reduction - SUTH, $1.35. (16mm, color, sound, 16 min.)
2. The Development of Electrochemistry - IFB, cat. no. 2 IFB 395, $195. (16mm, color, sound, 19 min.)
3. Electrochemical Cells - MLA, cat. no. 4133, $165. (16mm, color, sound, 22 min.)
4. Faraday's Law - MBT, cat. no. 612021, $190. (16mm, color, sound, 16 min.)
5. An Electrochemical Cell (Animated Mechanism) - MLA, cat. no. 4007, $21. (8-8, color, silent, 4 min.)
6. A Copper-Silver Electrochemical Cell - MLA, cat. no. 4005, $21. (8-8, color, silent, 4 min.)
7. A Silver-Hydrogen Electrochemical Cell - MLA, cat. no. 4015, $21. (8-8, color, silent, 4 min.)
8. Galvanic Cells: Half Cell Reactions - HR, cat. no. 84-2807/1, $25. (8-8, color, silent, 4 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies - HCC
   cat. no. 21736 - "Electrolysis" - $7.10
   cat. no. 21739 - "Galvanic Cells" - $8.20

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton, pp. 15, 20, 87-89, 124, 141, 144-146, 150, 151, 154, 160, 165, 166, 171, 185, 193, 196, 205, 210, 212, 213, 218, 221, 222, 224.

f. Transparency Master

"Cell Potential"
CELL POTENTIAL

\[ E = 0.40 \text{ volt} \]

\[ \text{H}_2 \quad \text{Pt} \quad \text{Cd} \]

\[ \text{c}_{\text{H}^+} = 1.00 \text{m} \quad \text{c}_{\text{Cd}^{2+}} = 1.00 \text{m} \]
a. Textbook Errors Summary

At lower pressures the high-energy population becomes depleted as a consequence of the chemical reaction.

Light cannot be thought to act as a catalyst in photochemical reactions since it is consumed in the course of the reaction and it shifts the position of equilibrium.

Catalytic inhibition of the decomposition of ammonia on a catalyst by hydrogen has been found to occur by a more complex mechanism than simply occupation of the active sites on the catalyst by the hydrogen.


b. References
5. Inorganic Reaction Mechanisms: An Introduction, Edwards, John O., Benjamin, 204 pp. (1964) - $4.95


c. Selected Films
1. Speed of Chemical Change - FAC, cat. no. 16-253, $175. (16mm, color, sound, 15 min.)
2. Catalysis - MLA, cat. no. 4127, $135. (16mm, color, sound, 17 min.)
3. Introduction to Reaction Kinetics - MLA, cat. no. 4121, $105. (16mm, color, sound, 13 min.)
4. Mechanism of an Organic Reaction - MLA, cat. no. 4166, $150. (16mm, color, sound, 20 min.)
5. Reaction Kinetics - HR, cat. no. 04-96495, $25. (8-8, color, silent, 4 min.)
6. Inversion, Retention, and Racemization - HR, cat. no. 04-96513, $25. (8-8, color, silent, 4 min.)

* Note that mechanism shown for HI formation is now known to be incorrect.

3. Animated Mechanisms
Film, or have students film, using Super-8 movie camera, reaction mechanisms using three-dimensional models. Expose 2 or 3 frames for each motion of models. For slow motions, translational movements should be about 1/16 inch and rotational movements about 15°. For faster motions, use larger movements or expose one frame per movement.

f. Transparency Master
"Mechanism of Reaction of HCl with (CH₃)₂COH" - 45 -
MECHANISM OF REACTION
of HCl with (CH₃)₃COH

a.) $H^+ + (CH₃)₃COH$

b.) $[(CH₃)₃COH]^- + (CH₃)₃C^+$

c.) $H_2O + (CH₃)₃C^+$

d.) $(CH₃)₃CCl$

- Hydrogen
- Oxygen
- Carbon
- Chlorine
22) REACTIVE METALS

a. Textbook Errors Summary

Lithium, usually thought to be only tetrahedrally coordinated by oxygen, has octahedral oxygen coordination in several minerals and in the nitrate and iodate.

The statement that the decomposition temperatures of the alkali nitrates are low and that the corresponding nitrites can be prepared easily is in error.

When the flame test is used as a confirmatory test for potassium in cobaltinitrite precipitate, the cobalt is found to interfere. The cobaltinitrite precipitate test also is of questionable value.

b. References

3. The Chemistry of the Metallic Elements, Steele, David, Pergamon, 152 pp. (1966) - $3.45

c. Selected Films

1. Alkali Metal Reactions with Chlorine and With Water - MLA, cat. no. 4004, $21. (8-8, color, silent, 4 min.)
2. Chemical Families - MLA, cat. no. 4112, $165. (16mm, color, sound, 22 min.)
3. The Sodium Family - CORF, $180. (16mm, color, sound, 16 min.)

d. Other Teaching Aids

1. Overhead Projector Transparencies
   (VUFOIL SETS from Science Kit, Inc., 2299 Military Road, Tonawanda, New York 14150)
   cat. no. SK-77910 - "Periodicity in Chemistry" - $34.00
   cat. no. SK-77915 - "Crystal Geometry - Close Packed Structures" - $34.00

e. Selected Lecture Demonstrations

1. Tested Demonstrations in Chemistry, Alyea and Dutton
   Consult index for numerous excellent demonstrations listed by name of element.
2. Filmed Demonstrations
   Film, or have advanced students film, using a Super-8 camera, various uses of the metals or their compounds - e.g., use of a sodium press to obtain sodi wire or ribbon for drying ether, preparation or use of an organolithium compound and a Grignard reagent, use of some hydrides of the metals.

f. Transparency Master:
   "Relative Sizes and Ionization Potentials"
**RELATIVE SIZES**
and
**IONIZATION POTENTIALS**
(electron-volts per atom)

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<th>Be</th>
<th>Be⁺</th>
<th>Be²⁺</th>
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23) ELEMENTS OF GROUPS III A and IV A

a. Textbook Errors Summary


Cryolite is consumed significantly in the Hall process with important economic and air pollution consequences.


Unfortunately, most of the texts which include the bridge structure of aluminum chloride did not complete the story with a correct statement regarding the structure of the solid. A correct description of the structure of solid aluminum chloride could be found only in one text, that of Masterton and Slowinski. In liquid and gaseous aluminum chloride, $\text{Al}_2\text{Cl}_6$, each aluminum atom is surrounded by a slightly distorted tetrahedron of chlorine atoms. However, in solid aluminum chloride, each aluminum atom is surrounded octahedrally by six chlorine atoms.

b. References


c. Selected Films

1. Corrosion III - Aluminum - WIL, $19. (S-S, color, silent, 4 min.)
2. The Modern Chemist - Diamond Synthesis - SUTH, $130. (16mm, color, sound, 13 min.)
3. Silico and Its Compounds - CORF, $150. (16mm, color, sound, 14 min.)

d. Other Teaching Aids

Lecture-Size Models - Write for catalog from:
Science Related Materials, Inc.
P.O. Box 1009
Evanston, Illinois 60204

e. Selected Lecture Demonstrations

See listings by name of element in:
Tested Demonstrations in Chemistry, Alyea and Dutton

f. Transparency Master

"Crystal Lattices - Boron and Diamond"
CRYSTAL LATTICES

Boron

Diamond
 ELEMENTS OF GROUPS V A AND VI A

a. Textbook Errors Summary


There is no evidence to support the existence of arsenic (V) chloride. Some elements of the first long period of the Periodic Table are noted to be reluctant to assume their highest expected covalencies.


Thermal decomposition of potassium chlorate catalyzed by manganese dioxide is quoted often as a convenient source of oxygen. Chlorine containing gases such as Cl₂ and ClO₂ are also formed.


Compounds based on 9-oxyanthracene have been mistakenly thought to be examples of stable oxygen free radicals.


H₂Se is often stated to be thermally unstable. Experiments show that H₂Se is stable at least to 280°C although mixtures of H₂Se and air are readily decomposed at this temperature.

b. References

1. The Inorganic Chemistry of Nitrogen, Jolly, Wm. L., Benjamin, 136 pp. (1964) - $4.95
2. Introductory Descriptive Chemistry: Selected Non-metals Their Properties and Behavior, Johnson, Ronald C., Benjamin, 156 pp. (1967) - $2.95
c. Selected Films

1. Nitric Acid - MLA, cat. no. k136, $135. (16mm, color, sound, 16 min.)
2. Nitrogen and Ammonia - CORF, $180. (16mm, color, sound, 16 min.)
3. Phosphorus - CORF, $175. (16mm, color, sound, 19 min.)
4. O for Oxygen - FAC, $175. (16mm, color, sound, 17 min.)
5. Paramagnetism of Liquid Oxygen - HR, cat. no. 80-201/3, $25. (8-8, color, silent, 4 min.)
6. Chemistry of Water - SUM', $135. (16mm, color, sound, 14 min.)
7. Sulfur and Its Compounds - CORF, $150. (16mm, color, sound, 14 min.)
d. Other Teaching Aids

Transparencies - REC - $6.00 each

cat. no. 21732 - "Electronegativity According to Pauling"
cat. no. 21742 - "The Effect of Hydrogen Bonding"
e. Selected Lecture Demonstrations

See listing by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton
f. Transparency Master

"Hydrogen Bonding and Boiling Point"
HYDROGEN BONDING
and
BOILING POINT
(at 1 atm.)
HALOGENS AND NOBLE GASES

a. Textbook Errors Summary


Iodine or bromine may interfere with the chromyl chloride test for chloride.

b. References

1. The Chemistry of the Non-Metals, Jolly, William, Prentice-Hall, 1.9 pp. (1966) - $2.95

c. Selected Films

1. The Family of Halogens - MGHT, cat. no. 612025, $150. (16mm, color, sound, 13 min.)
2. Chlorine - A Representative Halogen - SUTH, $135. (16mm, color, sound, 15 min.)
3. Bromine - Element from the Sea - MLA, cat. no. 4169, $165. (16mm, color, sound, 22 min.)
4. Chemical Somersault - ABC, free loan (16mm, B/W, sound, 29 min.)
5. A Research Problem: Inert (?) Gas Compounds - MLA, cat. no. 4160, $150 (16mm, color, sound, 19 min.)

d. Other Teaching Aids

None listed

e. Selected Lecture Demonstrations

1. See listings by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton.
2. Preparation of Chlorine, Bromine, and Iodine

Materials: 50 ml beakers, stirring rods, eyedroppers, CCl4, Clorox, 3 M HCl, 0.10 M NaBr, 0.10 M NaI, overhead projector, acetates, pens.

Procedure: Place four beakers on overhead projector and add a shallow layer of CCl4. To first add 1 drop HCl. To second add 5 ml NaBr, then 1 drop HCl with stirring. To third add 5 ml NaI and 1 drop HCl with stirring. Add 1 ml Clorox to each and stir vigorously. Compare. Write equations on acetate.


Materials: 50 ml beakers, stirring rods, eyedroppers, 0.1 M HF, 0.1 M HCl, 0.1 M HBr, 0.1 M HI, 0.1 M NaF, 0.1 M NaCl, 0.1 M NaBr, 0.1 M NaI, 0.05 M AgNO3, 0.1 M Ca(NO3)2, Universal pH indicator solution, overhead projector, acetates, pens, 35mm color slides of freshly precipitated AgCl, AgBr, AgI, CaF2.

Procedure: Show reactions of acids and salts with pH indicator and reactions of salts with AgNO3 and Ca(NO3)2 on overhead project. After each precipitation show color slide of precipitate. Write equations on acetate as reactions occur.

f. Transparency Master

"Xenon Tetrafluoride"
XENON TETRAFLOURIDE
A Chemical Suprise
26) TRANSITION ELEMENTS

a. Textbook Errors Summary

Conductivity measurements are used often to determine the structure of complexes. To do this, one must clearly understand the difference between equivalent and molar conductance.

The intermediate species in the formation of a complex ion are often erroneously ignored in calculations involving the formation constant of the ion.

In several texts of analytical chemistry the stability of complexes with polydentate ligands is incorrectly compared with that of unidentate ligands.

The ratios of energy terms for ligand-metal ion attraction, ligand-d-electron repulsion and d-orbital splitting by the crystal field are frequently inadequately emphasized.

Not all nucleophilic substitution reactions of octahedral complexes go via an aquo complex in aqueous solution. A number go by direct substitution.

b. References
3. Coordination Chemistry, Basolo, Fred and Ronald C. Johnson, Benjamin, 192 pp. (1964) $2.95
5. Symmetry in Inorganic Chemistry, Dorain, Paul R., Addison-Wesley, 122 pp. (1965) $2.50

c. Selected Films
1. Vanadium - A Transition Element - MLA, cat. no. 4172, $15. (16mm, color, sound, 22 min.)
2. Chromium and Manganese - CORF, $350. (16mm, color, sound, 38 min.)
3. Cation Analysis - Wet-Chemical Methods - HR, cat. no. 04-96398, $25. (S-S, color, silent, 4 min.)
4. Cation Analysis - Chromatography and Ion Exchange - HR, cat. no. 04-96414, $25. (S-S, color, silent, 4 min.)
d. Other Teaching Aids
Teacher Training Introduction to "Vanadium - A Transition Element" - MLA, cat. no. 4072, $40. (16mm, B/W, sound, 7 min.)
e. Selected Demonstrations
See listings by element in index of Tested Demonstrations in Chemistry, Alyea and Dutton.
f. Transparency Master
"Geometries of Complexes"
GEOMETRIES OF COMPLEXES
(idealized)

Cation or atom

Ligand

Coordinate bond

Definition of planes

linear

angular

square planar

trigonal pyramidal

tetrahedral

octahedral

square antiprism
27) ORGANIC CHEMISTRY: HYDROCARBONS

a. Textbook Errors Summary

Texts often cite neutral potassium permanganate as a reagent for conversion of alkenes to cis-glycols. Usually, alkaline permanganate is distinctly superior.

Because of its unusual reactions the cyclopropane ring is inaccurately referred to as olefin-like.

These reactions are sensitive to the reaction conditions and isomer mixtures often occur.

Large percentages of n-alkylated products in some cases suggest a competing nucleophilic displacement mechanism.

Common errors in the naming of alkanes, alcohols, carbonium ions, and pyrimidines are discussed.

b. References

2. Industrial Organic Chemistry, Stille, J. K., Prentice-Hall, 144 pp. (1968) $2.50

c. Selected Films

1. Carbon and Its Compounds - CORP, $1.20. (16mm, color, sound, 11 min.)
2. Hydrocarbons and Their Structures - CORP, $1.50. (16mm, color, sound, 13 min.)

d. Other Teaching Aids

Molecular Models - several types
Write for brochures from: Science Related Materials, Inc., P.O. Box 1009, Evanston, Ill. 60204
W. A. Benjamin, Two Park Avenue, New York, N. Y. 10016
Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632

e. Selected Lecture Demonstrations

1. Isomerism and Planar Representations
Materials: Small models, e.g., Benjamin (Maruzen) Kit, overhead projector, acetates, pens.
Procedure: Show a "linear" model of n-butane, lay the model on the overhead projector, and print a typical "linear expanded" formula to match the shadow pattern. Using the same model twisted into other shapes, show alternative representations for the same compound. Then follow the same procedure for isobutane. Contrast isomers with simple alternative planar representations.

2. Bromine and Hydrocarbons
Materials: 50 ml beakers, stirring rods, dilute bromine in carbon tetrachloride, iron nails, pure samples of cyclohexane, cyclohexene, benzene, acetylene gas, overhead projector, acetates, pens.
Procedure: Place cyclohexane and cyclohexene in beakers on projector and add bromine solution with stirring, counting drops. Then place bromine solution in beaker and bubble in acetylene gas slowly. Finally, place two beakers of benzene (one containing an iron nail) and one of cyclohexene on the projector. Add bromine to these and allow to stand on the lighted projector. Write equations for reactions.

Discuss: Addition, nucleophilic substitution, free radical reaction, bond delocalization.

f. Transparency Master
"Orbital Representations"
ORBITAL REPRESENTATIONS

Sigma bonds in methane

Pi bond in ethylene

Pi bond in benzene
ORGANIC CHEMISTRY: FUNCTIONAL GROUPS

a. Textbook Errors Summary

It is not possible to esterify phenols directly with carboxylic acids.

Use of the Fehling and Benedict tests to detect simple aliphatic aldehydes is not valid.

Simple aliphatic acids, except acetic, give mixtures on decarboxylation.

In pyrolysis of calcium and barium carboxylates complex mixtures usually occur.

Many primary amines, e.g., cycloalkylamines, give insoluble benzenesulfonamides.

Only a small proportion of Hofmann eliminations give exclusively alkene products.

Fluorine, unlike other halogens, is found to activate the position para to it.

Several common diazo coupling generalizations are not valid.

Primary and secondary alcohols are often said to decolorize neutral aqueous potassium permanganate. This is found generally to be untrue for saturated alcohols.

b. References
1. The Names and Structures of Organic Compounds, Benfey, Otto Theodor, Wiley and Sons, 212 pp. (1965) - $2.95

c. Selected Films
1. Mechanism of an Organic Reaction - MLA, cat. no. b166, $1.50. (16mm, color, sound, 20 min.)
2. Reaction Kinetics - HR, cat. no. 04-06455, $25. (8-8, color, silent, 4 min.)
3. Inversion, Retention, and Racemization - HR, cat. no. 04-96513, $25. (8-8, color, silent, 4 min.)

d. Other Teaching Aids
2. Teacher Training Introduction to "Mechanism of an Organic Reaction" - MLA, cat. no. 4066, $50. (16mm, B/W, sound, 9 min.)

e. Selected Lecture Demonstrations
Prepare combinations of projectable demonstrations, 35mm color slides, and teacher (or student) produced super-8 films on reactions of functional groups. Laboratory manuals and textbooks on qualitative organic analysis provide many suitable examples.

f. Transparency Master
"Common Functional Groups"
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<th>Group</th>
<th>Class</th>
<th>Example</th>
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<td>C=X (X=F, Cl, Br, I)</td>
<td>halide</td>
<td>CHCl₃ (chloroform)</td>
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<td>C-OH</td>
<td>alcohol</td>
<td>CH₃CH₂OH (ethanol)</td>
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<tr>
<td>C-O</td>
<td>phenol</td>
<td>(carbolic acid)</td>
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<td>CH₃CCH₃ (acetone)</td>
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<td>C-O-C</td>
<td>ether</td>
<td>C₂H₅OC₂H₅ (diethyl ether)</td>
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<tr>
<td>C-O-C</td>
<td>ester</td>
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29) **STEREOCHEMISTRY**

a. **Textbook Errors Summary**


Lack of a plane of symmetry is inadequate and should be replaced by the criterion of non-superimposable mirror images.


The conductivity of boric acid solutions containing glucose is used to assign the configuration on carbon-1. This argument was based on a furanose structure while glucose is now known to exist in a pyranose structure for which the argument is invalid.


The tartaric acids are often named D-tartaric acid or L-tartaric acid without reference to whether the carbohydrate (Rosanoff) or amino acid systems is being used. The difference lies in whether the absolute configuration of the lowest numbered or highest numbered asymmetric carbon is taken as the basis for the nomenclature.

b. **References**

2. *Introduction to Stereochemistry*, Mislow, Kurt, Benjamin, 205 pp. (1965) - $3.95

c. **Selected Film**

1. *Simple Stereochemistry* - HR, cat. no. 04-96471, $25. (8-8, color, silent, 4 min.)
2. *Optical Activity* - HR, cat. no. 04-96497, $25. (8-8, color, silent, 4 min.)

d. **Other Teaching Aids**

**Lecture-Size Models**

Science Related Materials, Inc., P.O. Box 1009, Evanston, Ill. 60204

e. **Selected Lecture Demonstrations**

1. **Enantiomers**

   **Materials:** Two spherical balloons in each of four colors and in white, double surface tape, large mirror.

   **Procedure:** Prepare in advance two mirror images of tetrahedrally-arranged colored balloons around central white balloon. Place one in front of and one behind large mirror on lecture bench. Display, then remove mirror. Show that the models are non-superimposable.

2. **Optical Activity**

   **Materials:** Two 10" x 10" sheets of polaroid, large petri dishes, saturated solutions of sucrose and of table salt, distilled water, overhead projector, ruler, wax marking pencil.

   **Procedure:** Lay one polaroid sheet on projector stage and mark a line through the center parallel to one edge. Place the other sheet on top of this and rotate it until maximum light intensity is observed. Mark a line on this corresponding to the line on the first sheet. Interpose a deep petri dish of water between the two sheets, adjusting focus as necessary to obtain best projection of both lines. Observe relative sheet positions for maximum light intensity with dishes of water, salt solution, and sucrose solution. [See also: Henderson, Giles, "A TV Lecture Demonstration of Optical Activity", *J. Chem. Ed.*, 44, 765 (1967)]

f. **Transparency Master**

"Polarimeter"

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68
30) **ABSORPTION SPECTRA**

a. **Textbook Errors Summary**


Many photochemistry texts ignore some of the basic physics of light absorption. A development of the Beer-Lambert relation from Maxwell's equations is given and photoinitiation processes are discussed.

b. **References**


c. **Selected Films**

1. *Absorption Spectra* - EAL, cat. no. 80-2025, $16. (8-8, color, silent, 4 min.)
2. *Visible and Ultraviolet Spectra* - HR, cat. no. 04-96215, $25. (8-8, color, silent, 4 min.)
3. *Molecular Spectroscopy* - MLA, cat. no. 4142, $165. (16mm, color, sound, 23 min.)
4. *Infrared* - AEC, free loan (16mm, color, sound, 15 min.)
5. *Infrared Spectroscopy* - HR, cat. no. 04-96091, $25. (8-8, color, silent, 3 min.)
6. *Nuclear Magnetic Resonance* - WIB, $300. (16mm, color, sound, 28 min.)
7. *Nuclear Magnetic Resonance* - HR, cat. no. 04-96273, $25. (8-8, color, silent, 4 min.)
8. *Analysis by Mass* - IFB, cat. no. 3, $22. (16mm, color, sound, 27 min.)
9. *Mass Spectra* - HR, cat. no. 04-96190, $25. (8-8, color, silent, 4 min.)

d. **Other Teaching Aids**

Prepare, or have students prepare, Super-8 films showing operation of locally-available instruments.

e. **Selected Lecture Demonstrations**

Prepare 35mm slides or transparencies of textbook or experimental spectra for student interpretation.

f. **Transparency Master**

"MB"
2-bromopropane

- 64 -

- ERIC -
a. Textbook Errors Summary


All of the proteins characterized to date are known to be made up of L-amino acids. In the small number of cases where the helical sense of proteins has been determined they have been found to be right-handed. The helical sense of DNA is also known to be right-handed. It is perhaps germane to recall some of the devices used to remember the helical sense. One of the most convenient is to imagine a point travelling along the helix. One grasps the helix with the appropriate hand so that the fingers point in the direction of travel in the helical path and the thumb points in the direction of travel with respect to the helical axis. If the right hand fulfills the requirements it is a right-handed helix; the left hand, the opposite. Alternatively, one can tell the helical sense at a glance by noting that if the helical axis is vertical a line tangential to the portion of each turn of the helix closest to the observer "leans" to the right for the right-handed form, and to the left for the left-handed form.

b. References

1. Elasticity, Plasticity and Structure of Matter, Houwink, Roelof, Dover, 386 pp. (1957) - $2.45
3. The Meaning of Crystallinity in Polymers, editor Price, Fraser P., General Electric, 149 pp. (1967) - $5.95
5. The Biosynthesis of Macromolecules, Ingram, Vernon M., Benjamin, 223 pp. (1967) - $3.95

c. Selected Films

1. Miracle Materials - ALFI, $125. (16mm, B/W, sound, 23 min.)
2. Physical Chemistry of Polymers - STER, free loan (16mm, color, sound, 22 min.)
3. Chemistry of the Cell - 1: The Structure of Proteins and Nucleic Acids - MGHT, $250. (16mm, color, sound, 21 min.)

d. Other Teaching Aids

(See earlier listings for sources of models).

e. Selected Lecture Demonstrations


f. Transparency Master

"α and β Glycosides"
α and β Glycosides
A variety of physical measurements made on ionized species of amino acids have supported the dipolar or Zwitterion interpretation of the titration behavior. However, the assignment of a pK value to a particular acidic group becomes more difficult as the groups in question become less familiar. The titration of pyridoxine is an example of a complex polybasic compound where the measured pKa values of 5.00 and 8.96 cannot be unequivocally associated with the pyridinium or phenolic groups by using pyridine (pKa ~ 5) and phenol (pKa ~ 10) as analogous reference compounds. Using the analogy, one would associate the low pKa with the pyridinium group, and the high pKa with the phenolic group. Careful spectrophotometric analysis of the pyridoxine system has established just the opposite; that is, the low pKa is associated with the phenolic group and the high pKa with the pyridinium group.

**References**

5. *The Primary Structure of Proteins (Principles and Practice for the Determination of Amino Acid Sequence)*, Harper and Row, (1968) - $5.95

**Selected Films**

1. *Biochemistry and Molecular Structure* - MIA, cat. no. 4181, $169. (16mm, color, sound, 22 min.)
2. *Cell Division-Mitosis* - EBF, cat. no. 68055, $18. (8-8, color, silent, 3 min.)
3. *Cell Respiration* - MHT, cat. no. 613238, $300. (16mm, color, sound, 28 min.)
4. *Chemical Machinery* - MHT, cat. no. 613260, $300. (16mm, color, sound, 28 min.)
5. *Gateways to the Mind* - STER, free loan (16mm, color, sound, 59 min.)

**Other Teaching Aids**

(See earlier listings for models).

**Selected Lecture Demonstrations**

Consult subject index in *Tested Demonstrations in Chemistry*, Alyea and Dutton

**Transparency Master**

"Amphoterism of Glycine"
**AMPHOTERISM OF GLYCINE**

\[
\begin{align*}
H_3\text{NCH}_2\text{COOH} & \quad \text{‘acidic’ form} \\
\text{OH}^- & \quad \text{H}^+ \\
H_3\text{NCH}_2\text{COO}^- & \quad \text{‘neutral’ form} \\
\text{OH}^- & \quad \text{H}^+ \\
H_2\text{NCH}_2\text{COO}^- & \quad \text{‘alkaline’ form}
\end{align*}
\]

Note: \( H_2\text{NCH}_2\text{COOH} \) negligible
33) GENETIC CODE

a. Textbook Errors Summary
   None listed

b. References
   3. The Double Helix, Watson, James D., New American Library, 143 pp. (1968) - $0.95

c. Selected Films
   1. Gene Action - EBF, cat. no. 2138, $200. (16mm, color, sound, 16 min.)
   2. DNA Transformation Experiment - EAL, cat. no. 81-6058, $23. (8-8, color, silent, 4 min.)
   3. Extraction of Nucleic Acids - THORNE, $120. (16mm, color, sound, 10 min.)

d. Other Teaching Aids
   1. DNA Action Model, Clarke, Robert F., Charles Schlanker, and Richard Sagness, Burgess, (1968)
      $1.25
   2. Elements of Protein Synthesis, Thomas Peter Bennett, Freeman, approximately $2.00

e. Selected Lecture Demonstrations
   Suggestion: Invite faculty from biochemistry, biology, genetics, medicine for class discussion. Also consider discussions involving science and religion.

f. Transparency Master
   "Base Pairing"
BASE PAIRING

- C - G
- A - T

hydrogen bond
sugar
phosphate
A - adenine
T - thymine
G - guanine
C - cytosine

Thymine
CH₃

Adenine

sugar, etc.

Cytosine

Guanine

sugar, etc.

sugar, etc.
APPENDIX A

LIST OF COMMERCIAL SUPPLIERS

ACADEMIC PRESS, INC.
111 Fifth Avenue
New York, N. Y. 10003

ADDISON-WESLEY PUBLISHING CO., INC.
Reading, Massachusetts 01867

AES
Audio-Visual Branch
Division of Public Information
U.S. Atomic Energy Commission
Washington, D. C. 20545

AIM
Association Instructional Materials
O/C Association Films, Inc.
347 Madison Ave. (Dept. DC)
New York, N. Y. 10017

ALFI
Almanac Films, Inc.
29 E. 10th Street
New York, N. Y. 10003

ALLYN AND BACON, INC.
470 Atlantic Avenue
Boston, Massachusetts 02110

AMERICAN ELSEVIER PUBLISHING CO., INC.
52 Vanderbilt Avenue
New York, N. Y. 10017

APPLETON, CENTURY, CROFTS, INC.
460 Park Avenue South
New York, N. Y. 10016

BARNES AND NOBLE, INC.
105 Fifth Avenue
New York, N. Y. 10003

W. A. BENJAMIN
Two Park Avenue
New York, N. Y. 10016

BURGESS PUBLISHING CO.
426 So. Sixth Street
Minneapolis, Minnesota 55415

CAMBRIDGE UNIVERSITY PRESS
32 East 57th Street
New York, N. Y. 10022

CHEMICAL EDUCATION PUBLISHING CO.
20th and Northampton Streets
Easton, Pennsylvania 18042

CORF
Coronet Films
65 E. South Water Street
Chicago, Illinois 60601

DOUBLEDAY AND CO., INC.
501 Franklin Avenue
Garden City, N. Y. 11530

DOVER PUBLICATIONS, INC.
180 Varick Street
New York, N. Y. 10014

EDMUND SCIENTIFIC COMPANY
101 E. Gloucester Pike
Barrington, N. J. 08007

EDUCATIONAL MATERIALS AND EQUIPMENT COMPANY
Box 63
Bronxville, N. Y. 10708

FAC
Film Associates of California
11559 Santa Monica Blvd.
Los Angeles, California 90025

FAWCETT PUBLICATIONS, INC.
67 West 44th Street
New York, N. Y. 10036

W. H. FREEMAN AND COMPANY PUBLISHERS
600 Market Street
San Francisco, California 94104

HEATH-RAYTHEON
See RAYTHEON

HOLDEN-DAY, INC.
500 Sutter Street
San Francisco, California 94111

HOLT, RINEHART AND WINSTON, INC.
333 Madison Avenue
New York, N. Y. 10017

HOUGHTON-MIFFLIN
110 Tremont Street
Boston, Massachusetts 02116

HR
Harper and Row, Publishers, Inc.
49 East 33rd Street
New York, N. Y. 10016

ICF
International Communication Films
1271 Reynolds Avenue
Santa Ana, California 92705

IFB
International Film Bureau, Inc.
332 S. Michigan Avenue
Chicago, Illinois 60604

INDU
Indiana University
Audio-Visual Center
Bloomington, Indiana 47401

LGC
Longmans, Green and Co., Ltd.
48 Grosvenor Street
London W.1., England

THE MACMILLAN COMPANY
866 Third Avenue
New York, N. Y. 10022

MGH
McGraw-Hill Book Company
330 W. 42nd Street
New York, N. Y. 10036
1) Laboratory Safety

The safety programs in most academic laboratories leave much to be desired, not only from the
view of accident hazards, but also from the aspect of proper teaching. It is recommended that every
effort be made to teach and require proper laboratory safety in chemistry.

Three excellent references are available:

a. Safety in Chemistry Laboratories, Chemical Education Publishing Company (1967) - $3.00
b. The Journal of Chemical Education - continuing series "Safety in the Chemical Laboratory,"
   edited by Norman V. Steere
c. Handbook of Laboratory Safety, Chemical Rubber Publishing Company, 2310 Superior Avenue,
   Cleveland, Ohio 44114

Some simple precautions are useful in preventing accidents or in minimizing injury in the event
of accident:

a. Give students two copies of safety rules and require them to sign and return one copy.
b. Enforce eye protection requirement rigorously. Require routine use of pipet bulb (not mouth).
c. Train laboratory assistants and stockroom personnel in emergency procedures. Periodic
   unannounced simulated emergencies help maintain preparedness.
d. Post emergency telephone numbers and basic first aid procedures conspicuously in all
   laboratories.
e. Mark locations of fire extinguishers, safety showers, and eyewash sprays (vegetable sprayers
   are excellent) with conspicuous signs.
f. Send brief written reports of accident details with person accompanying an accident victim
   to the medical facility.

For training sessions of instructors and students, safety films may prove valuable. Some which
are currently available are:

a. Chemical Booby Traps, General Electric Educational Films, 60 Washington Avenue, Schenectady,
   N.Y. 12305 (10mm, color, sound, 10 min., $120.)
b. Safety in the Chemical Laboratory, Manufacturing Chemists Association, Inc., 1825 Connecticut
   Avenue, N.W., Washington, D.C. 20009 (10mm, color, sound, 20 min., $100.)
c. Safety in the Laboratory, Association Instructional Materials, 347 Madison Avenue (Dept. DC)
   New York, N.Y. 10017 (10mm, color, sound, 8 min., $90.)
d. [Safety Series], Harper and Row, Publishers, 49 E. 33rd Street, New York, N.Y. 10016
   (Five 8-8 films, color, silent, $25. each)
   - Basic Laboratory Safety
   - Handling Reagents
   - Laboratory Emergencies
   - Laboratory First Aid
   - Accident Prevention

2) Films for the Laboratory

A wide variety of 16mm and Super-8 films are now commercially available for introducing laboratory
techniques or specific experiments. For descriptive catalogs, write:

a. AIM - see Appendix A
g. Kalmba Co., Concord, Mass. 01742
b. CORF - see Appendix A
h. Macalaster Scientific Co. - see REC Appendix A
c. IAL - see Appendix A
i. MONT - see Appendix A
d. EBF - see Appendix A
j. W.R. Saunders, West Washington Square,
   Philadelphia, Pa. 19105
e. HR - see Appendix A
f. ICF - see Appendix A
k. Wiley - see Appendix A

3) Laboratory Separates

For the teacher who prefers an individualized collection of experiments to a more conventional
laboratory manual, the new Laboratory Separates Programs should have considerable appeal. Two such
programs are now active in college chemistry and other publishers are planning ventures. For details
on the current materials, write: W. H. Freeman and W. Lard Grant Press - see Appendix A
APPENDIX C

- THE AC\(_3\) CLEARINGHOUSE FOR FILMS AND SLIDES -

Teachers willing to share their production of instructional materials in the form of silent 16mm or Super-8 films or 35mm slides are invited to submit copies to the AC\(_3\) Clearinghouse for duplication and distribution at cost. For details of submission procedures or order forms for Clearinghouse materials, write:

Rod O'Connor
AC\(_3\) Clearinghouse
Department of Chemistry
The University of Arizona
Tucson, Arizona 85721