JOURNAL OF CHEMICAL EDUCATION

pubs.acs.org/jchemeduc Communication

Using Classic Movie Chemistry Scenes to Introduce Classroom Activities

Nicholas C. Thomas*

Cite This: https://doi.org/10.1021/acs.jchemed.1c00076 Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: A list of classic movies containing chemistry-related scenes is provided for instructors to use when introducing a variety of general chemistry topics. Most of these movies have not been previously discussed in this context. The scenes can be legally copied for use in classroom PowerPoint lectures, and steps for doing this are discussed. The clips can be used alongside suggested activities for demonstrations, laboratory experiments, classroom discussions, and problem-solving or essay assignments to complement the film scenes.

KEYWORDS: *High School/Introductory Chemistry, First-Year Undergraduate/General, Safety/Hazards, Demonstrations, Multimedia-Based Learning, Physical Properties, Nomenclature/Units/Symbols, Stoichiometry, Acids/Bases, Qualitative Analysis*

INTRODUCTION

Classic Films in the Classroom

Adapting scientific principles in motion pictures is a well-known plot device,[1,2] and playing scenes from films that depict specific chemical concepts has been suggested as an entertaining addition to classroom topics to further engage students.[3−11] The focus has generally been on more recent science fiction films,[12−15] including popular franchises such as *Star Wars*, *Harry Potter*, and the *Marvel* universe since these are very familiar to contemporary students. While older movies have not been entirely ignored,[3] films from the classic movie period (1930s−1960s) are more likely to be overlooked since students may view them as outdated, slower paced, and lacking the spectacular special effects and popular actors of the day. However, students may be pleasantly surprised to learn that older films contain scenes with fascinating and, in some cases, quite detailed chemical dialogue. Furthermore, many of the topics in this collection of classic movie scenes are taught in high school chemistry and physical science classes, so all could be viewed by younger students since older movies are more likely to be rated for general audiences.

This paper describes scenes from several films released during the classic movie era, which, for the most part, have not been previously described in the above references. They depict short chemical-related scenes instructors could combine with classroom activities when introducing chemistry topics. The simple steps required to extract clips from movies and insert them into PowerPoint presentations so they can seamlessly be incorporated into lectures are explained in the Supporting Information. Curriculum topics include lab safety, density, unit conversion, stoichiometry, acids and bases, the periodic table, and more. To complement the film scenes, there are suggestions for specific activities such as demonstrations, lab exercises, classroom discussions, and problem-solving or essay assignments. Some clips could also be entertaining if played during introductory lectures in other courses such as qualitative analysis and forensic chemistry. Copying film clips for classroom use may be permissible under U.S. copyright laws, and details are provided in the Supporting Information along with further suggestions for classroom activities. (Disclaimer: The U.S. Copyright Law provision cited in the Supporting Information, and the related discussion, is not intended as legal advice from ACS. Users of this type of content do so at their own risk and should consult with their own legal counsel as to whether it applies in their specific case.)

While no formal student surveys have been conducted to evaluate whether the film clips enhance retention of material, informal student comments have indicated a mostly positive response. It may also be beneficial to remind students that, rather than regarding the clips as mere fragments of less familiar older movies, they could be viewed as snippets of cinema history where chemistry briefly stars.

TOPICS

The following list of film scenes is grouped by general chemistry topics. Movie titles and date of release are followed by the approximate start time for each scene (in minutes) and its duration (in seconds).

Lab Safety

***The Affairs of Dobie Gillis*, 1953 (19:15 min; 35 s).** One of the universally enforced safety requirements for students working in a chemistry laboratory is the wearing of approved safety goggles, but not in this movie from the 1950s where neither the instructor nor college students in the classroom are

Received: January 26, 2021
Revised: March 24, 2021

wearing any eye protection. During this scene[16] in a Fundamentals of Chemistry class, the instructor tells students "on your table you'll find a tube containing potassium chlorate. The tubes are connected to the water troughs. Light your Bunsen burners. Warm the test tube until you see the bubbles rising from the water troughs into the gas bottle. Now be careful, don't let those bubbles come too fast."

The thermal decomposition of potassium chlorate is a common general chemistry lab. Although an actual explosion from this experiment would be unlikely, the movie scene is still disturbing considering the students are heating samples in test tubes with open flames but with no eye protection while collecting the evolved oxygen. This clip should be played when discussing lab safety, and hopefully, students will cringe when watching the actress, Debbie Reynolds, pressing her unprotected face close to a heated chemical highlighting the need for wearing safety goggles at all times in a chemistry lab. The same clip can be used when discussing stoichiometry calculations (below).

Unit Conversion

***Killers from Space*, 1954 (50:10 min; 40 s).** A nuclear scientist, played by Peter Graves, is captured by aliens and held at their underground base where he learns of a plan to exterminate humanity using radiation the aliens have captured from Earth's atomic bomb tests. How much radiation have they stored? "To date, we have accumulated several billion electron-volts from your atomic explosions," explains the alien.

As a classroom exercise in unit conversion, students can convert electron-volts into joules in order to appreciate its magnitude. Assuming "several billion" to mean 3.0 billion eV and using the conversion factor 1 eV = 1.6×10^{-19} J, the aliens would have stored a mere 4.8×10^{-10} J. Hardly enough energy required for alien world domination!

Atomic Structure

***This Island Earth*, 1955 (38:40 min; 20 s).** In what must be one of the greatest on-screen science bloopers involving atomic structure, two scientists direct another scientist to his new laboratory where he has been enticed to work by aliens. Entering the room, they are startled by a cat. "It's only Neutron," says one scientist. "We call him that because he's so positive."

When introducing subatomic particles, this brief scene will amuse students and could fall under the category of "Find the (obvious) science error in the following scene."

Chemical Formulas

***Three Little Pigskins*, 1934 (13:50 min; 15 s).** While this scene is from a Three Stooges short rather than a feature film, it illustrates an interesting aspect in the history of chemical formula notation that will be unfamiliar to most students. The Stooges (Larry, Curly, Moe) find themselves playing in a college football game[17] and enter the field wearing unique jersey numbers: Larry's reads 1/2, Curly's is a question mark, and Moe's is H^2O^2, which presumably represents the formula for hydrogen peroxide with superscripts instead of the modern subscripts depicting atom proportions.

When Berzelius first proposed using a system of letters and numbers for chemical formulas in the early 19th century, the numbers were indeed written as superscripts. Despite initial resistance to his new notation, by the midcentury it became widely accepted with the subscript figures eventually becoming standard.[18] It is conceivable a film writer was aware of the old notation and, being a Three Stooges production, used the formula farce as a typical Stooges sight gag.

Density

***Voyage to the Bottom of the Sea*, 1961 (18:40 min; 60 s).** In this movie that inspired the popular 1960s sci-fi series of the same name, the submerged nuclear-powered *Seaview* submarine is pelted with large iceberg chunks sinking into the ocean resulting from a massive temperature rise on Earth's surface.

Students should recognize the conspicuous science error, since icebergs float in seawater. As a class demonstration, the instructor could show the obvious effect of ice cubes in both freshwater and simulated seawater (prepared from NaCl in tap water) leading to the expected results. For comparison, ice cubes prepared from the frozen seawater could be placed in freshwater. Will they also float? (See Supporting Information.)

***The Night the World Exploded*, 1957 (27:50 min; 60 s).** Two scientists find a new "mineral" in a cave, and holding a sample, one remarks "it's heavy" to which the other responds "yes, a lot of mass compressed in that little chunk"—a simple yet accurate description of density while also implying the material has high density.

Although mineral hardness is not usually discussed when introducing density in general chemistry, the two physical properties are linked by a follow-up comment in the same scene where one scientist attempts to ascertain the new mineral's hardness. "Let's see how it stands up under a pair of pliers," he suggests. "No marks—the hardness seems to correspond with the density." Students can be asked, "Is there a correlation between density and hardness for minerals?" For the 10 minerals on the Mohs Scale of Hardness, there is a general increase in hardness as the density increases (Figure 1),[19] although other factors are involved such as the atomic mass of elements in the mineral. This clip could also be shown when discussing the properties of solids.

Stoichiometry Calculations

***The Affairs of Dobie Gillis*, 1953 (19:15 min; 35 s).** In addition to illustrating safety concerns in the Safety section above, the thermal decomposition of $KClO_3$ scene can also be used as a stoichiometry problem when introducing gas laws.

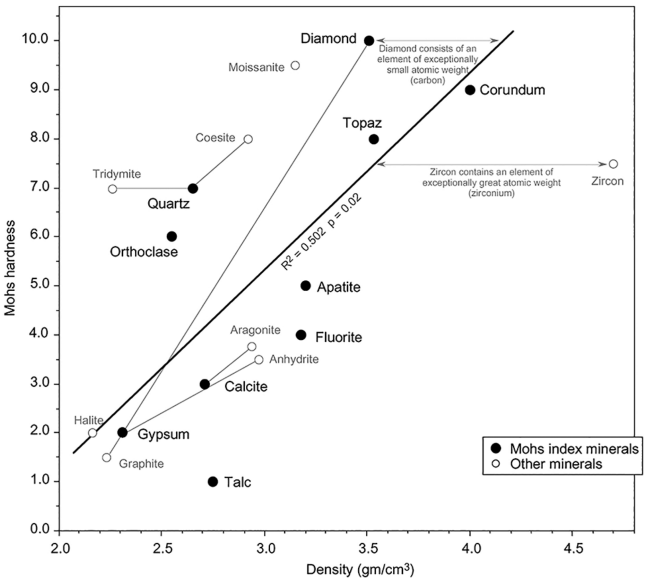

Figure 1. Chart showing density and hardness for minerals. Image by L. B. Railsback and used with permission; see ref 19.

https://doi.org/10.1021/acs.jchemed.1c00076
J. Chem. Educ. XXXX, XXX, XXX−XXX

Students can calculate the volume of oxygen evolved from the on-screen experiment using $PV = nRT$ (assume P = 1.00 atm; T = 298 K at the collection site; mass of $KClO_3$ = 10 g). The oxygen volume generated would be about 3 L.

***Carry on Teacher*, 1959 (60:50 min; 25 s).** Students at a British school refer to the well-known formula for preparing gunpowder that requires the mixing of "sulfur, potassium nitrate, and carbon—anyone can make gunpowder," remarks one student to another.

The scene could lead to students calculating the mass ratios and mole ratios in the combustion reaction and appreciating how different they can be. Assuming the composition of gunpowder is 75% potassium nitrate, 15% carbon (charcoal), and 10% sulfur by mass,[20] this gives a mass ratio of 7.5, 1.5, and 1.0, respectively, compared to a mole ratio of 2.4, 4.0, and 1.0 mol, respectively (when based on sulfur as one mole).

Periodic Table/Elements

***The Night the World Exploded*, 1957 (30:10 min; 50 s).** The newly discovered cave "mineral" mentioned in the Density section above is found to radiate considerable heat and, when dry, spontaneously expands and ignites. "We found out what was producing that pressure down here... those rocks," says one scientist. "Or maybe we better call them element 112... There are 111 known elements, that (rock) has to be the 112th."

This ludicrous conclusion could facilitate a class discussion or essay on the transuranium elements. Even in the 1950s, the idea of large chunks of element 111 being discovered underground would have been laughable to scientists of the day.

Acids and Bases

***Young Tom Edison*, 1940 (8:00 min; 80 s).** After acting up in class, young Thomas Edison (played by Mickey Rooney) and his sister are sent to another room for punishment.[21] Tom, who just happens to have bottles of concentrated hydrochloric acid and ammonium hydroxide in his pockets, decides to mix the two solutions. The result is an immediate and massive release of "smoke", forcing evacuation of the school.

While the on-screen reaction is greatly exaggerated for effect, it is nonetheless based on a real acid−base reaction. Instructors can safely demonstrate this well-known reaction by combining vapors from bottles of the reagents in a fume hood producing "smoke" consisting of ammonium chloride particles. Mixing the two solutions together does generate more "smoke" but still considerably less than produced in the film.

***The Blob*, 1958 (23:45 mi; 60 s).** Two teens find an elderly man with a strange jelly-like globule attached to his arm and transport him to the country doctor's office. As the strange blob grows, digesting the man, the doctor telephones his nurse for assistance. She soon becomes trapped in a room with the growing alien entity as the doctor directs her to douse the Blob with a bottle of trichloroacetic acid. The creature advances, unfazed, as the nurse utters "doctor, nothing will stop it" (a curious statement considering no other countermeasures have been attempted to thwart the threatening alien).

General chemistry students may be unfamiliar with trichloroacetic acid, so instructors can pose a possible homework assignment to determine if trichloroacetic would have likely been found in a physician's office in the 1950s. Due to its corrosive nature on flesh, the acid was considered a standard clinical treatment for wart removal.[22] Therefore, tackling the Blob with this reagent would not have been unreasonable.

***I Want to Live*, 1958 (102:22 min; 60 s).** This semifictionalized film examines the death penalty, concluding with a young woman on death row being led to the gas chamber. Prison staff prepare the chemicals, sulfuric acid and cyanide "eggs" that are mixed in the chamber to release fatal hydrogen cyanide gas.

The director, Robert Wise, reportedly[23] attended an actual execution at San Quentin prison to accurately recreate the gas chamber in the studio, including the chemical reaction scene showing "eggs" (large pellets) of what appears to sodium cyanide being wrapped in cloth.

Hydrogen cyanide leads to death by inhibiting cellular respiration.[24] Although not shown in the film, after the HCN was scrubbed from gas chambers, ammonia was reportedly introduced to neutralize any residual HCN.[25] Students should be able to write equations for these acid−base reactions.

The Nobel Prize

***The Atomic Submarine*, 1959 (4:30 min; 20 s).** A nuclear submarine is tasked with defending the world from an alien attack. Early in the film the submarine skipper meets with military and science leaders at the Pentagon and is introduced to Dr. Ian Hunt. "*The* Dr. Hunt, winner of the Nobel Prize in Oceanography?" asks the submarine's commander.

When discussing significant moments in chemical history, reference to Nobel Prize-winning chemists (e.g., Arrhenius, Rutherford, Curie) or physicists (e.g., Thomson, van der Waals, Bohr) is not uncommon. This scene would be a curious aside and a reminder to students that science Nobel Prizes are awarded in only three areas; oceanography is not one of them.

Coordination Chemistry

***Murder Ahoy*, 1964 (11:50 min; 170 s).** When a man dies after inhaling snuff, Miss Marple suspects poisoning and tests a portion of the snuff in her makeshift kitchen laboratory. Miss Marple first boils a snuff sample in water and, after filtering, tests for a well-known poison by adding a little sulfuric acid (mentioned in an earlier scene) followed by a light-colored chunk of crystalline solid.[26] She announces, "now if this changes color..." and the solution darkens. "So that's what it was... strychnine!"

Instructors can explain that an early qualitative analysis for strychnine was Mandelin's test, which involves adding sulfuric acid and ammonium vanadate to a sample.[27] A positive reaction is indicated by the formation of a purple color due to the reduction of V^{5+} to V^{2+}. Although the film is black and white, the appearance of a dark color in the test tube, as well as the use of sulfuric acid, would suggest that Christie had done her homework. The procedure is still used today as a spot-test for a variety of drugs, with the final color varying with the reduced oxidation state of the vanadium.[28]

***Curucu, Beast of the Amazon*, 1956 (45:15 min; 15 s).** While investigating mysterious deaths on a plantation in the Amazon jungle, the lead characters' discussion in a tent is interrupted when a large spider appears and is shot by one of them. Falling to the ground, the dead spider is seen oozing blood, red blood.

Posing the question "do spiders have red blood?" would make an interesting assignment when discussing bioinorganic molecules. Unlike mammals that use red iron-based hemoglobin for internal oxygen transport, invertebrates such as mollusks and arthropods use copper-based hemocyanin,[29] which when oxygenated gives their blood a distinct blue or blue-green appearance. As an interesting commentary, it would be amusing to ask students just how large a spider would have to be before considering shooting it with a rifle, as in the scene.

https://doi.org/10.1021/acs.jchemed.1c00076
J. Chem. Educ. XXXX, XXX, XXX−XXX

CONCLUSION

Since many instructors now deliver lectures via PowerPoint, it is relatively easy to slip a short film clip or two into a class presentation to engage students. The focus in this paper has been on older movies, most not previously evaluated for their chemistry content. Despite the obvious chemical errors frequently found in older films (e.g., *The Night the World Exploded*), some did attempt to base scenes on correct science (e.g., *Young Tom Edison*), although facts may be exaggerated for effect. Nevertheless, in either case, clips from these films can still provide valuable and entertaining teaching moments when introducing fundamental chemical concepts.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available at https://pubs.acs.org/doi/10.1021/acs.jchemed.1c00076.

Instructions for demonstrations and activities (PDF, DOCX)

AUTHOR INFORMATION

Corresponding Author

Nicholas C. Thomas − *Chemistry Department, Auburn University at Montgomery, Montgomery, Alabama 36124-4023, United States;* orcid.org/0000-0003-0639-5026; Email: nthomas@aum.edu

Complete contact information is available at: https://pubs.acs.org/10.1021/acs.jchemed.1c00076

Notes

The author declares no competing financial interest.

REFERENCES

(1) Dubeck, L. W.; Moshier, S. E.; Boss, J. E. *Fantastic Voyages: Learning Science through Science Fiction Films*, 2nd ed.; Springer-Verlag: New York, 2004.
(2) Dudeck, L. W.; Boss, J. E.; Moshier, S. E. *Science in Cinema: Teaching Science Fact through Science Fiction Films*; Teachers College Press: New York, 1988.
(3) Griep, M.; Mikasen, M. *ReAction! Chemistry in the Movies*; Oxford University Press: New York, 2009.
(4) *Hollywood Chemistry*; Nelson, D. J., Grazier, K. R., Paglia, J., Perowitz, S., Eds.; ACS Symposium Series; ACS: Washington, DC, 2013; Vol. *1139*, pp i−v.
(5) Dietrich, N.; Jimenez, M.; Souto, M.; Harrison, A. W.; Coudret, C.; Olmos, E. Using Pop-Culture to Engage Students in the Classroom. *J. Chem. Educ.* **2021**, *98* (3), 896−906.
(6) Frey, C. A.; Mikasen, M. L.; Griep, M. A. Put Some Movie Wow! in Your Chemistry Teaching. *J. Chem. Educ.* **2012**, *89* (9), 1138−1143.
(7) Goll, J. G.; Woods, B. J. Teaching Chemistry Using the Movie *Apollo 13*. *J. Chem. Educ.* **1999**, *76* (4), 506−508.
(8) Goll, J. G.; Wilkinson, L. J.; Snell, D. M. Teaching Chemistry Using *October Sky*. *J. Chem. Educ.* **2009**, *86* (2), 177−180.
(9) Hollis, W. G., Jr. *Jurassic Park* as a Teaching Tool in the Chemistry Classroom. *J. Chem. Educ.* **1996**, *73*, 61−62.
(10) Griep, M. A.; Mikasen, M. L. Based on a True Story: Using Movies as Source Material for General Chemistry Reports. *J. Chem. Educ.* **2005**, *82* (10), 1501−1503.
(11) Last, A. M. Chemistry and Popular Culture: The 007 Bond. *J. Chem. Educ.* **1992**, *69* (3), 206−208.
(12) Kirby, D. A. *Lab Coats in Hollywood: Science, Scientists, and Cinema*; MIT Press: Cambridge, MA, 2013.
(13) Burks, R.; Deards, K. D.; DeFrain, E. Where Science Intersects Pop Culture: An Informal Science Education Outreach Program. *J. Chem. Educ.* **2017**, *94* (12), 1918−1924.
(14) Avila-Bront, L. G. An Experiential Learning Chemistry Course for Nonmajors Taught through the Lens of Science Fiction. *J. Chem. Educ.* **2020**, *97* (10), 3588−3594.
(15) Mojica, E.-R. *CHEMTERTAINMENT: Using Video Clips from Movies, Television Series, and YouTube To Enhance the Teaching and Learning Experience of an Introductory Chemistry Lecture Class*; ACS Symposium Series; ACS: Washington, DC, 2019; Vol. *1325*, Chapter 2, pp 21−34.
(16) Photo on this author's website. https://www.getnickt.org/jcereynolds (accessed 2021-03-24).
(17) Photo on this author's website. https://www.getnickt.org/jcestooges (accessed 2021-03-24).
(18) Sutton, M. A Clash of Symbols. *Chemistry World*; October 2008. https://www.chemistryworld.com/features/a-clash-of-symbols/3004459.article (accessed 2021-03-24).
(19) Railsback, L. B. Some Fundamentals of Mineralogy and Geochemistry. http://railsback.org/Fundamentals/DensityHardnessPlots05I.pdf (accessed 2021-03-24).
(20) Antelman, M. Lecture Demonstrations of Incendiaries II. *J. Chem. Educ.* **1955**, *32* (5), 273−275.
(21) Photo on this author's website. https://www.getnickt.org/jcerooney (accessed 2021-03-24).
(22) Pezeshkpoor, F.; Banihashemi, M.; Yazdanpanah, M. J.; Yousefzadeh, H.; Sharghi, M.; Hoseinzadeh, H. Comparative Study of Topical 80% Trichloroacetic Acid with 35% Trichloroacetic Acid in the Treatment of the Common Wart. *J. Drugs Dermatol.* **2012**, *11* (11), 66−69.
(23) IMDb. *I Want to Live* (1958). https://www.imdb.com/title/tt0051758/ (accessed 2021-03-24).
(24) Labianca, D. A. On the Nature of Cyanide Poisoning. *J. Chem. Educ.* **1979**, *56* (12), 788−791.
(25) Methods of Execution. Death Penalty Information Center, 2021. https://deathpenaltyinfo.org/executions/methods-of-execution/description-of-each-method (accessed 2021-03-24).
(26) Photo on this author's website. https://www.getnickt.org/jcerutherford (accessed 2021-03-24).
(27) Poe, C. F.; O'Day, D. W. A Study of Mandelin's Test for Strychnine. *J. Am. Pharm. Assoc.* **1930**, *19*, 1292−1299 https://onlinelibrary.wiley.com/doi/abs/10.1002/jps.3080191206 (accessed 2021-03-24).
(28) Color Test Reagents/Kits for Preliminary Identification of Drugs of Abuse. National Institute of Justice, 2000. https://www.ncjrs.gov/pdffiles1/nij/183258.pdf (accessed 2021-03-24).
(29) Senozan, N.; Hemocyanin, M. The Copper Blood. *J. Chem. Educ.* **1976**, *53* (11), 684−688.