Alchemy in the Chemistry Classroom

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Chemistry in the STEM Classroom, Dr. Brandon Rodriguez

Considered witchcraft and rooted in misunderstanding, the history of Alchemy and its connections to modern day science can be traced through Arab and Greek history, making its way towards Europe and into the minds of famous historical scientists. What is Alchemy? What is the history of this "science" and is it relevant to students in the twenty-first century classroom?

Alchemy is a practice, in early scientific thinking, that believed that immature metals, such as lead, would eventually evolve into gold. Early scientists (pre-periodic table) believed that everything was made of four basic elements: earth, air, fire and water which were accompanied by sulfur, salt and mercury. Alchemists believed these elements could be manipulated, creating gold. Gold was the ultimate standard as it was the element perceived to be in perfect balance of all these root elements, or the most mature. The practice of Alchemy was to speed the process of maturing of other metals along with the manipulation of these elements. In the research turning lead into gold is often referenced, however, lead is not one of the main elements listed in alchemist practice. Clearly other elements were known, just not considered the root elements. A 2016 article by Benjamin Radford explains that turning immature metals into gold was not out of greed. "Gold symbolized the highest development in nature and came to personify human renewal and regeneration. A 'golden' human being was resplendent with spiritual beauty and had triumphed over the lurking power of evil." (Radford, 2016) The true goal, however, was to find the "Philosopher's Stone" which was believed to hold magical healing powers as well as the

power to turn metals into gold. Radford also explains that the Philosopher's Stone was not stone, but likely a magical liquid or powder. The practice of Alchemy was so well accepted, that even Sir Issac Newton wrote about and studied this science, and astronomer Tycho Brahe was believed to have consumed gold (based on the amount found in his body) as it was then believed to be medicine. If these revered scientists also practiced Alchemy, could there be some evidence to support them?

While often mocked in the scientific community, an article published in Smithsonian Magazine in 2014 states that in the 1980s, scientists were able to find value in some contributions made by alchemists. Alchemists were known for secrecy and often wrote about their scientific discoveries in code. "This painstaking process of decoding allowed researchers, for the first time, to attempt ambitious alchemical experiments." (Conniff, 2014) As these experiments were repeated, modern scientists were able to distinguish that early alchemists were doing the best they could to explain what they observed. Conniff argues that scientific ideas are born of the ideas that came before- and that possibly alchemy deserves more respect than it is given.

NASA blogger WD Greene explains what alchemy means to him as he dubs himself a chief alchemist in a 2011 post. "No, we don't start with a heap of scrap metal and end up with bars of gold or the philosopher's stone. Rather, we start with a heap of paper and end up with a rocket engine — and, well, a larger heap of paper. As much as bending and grinding and welding and balancing and casting and torquing, the story of the paperwork is big part of how a rocket engine comes to be." (Greene, 2011) Greene then goes on to describe the inner workings of the development of new technology at NASA, and how much paperwork is really involved. In

a recent live class with Dr. Brandon Rodriguez, I was surprised to learn how long it has been since Dr. Rodriguez had been in an actual lab setting. Most of his PhD work was completed via computer and with paperwork, developing new ideas for the Chemistry world. Greene argues "alchemy is exactly what is going on behind the scenes, deep within the dungeons of NASA as we develop a rocket engine." (Greene, 2011) In this case, however, these scientists are manipulating paperwork into giant ideas instead of immature metals into gold.

How often in our current Chemistry classrooms do we use copper pennies and turn them into gold? I scoured the Flinn version of this activity and there is no mention of Alchemy, however the tagline reads "Get rich quick by turning an ordinary penny into 'silver' and then 'gold'!" (Flinn, 2019) While ancient alchemists likely would not be able to explain the exact chemical reaction taking place, I argue that some of the principles behind this activity were likely practiced by alchemists in their quest to help immature metals find their true calling. Does this make the practice of Alchemy worth discussing in our Chemistry classrooms? Wouldn't some students find these early ideas interesting?

I am left with questions about sulfur, salt and mercury and why these elements were the root of alchemy? I couldn't find a credible source to explain the connections or early beliefs. Alchemy was practiced before the periodic table was organized and I wonder how the discovery of new elements shook that scientific world at that time. One important lesson that speaks to this, for our students, is found right in the NGSS Nature of Science standards. "Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence." (NGSS, 2019) Alchemy is a good example of early chemistry and how this science has evolved.

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