VUCA and CHEM

Gisela P. Concepcion, PhD
June 10, 2022
gpconcepcion@gmail.com

Today's "VUCA" world draws fear in many of us. We live in Volatile, Uncertain, Complex and Ambiguous (VUCA) times – in a "troubled" world. We can't seem to know how to respond to unexpected "happenings", in a timely way, as individuals, families, communities, nations and as a whole planet. Everything in our surroundings changes so fast, and we seem to be losing control of our lives.

Scientists refer to VUCA simply as a complex system. Complexity scientists are those who gather data over time and space, on many factors that may cause or affect a natural or man-made event or "phenomenon", e.g., an impending storm, the pollution of a river, infestation of a crop, spread of a virus leading to a pandemic, uncontrolled use of painkiller drugs like morphine leading to an opioid epidemic, uptake of a new product in the consumer market, etc. These computational scientists detect trends and patterns in the data, work out a model, and make predictions about "what's next" - in the near, intermediate and distant future. They prepare us in advance to respond to future occurrences, and hopefully, our fears will be allayed.

Data scientists use good data to produce good, statistically valid models. The more good data, the better; otherwise, one could turn up a bad model which ends up as "GIGO" or "Garbage In, Garbage Out". What kind of scientific data do we need to capture what's really going on in a world in turmoil? Lots of chemical data - because the world we live in is a chemical material world. The natural world, both living and non-living, is made up of substances which are small, medium-sized or large chemicals or molecules. And so is our man-made or technological world.

Chemistry is a central science, and with its handmaids physics and mathematics, it is at the crossroads of biology, medicine, environmental and earth science. Over the past 5,000 years, chemistry has fundamentally shaped human civilization through technology with significant contributions to the health, wealth and prosperity of society.

Think of the chemistry of materials used to provide our basic needs of food, clothing and shelter. Think of old and new chemical technologies that are the basis of huge industries, such as pasteurization of dairy products, refrigeration for food storage, fertilizers for agriculture, cotton, silk and nylon for clothing, dyes for fabric and paint, glass for architecture, concrete for construction and urbanization, and many more. Many avid users and consumers of household products that make our lives comfortable and convenient, do not know about, or tend to forget, all the chemical science that went into developing these products.

Chemical science has been practiced in various forms for decades, in fact for centuries, to answer big questions about life, our planet and the universe. Astronomers and astrophysicists have studied the origin and fate of the stars and galaxies; geologists and geochemists have followed plate tectonics, geological movements and land formations, and anthropologists, archaeologists and evolutionary biologists have traced the evolution of man and other life forms throughout billions of years. Understanding each of these requires knowing the chemical structures and chemical changes involved in these natural processes.

Now comes the VUCA world we live in, which to a great extent we created - through well-intentioned technologies developed in the past, many of them chemical technologies, which are now seen to have some negative impacts. Examples are fossil fuels, plastics and some chemical ingredients which turn out to be environmental pollutants and mutagens (causing gene mutations). Climate change, rising temperatures, extreme weather conditions, disease outbreaks, inadequate energy and food production, pollution in land, sea and air, are major concerns in the VUCA world. These problems pervade our lives. They are actually interconnected or intertwined, posing important challenges to our complexity scientists working closely with chemists, biologists and physicists who provide them the data.

The good news is our greater capacity to deal with these problems today. For example, we now have real-time monitoring of carbon dioxide, other greenhouse gases and chemical pollutants in the air, huge reductions in the use of fossil fuels and a steady rise in the use of "green" energy (from sunlight, wind and water), recycling or upcycling of plastics, SMART vertical farming of vegetables in nutrient-rich water (instead of soil) under controlled light and temperature conditions, and many more, as part of our planetary health and "future earth" programs.

And we have developed effective ways to deal with complex diseases such as cancer and transmissible infections such as COVID-19. For your greater understanding, you could ask a biochemist to explain how diagnostic kits, small molecule drugs, vaccines and other biologicals, such as therapeutic antibodies and cytokines, are developed and how they work at the molecular or biochemical level.

Now let's come closer to our daily, personal lives. What keeps us feeling "happy, safe and secure" despite VUCA? I'd still say it's CHEMICALS! BIOCHEMICALS! "Happy Hormones" like oxytocin, dopamine, serotonin and other endorphins are chemical messengers that promote positive feelings of happiness, peace, calm and love. The levels of these endorphins change when we pray and reflect, relax, smile and laugh, and feel happy with family and friends.

I recall that in one chemistry seminar course I took in college, my chosen topic was the molecular basis of memory. I was fascinated by the workings of the human brain. Little did I know that one day, as a biochemist, I would do some neuroscience research involving dorsal root ganglion (DRG) neurons. We use DRG neurons to study peptides (a kind of biochemical) produced in marine cone snail venoms. The snails use these peptides to paralyze and pacify their prey which are fish, worms, or other snails. This is part of our project to discover new drugs from venomous snails to combat pain (as an alternative to addictive morphine which is causing the opioid epidemic), and to fight inflammation and neurodegeneration.

Why did I choose to stay in Chemistry and not go to Medicine afterwards to help me understand the human nervous system? Because I knew that Chemistry would explain how things work at the most fundamental level - the molecular level. Nobel Laureate in Chemistry Linus Pauling once said, "Man is simply a collection of molecules and can be understood in terms of molecules". He may not have been entirely right but there is a lot of truth to what he said.

Gisela P. Concepcion, Ph.D. is a professor emeritus of the University of the Philippines Diliman. She is an academician of the National Academy of Science and Technology (NAST) and a fellow of The World Academy of Sciences (TWAS). This article was inspired by a talk she gave last year at the Kapisanang Kimika ng Pilipinas (KKP) Ist International Conference: Young Chemistry Professionals Mentoring Symposium.