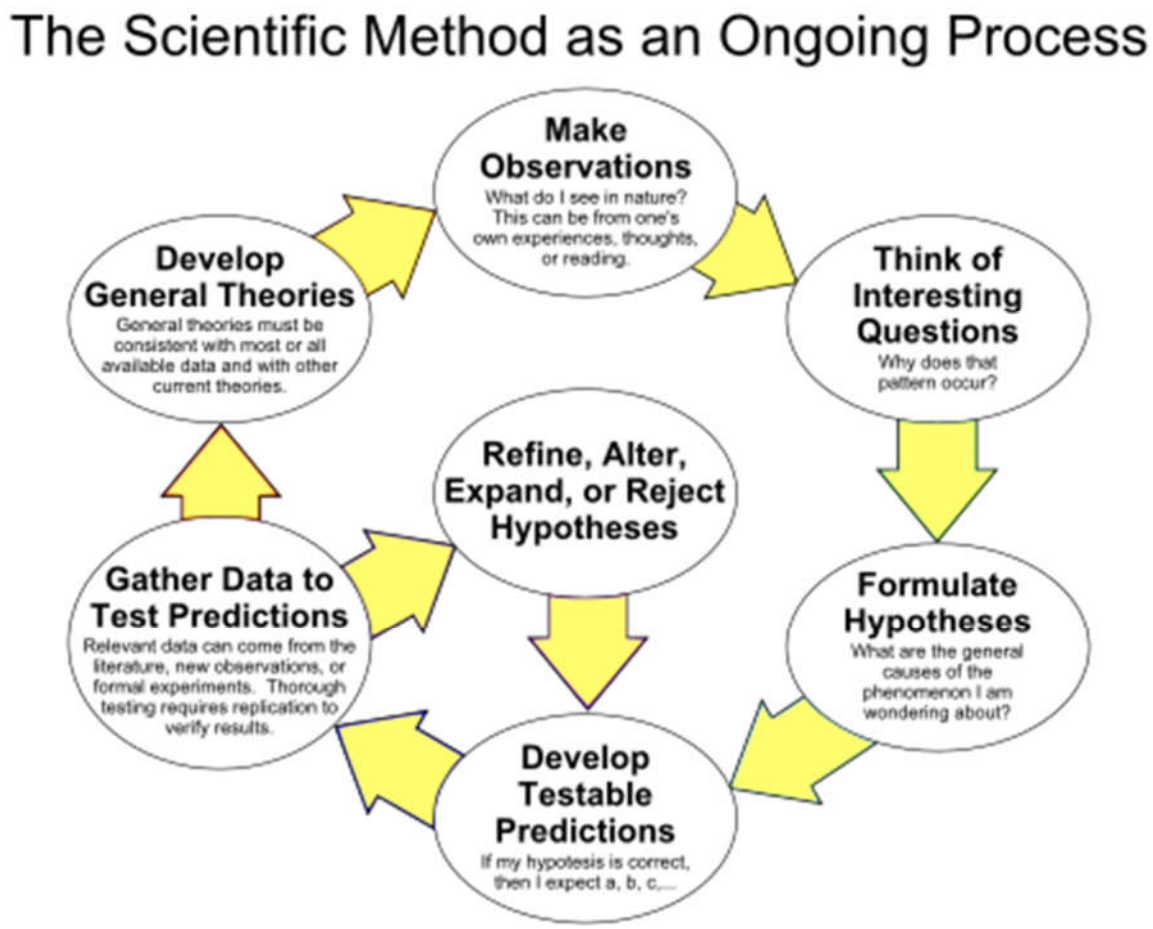
 By Lynne S. Rodgers

The Living Experiments of Science, Technology, Engineering and Mathematics at The Napa Valley Model Railroad Historical Society.

The value of this museum cannot be overstated as a living breathing experiment in the Napa Valley for schools and budding new explorers of STEM skills and practical applied STEM education. The museum layout model, locomotive and protocol developers implement STEM skills, research and development in order to make the model function.

Science: When speaking of "The Model," it is comprised of three levels of functioning experiments. The most obvious is the railroad and the trains that run on it. Superimposed and less obvious are the protocols designed to run the railroad according to specific conditions, regulations and roles managed by operations personnel. The intention here is to use the layout and make it function according to specific conditions under protocol. This railroad is a functioning model built to a scale of 1/87. To operate passenger trains accurately, the protocol must also run the trains by a "Fast Clock," which means it has to work in scale time. The object of these experiments is to simulate a 1/87th (HO) scale railroad as accurately and as close to realistic as you can get within the confines of walls. The system follows the scientific method as seen below and so does any change in protocol, technologies, architecture, landscape or layout design, as all these details impact the function of the model as a whole.

Nomenclature: Sometimes when people see an engine or a railroad car, it is commonly referred to as “a Train.” Trains and engines are very specific things. A train is an assembly of railroad cars with at least one engine. A more accurate name for an engine is “Locomotive.” It is very possible to see a train with several locomotives. There are many different kinds of railroad cars and locomotives. The more common ones known to the public are box cars, flat cars, tank cars and passenger cars, but there are many other types of cars. Railroad cars are specific to the load that they are designed to transport. An interesting fact is that some rail cars are privately owned by companies other than railroads.



The above diagram demonstrates the process used to drive our experiments and how we develop our model. The model has many component parts. We also can run three experiments simultaneously. First, we can run an operating session where the railroad is made to function as a working experiment under protocols. Because this involves man power and role assignments we must function as a company. Second, we must endeavor to maintain, repair and continuously improve the model and privately owned equipment of the members. Thirdly, the NVMRHS operates as a 501(c)(3) and museum which makes all of the rest of our craft possible. This part of the experiment is an enterprise of organizational behavior and funding. In this way we really are not different than other Engineers and Scientists. In short, the layout that you see is a lab.

The most obscure of the three experiment models is the development, management and organizational behavior model of the Historical Society which operates a model railroad and a non-profit, with an interest in continuously developing the functioning technological interface of all three models simultaneously and maintains a meaningful presence to the Napa Valley community. The end result is a unique combination of architecture, science, technology and history.

Experiments: The challenge here is to develop parts of the railroad to great accuracy in historical and functional detail, increasingly pursuing realistic performance and function. These are not the electric trains of childhood that many of us remember and at a closer look you will promptly appreciate that these are not toys. These locomotives and cars are scale models, many of which are unique to an existing prototype locomotive or car of some kind. The challenge is to get each one to function on the layout and to function reliably within the protocol on the historically inspired layout landscape, which is also an architectural model. In other words, the pursuit is always to get a model train to work on a system of railroad lines as a prototype train would on a prototype railroad. To get them to work, each part undergoes the scientific process with meticulous and rigorous inspection. Without that level of attention to detail the model as a whole cannot function reliably or realistically, particularly during an operating session.

Other Types of Electric Trains: Other types of electric trains exist and there are also toy trains. They are beautiful and fun to work with and many people begin their fascination as young children laying down track for those types of trains. However, those types of trains are not run on our railroad. They are different from this project. To be clear, collecting and working with those trains is a respectable hobby, however it is a *different* hobby. The distinction is the extensive engineering component of this railroad and the attention to scale measurements. As a result of the method of construction, there is no portability in this model. That is not unusual for this type of railroad. Therefore, because it has taken decades to create it is un-replaceable. It is indeed priceless.

Technology: Each locomotive is fitted with a computer chip (decoder) that is operated by an engineer with a wireless controller (throttle). With the use of computer technology, the dispatcher observes and controls the routing of all trains on the main line, as is done on a full size railroad. Technology is also used for tracking inventory, data management, equipment inspection and curatorship of historical documents, communication and business management. Our membership is involved in the constant process of continuing their own education and educating the public.

Engineering: The scenery is designed with the purpose of function with the greatest commitment to detail of esthetics that is both purposeful and captivatingly beautiful. There is however, much that is not visible to the public below the surface of the scenery. For example, there is track and signal lighting below the surface of the landscape inside tunnels and there is electrical wiring and mechanical engineering below the layout. The LED signal lighting is also a functioning system, programmed to respond to conditions on the track and operates to assist in traffic control management. Our signals actually work with the switching system as they would on a full size railroad, and the trains are run down the tracks accordingly. So when you observe the engineers running the trains, they are obeying and responding to the signals to guide the movements of their equipment. The system is engineered and designed to overlap its functioning and have numerous systems interface simultaneously. Sophisticated and meticulous planning and wiring of the electrical system that runs the length of the entire layout makes these system interfaces possible. Sound and lighting are also a method of signaling. Standard conventional railway algorithms are utilized and implemented as standards of practice that would be understandable by any railroad Engineer or Conductor.

Mathematics: Geometry is used in the design of turnouts and track patterns. Weights and measures are used in the inspection of locomotives, freight and passenger cars. Protocols and algorithms are mathematical in nature and they are used to direct human behavior and assist in establishing order and problem solving. These are key critical thinking skills. Topographical maps are displayed in the facility for the study of existing railroads, historical and or no longer existing railroads. The value of mathematics cannot be over stated. We use these concepts so naturally that it doesn't even feel mathematical to us. But we know that everything is calculated including the time we use to run the system. This system would be impossible to create and function predictably without the daily use of Science, Technology, Engineering and Mathematics.

NOTES FOR THE PUBLIC: *We welcome women. In fact, this document was created by a female society member. We are sensitive to the discussion in the public about the under representation of women in STEM education and careers. Although we have always welcomed women into our organization, we have only three members who are women. Therefore, we continue to encourage women and girls to explore with intention how and why things work and challenge themselves to explore the possibilities of their own role in exploring STEM as a potential pursuit for career and for fun!*

BIO: *Lynne Rodgers is one of the newest members of the NVMRHS. She is a member of The Sigma Theta Tau International Honor Society of Nursing and a Student Family Nurse Practitioner with a particular interest in aging and brain health and function. She is the mother of two men, a reading tutor for children with dyslexia and a poultry farmer. She enjoys full scale construction, interior design and landscape architecture.*