**Electrical Energy**

**Essential Idea:** Models of electrical energy have developed with time as our understanding of the science has developed. With this man has created a multitude of devices to harness the power and flexibility of electricity.

**Understanding the Nature of Science:**

1. A brief qualitative overview of the historical development of electricity through individual scientists should be undertaken specifically with regard to the NOS links.
2. Early forms of electricity studied included lightning and static electricity. **1.2**
3. Hauksbee strived to understand the natural phenomena by asking questions and looking for explanations, this is the thematic investigation. **1.2, 1.8**
4. Franklin was crucial to identifying effects and proposing causes. **1.2, 1.4, 1.8, 2.5**
5. \*Luigi Galvani considered electricity to be a property of living things. **1.5, 1.8, 2.5**
6. Alessadro Volta disproved Galvani’s ideas by producing a continuous flow of electricity from a battery which was made from different metals. **1.2 1.3, 1.8**
7. Hans Christian Ørsted and Andre-Marie Ampere were the first to investigate the connection between electricity and magnetism. This resulted in the invention of the electric generator and the electric motor by Michael Faraday. **1.2, 1.3, 1.8, 1.9**
8. By employing quantitative thinking, Volta established the concept of electrical current, i.e., the amount of electricity *flowing* out of a source. **1.6, 1.8**
9. Quantitative Observations allowed a more mathematical approach and formulation of laws by Coulomb, Faraday and Ohm among many others. **1.3, 1.6, 1.8, 1.9, 2.4, 3.2**

**Guidance:**

1. Electrical current involves the movement of charged particles in an electric or magnetic field. This flow of charge can do work on other systems. Scientists describe electrical phenomena in terms of:
   1. Electric Charge
   2. Electric Current
   3. Potential Difference/Voltage
2. This is a hybrid description of energy where the work done is calculated by is described per unit of charge that has flowed.

**Practical Activities:**

1. Investigate static electricity (using different rods and fabrics, van de Graaff generator).
2. Electromagnetic induction (hands-on or simulation)
3. Building simple electrochemical cells using different pairs of metals.

**Research Activities:**

1. Chart the discoveries of key scientists who investigated “Electricity” and the success of the modes they proposed compared to current understanding.
2. Consider electricity in nature in relation to lightning, electric eels/rays and static electricity, living cells, nerve impulses.
3. Consider Hauksbee’s experiments with static electricity resulting in his “electric machine” and how the use of the machine as entertainment stimulated public interest in the new phenomena called “electricity.”
4. We would not have regarded Franklin’s work as truly scientific in our present-day terms. But as a figure of the Enlightenment, he exemplified the “thinking man” of his time. Discuss.
5. Compare the work (and rivalry) of Galvani and Volta in relation to electrical current and why Volta became an international celebrity.
6. Research the Barlow—Ohm dispute in terms of evidence based on science and the development of a law.

**Man’s Impact on the Planet**

1. Prior to the development of electric lighting, artificial lighting was in the form of a candle or gas light. Electricity was considered a cleaner source of power but the subsequent impact of burning fossil fuels to create electricity in power stations was not a consideration. Knowledge of magnetism has allowed us to develop sophisticated motors that move people and goods. Such motors require a source of energy which may cause damage to the environment. This has helped to draw attention of the need for the development of alternative energy sources (see A 1.6)