Several Minnesota Master Teachers gathered together in the summer prior to this conference to research the life and work of the presenters at the 2015 Nobel Conference. The group developed several pieces of classroom ready curriculum that focus on the topics of the conference. There are several different types of materials including basic biographies, readings, simulations, and lab activities. The materials are all described concisely in the information below.

The development of this material happens annually as a part of the Nobel Curriculum Development Program at Gustavus Adolphus College in St. Peter, MN. It is presented here on the web in an editable format. We encourage teachers to download these materials and use them as they are…and/or adapt them to best fit their classroom and learner needs.

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| Title | **Rock Pocket Mouse Evolution** |
| Speaker | Dr. Sean B. Carroll |
| Concepts and Keywords | Evolution, variation, natural selection, switches, evolutionary developmental biology, evo-devo, mutation, adaptation, population |
| Type of Activity | Pre-Conference/Video Clip, Activity |
| Duration | 50 minute period |
| Description | Students watch a video clip and then engage in discussion about the genetic mutations responsible for changes in this species. Students then have a jigsaw discussion and journal on several questions. |
| Document Overview | This lesson is designed to provide an overview of natural selection and adaptation in a population as well as introduce the topic of evolutionary developmental biology, “evo-devo”. It can be used to prepare students for Sean B. Carroll’s talk, and/or as an introduction to a Population Genetics Unit. This lesson contains copyrighted material, and material adapted and compiled from resources available from HHMI Biointeractive. *One additional pdf is included with this activity.* |

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| Title | **Biography and History - A Project with Connections!** |
| Speaker | Dr. Steven Chu |
| Concepts and Keywords | Energy, Timeline, Change over time, Networking, Stanford, Bell Labs, Curiosity, Science in Personal and Social Perspectives, Dr. Steven Chu |
| Type of Activity | Small group research and presentation followed by large group sharing and discussion. |
| Duration | Two class periods:  Day 1 - Conduct research and develop an understanding of a particular time period  Day 2 - Present the timeline by group while students build a mapping of the connections. |
| Description | Small Group Jigsaw Activity: Students research a specific time frame within Chu’s lifetime, career, and interactions/influences that propelled him into the next phase of his career. Students then share their group’s focus with the whole class and the class develops a broad picture/web of Chu’s life. |
| Document Overview | This is an activity designed to help a class build a background in the life’s work of Dr. Steven Chu. It is built as a jigsaw-style activity with a series of time periods to be explored and shared with emphasis on the connections between each of these phases of Dr. Chu’s life and work. |

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| Title | **Ultimatum Game** |
| Speaker | Jennifer L. West  Patricia Smith Churchland  António Damásio |
| Concepts and Keywords | Neurotransmitters, Decision-Making, Serotonin, Ultimatum Game |
| Type of Activity | Investigation and follow up readings. |
| Duration | 60-90 minutes; probably 2 class periods, one for data collection and one for analysis |
| Description | An investigation that uses the Ultimatum game to learn about decision making and how neurotransmitter levels may be a factor in affecting a person’s decisions. |
| Document Overview | This lesson plan provides an investigation that correlates to the Medicine/Genetics strand content that will be presented at the Nobel Conference. Further, it can be used as an activity/investigation in the areas of Bioethics, Neurobiology, or Anatomy and Physiology. |

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| Title | **Observing Nervous Responses** |
| Speaker | António Damásio |
| Concepts and Keywords | Nervous system, reflex, reaction, homeostasis, evolutionary advantage |
| Type of Activity | Lab activity |
| Duration | 1 or 2 class periods |
| Description | Students experience various human nervous reactions and reflexes while collecting data. |
| Document Overview | Through a station-based lab activity, students will get a better understanding of reaction versus reflex. They will subject their body to several tests to collect and analyze data about their personal responses. The ideas of homeostasis and evolutionary advantage are highlighted. This could be an introduction to the nervous system, specifically the brain. |

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| Title | **Speaker Biography: W. Gary Ernst** |
| Speaker | W. Gary Ernst |
| Concepts and Keywords | Ernst Biography and Overview |
| Type of Activity | A short reading with web links to provide an overview of this speaker. |
| Duration | One class period and/or as a homework assignment. |
| Description | In 2010, Ernst was awarded the GSA (Geological Society of America) International Section Distinguished Career Award. This is an excerpt from his introduction for the award, by Yildirim Dilek and Ernst’s rebuttal to the award. |

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| Title | **The Last Hours of Ancient Sunlight: We're Made Out of Ancient Sunlight** |
| Speaker | Dr. Harry Gray |
| Concepts and Keywords | Ancient sunlight, energy, trees, animals. |
| Type of Activity | This is an excerpt from this book that can be read in class or as homework for discussion. |
| Duration | One class period or one or more days of homework. |
| Description | An article to read. |
| Document Overview | The author investigates how fundamentally all that is on Earth is the result of energy from the Sun. |

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| Title | **Here Comes the Sun: Water Hydrolysis and it’s Connection to Solar Energy** |
| Speaker | Dr. Harry Gray |
| Concepts and Keywords | Hydrolysis, Electrolysis, Water Splitting, Solar Energy, Chemical Energy, Electrolyte, Photosynthesis, Energy |
| Type of Activity | Inquiry Lab |
| Duration | 50 minute class for Inquiry Lab, Optional 2nd day: Discuss creating technology to support renewable resources. This lab will connect collection of hydrogen using solar power to create chemical energy. |
| Description | A simple lab to hydrolize water in a plastic bottle with a 9 volt battery |
| Document Overview | This is an overview of electrolysis and a guide for students to conduct an investigation. |

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| Title | **Electron Transport in Solar & Fuel Cells** |
| Speaker | Dr. Harry Gray |
| Concepts and Keywords | Electron Transport, Solar Cells, Fuel Cells, Energy |
| Type of Activity | A presentation to provide an overview of the role of electrons in fuel cells and solar cells. |
| Duration | 20 minutes |
| Description | Students will make connections between the electron and the engineered systems that use electron transport to transfer energy. |
| Document Overview | A ten slide presentation. |

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| Title | **Sequencing DNA Activity** |
| Speaker | Savante Pääbo |
| Concepts and Keywords | This activity develops a very basic understanding of DNA sequencing methodology allowing students to follow how Pääbo obtained his data. |
| Type of Activity | Students use a game to understand DNA sequences, then examine conserved sequences across species. Finally students trace DNA evidence of common ancestry by examining data from DNA sequences. |
| Duration | Part 1: 20 mins, Part 2: 10 mins, Part 3: 85 mins |
| Description | Students will be able to describe what happens to DNA sequences over millions of years as species diverge to differentiate conserved sequences from divergent ones and make the connection to common traits across species to use their ability of comparing patterns to detect similar patterns in chromosome banding across species. |
| Document Overview | *This activity includes an overview document followed by 10 pdf and presentation files to use with students.* |

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| Title | **Laetoli Trackway Puzzle** |
| Speaker | Savante Pääbo |
| Concepts and Keywords | Geologic patterns, nature of science, evolutionary change, evidence in the present can reveal events of the past. |
| Type of Activity | Dry lab |
| Duration | 1-2 Class Periods |
| Description | Footprint diagrams were made from the trackway of Australopithecus afarensis ("Lucy's" species) at the Laetoli site in East Africa. They are topographic in nature, showing details of depth and superposition. Students are asked a series of probing questions, some requiring direct observation, others expecting inferences and analysis. This is an excellent example of an historical problem-solving exercise, using clues to derive a likely picture of a past event, very much like crime scene scientists must do. It's also open-ended, where students try to reach a "best explanation" based on the data and reasonable interpretations, with no "correct answer" available. |
| Document Overview | Using the Laetoli Footprints, students will explore how scientists use current patterns to understand the past. Students will answer the questions: what do the footprints tell us? How do scientists find that out? Students will measure and correlate their foot lengths and body heights and use that data to estimate the height of the Laetoli hominid. |

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| Title | **Foot Steps in Time** |
| Speaker | Savante Pääbo |
| Concepts and Keywords | The Nature of Science, correlation between foot size and height, using the fossil record as a means to collect data |
| Type of Activity | Dry lab |
| Duration | Several class periods |
| Description | Students will use the Laetoli fossil record to make observations, then collect data to predict size of ancient human ancestors. |
| Document Overview | The 3.6 million year old tracks of an early hominin in Laetoli provide a tantalizing opportunity to explore how scientists use patterns of the present to understand the past. What do these footprints tell us? How can we find out? Students measure and correlate their foot lengths and body heights, then use that data to estimate the height of the Laetoli |

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| Title | **Building Cladograms and A Comparative DNA Analysis** |
| Speaker | Savante Pääbo |
| Concepts and Keywords | Cladogram, Evolution, Gene Sequences, Mutations, Relationships, Super Computer |
| Type of Activity | This is a hands-on “dry” lab that will have the students analyzing a set of data and attempting to make an evolutionary relationship among the organisms by building a series of cladograms. They will learn and practice making a cladogram first, and then utilize this new found skill later in the lab. |
| Duration | This is a lengthy activity set that might need as many as 3 to 4 days to complete based on a 45-55 minute class period. |
| Description | Students develop an understanding of Cladograms and then proceed to build one. |
| Document Overview | This is a series of activities of help students understand the nature of evolutionary relationships in terms of morphological and genetic similarities and differences. The students will first be introduced on what is, and how to, build a cladogram. This practice activity will then prepare them for the more complex DNA analysis of a large group of mammals. In the end, the students will attempt to build a cladogram on the relationships of the mammals.  In the secondary and more complex mammal analysis, the students will replicate the logical processes that Darwin employed during his scientific career. They will then continue to focus their analysis by utilizing the techniques of the Human Genome Project from the late 20th by sequencing a specifically shared mammalian gene common to all the organisms in the lab.  Lastly, the students will be directed to the Biological Super Computer Center at San Diego State University to have the computer build the cladogram, based on the gene sequences of the various organisms.  Ironically, the students will find that their first attempts at building evolutionary relationships from their intuitive (Darwinian) perspective and pretty close to the more sophisticated Super Computer generated analysis. |

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| Title | **Speaker Biography: Savante Pääbo** |
| Speaker | Savante Pääbo |
| Concepts and Keywords | Pääbo Biography and Overview |
| Type of Activity | A set of web links to review the basics of this speaker. |
| Duration | One class period and/or as a homework assignment. |
| Description | Svante Pääbo's research on the DNA of human and nonhuman primates has exposed the key genetic changes that transformed our grunting ape-like ancestors into the charming latte-sipping humans we are today. |

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| Title | **Modeling Cell Labeling to Identify Cell Types** |
| Speaker | Jennifer West |
| Concepts and Keywords | Macromolecule functions, selective cell labeling, targeted drug therapy, inquiry |
| Type of Activity | Lab |
| Duration | One 50-minute class period |
| Description | In this investigation, students will model cell specific labeling to identify cancerous cells by testing several solutions with reagents that detect the presence of macromolecules. |
| Document Overview | Cancer researchers are using nanomolecules to specifically identify and treat cancer cells in mice. The use of nanomolecules allows for the delivery of chemotherapy drugs to only nanomolecule-labeled tumors, in effect, eliminating the standard chemotherapy side effects. As an analogy to this process, in a lab setting, students investigate unknown solutions and test for the presence of lipids, proteins, and simple and/or complex carbohydrates. Students will learn which reagents positively identify each type of macromolecule, and then use this information to help identify macromolecules present in an unknown solution. This will be analogous to what the cancer researchers look for among cells of the body, to see how selective cell labeling can isolate cells of interest in a commingled population of different cell types. |

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| Title | **Transforming Organ Transplantation** |
| Speaker | Jennifer West |
| Concepts and Keywords | Organ Transplantation, Tissue matching, Stem cells, 3D printing, Biomimetic hydrogels, Bioengineering |
| Type of Activity | Pre-conference video research and jigsaw activity to prepare students for Jennifer West’s presentation. |
| Duration | Two 50-minute class periods, with optional summary homework assignment. |
| Description | This activity is a jigsaw to engage students in the evolution of organ transplantation and the impact of technology upon it. |
| Document Overview | This activity is designed to give students a background on how the process of organ transplantation has changed and how new technologies will impact the transplantation process. This will correlate with Jennifer West’s presentation at the Nobel Conference. |