Overview: Students will use human inheritable disorders to illustrate the validity of Mendel's laws of inheritance. Students will also investigate the use of the current DNA technologies available for treatment and potential cures. As a result of this activity, students will have a more in depth understanding of mutations and their effects on the human population.

Standards (Content and Characteristics):

SB2. Students will analyze how biological traits are passed on to successive generations.
   d. Describe the relationships between changes in DNA and potential appearance of new traits including
      o Alterations during replication.
         o Insertions
         o Deletions
         o Substitutions
      o Mutagenic factors that can alter DNA.
         o High energy radiation (x-rays and ultraviolet)
         o Chemical
   f. Examine the use of DNA technology in forensics, medicine, and agriculture.

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
   a. Exhibit the above traits in their own scientific activities.
   b. Recognize that different explanations often can be given for the same evidence.
   c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh6. Students will communicate scientific investigations and information clearly.
   c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
   d. Participate in group discussions of scientific investigation and current scientific issues

SCSh7. Students will understand important features of the process of scientific inquiry.
   e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.
Enduring Understandings:

- Cells in sexually reproducing organisms contain two copies of each chromosome; therefore, two copies of each gene explain many features of heredity such as how variations that are hidden in one generation can be expressed in the next.
- Hereditary information, coded by DNA, is passed down from generation to generation in a predictable way.
- Mutations can occur in both autosomal and sex chromosomes and have various causes, but only mutations in germ cells can contribute to the variation that changes an organism’s offspring.

Essential Questions:

1. What are some of the major causes of genetic mutations that lead to diseases?
2. What treatments can be offered to alleviate the symptoms of a genetic disorder? What progress has been made in the research of gene therapy?
3. How are Mendel's laws demonstrated by the occurrence of genetic diseases?
4. Was your investigated syndrome or disease an autosomal mutation or a mutation that occurred in the germ cells? Explain your answer using Mendel's laws of inheritance.
5. Why do dental assistants take care to cover your reproductive organs while X-ray ing your teeth without shielding your head, neck or arms?

ADMINISTRATION PROCEDURES

Pre-Assessment:

Selecting from one of the scenarios listed, the teacher will play the role of a parent and talk to the class about what is wrong with their child keeping the information minimal. Have students write down three questions they would ask this doctor and/or parent about the child's disease.

<table>
<thead>
<tr>
<th>Outcome / Performance Expectations:</th>
<th>Identify the uses and effects of DNA technology.</th>
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<td>Identify agents responsible for genetic alterations.</td>
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<td></td>
<td>Predict the effects of alterations to the genetic code.</td>
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<td>Predict the effects of mutations to the individual's genetic code.</td>
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General Teacher Instructions: This task involves role-playing, Internet research, and several medical ethics problems. Students will be picking a scenario to research, determine the genetic disorder, and role play doctor-patient-parent or have a genetic counselor conference. They will determine possible treatment options. These specific questions below will guide the students in their research:

1. We have never had this in my family so how did this happen?
2. What is the real cause of this disorder? (Scientific explanation e.g., alterations during replication or mutagenic factors)
3. How do you detect this disease?
4. Is there any treatment developed that can help my child? (Teacher note: A rubric is a good way to access the outcomes of this performance task. It will also reinforce what is required within the group work and presentation. A good site for creating rubrics is rubistar-http://rubistar.4teachers.org/)

Materials Needed: Use of Internet and other sources for researching genetic diseases; www.cdc.gov - provides an invaluable source (Teacher note: CDC site also can be accessed in Spanish and other language www.cdc.gov/spanish/) Other sites to access include NINDS – National Institute of Neurologic Disorders and Strokes-www.ninds.nih.gov and the National Institute of Health (NIH) www.nih.gov/

Task with Student Directions: You and your group will choose a genetic scenario. Each group member will play one of the following roles: (1.) the doctor (or counselor), (2.) the parents, or (3.) the child. Working in groups and using the guiding questions supplied by the teacher, the group will research the problem, its cause and possible treatment.

Guided Parent Questions:

1. We have never had this in my family so how did this happen?
2. What is the real cause of this disorder? (Scientific explanation e.g., alterations during replication or mutagenic factors)
3. How do you detect this disease?
4. Is there a treatment developed to help my child?

You may need to create additional parent questions. As a group you need to create the doctor’s response to the parent questions. In addition to the doctor’s response you need to create questions the doctor will ask the parent (e.g., What are
the symptoms? How long has the patient had these symptoms?...) Students will then present their role-playing to the class for their chosen scenario. (Teacher note: have students pick from a “hat” both for the scenario and their role in the role playing. Once selections have been made, students can organize themselves within their groups. In addition, encourage groups to dress in costume. For example, doctor’s uniform, parents and child).
See SCENARIOS attached below.

**Resources:**
Internet sites concerning specific genetic diseases- several are listed in the materials needed section above;
scenarios are adapted from:
“Decisions, decisions” by Sharon Nelson

**Homework / Extension:**
Invite a health professional to speak to the class.
Plan a Socratic Seminar based on an issue is introduced as a result of class presentations of the scenarios. .

**Instructional Task Accommodations for ELL Students:**
- Provide step by step directions; check for comprehension
- Provide ample time for each group to interact and discuss research findings
- Decrease language demands for ELL students (speaking part)
- Create a word wall for vocabulary; word wall can be interactive whereby students use yarn to make connections with key vocabulary
- Include illustrations with the word wall

**Instructional Task Accommodations for Students with Specific Disabilities:**
- Review and Implement IEP accommodations for specific student needs
  - Use word banks for written assessments such as essays
  - Provide step by step directions; check for comprehension
  - Provide extended time for Internet research
  - Allow time for students to practice their parts Create a word wall for vocabulary; word wall can be an interactive whereby students use yarn to make connections with key vocabulary
  - Include illustrations with the word wall
  - Use KIM vocabulary strategy (Key word, Illustration, and Meaning in students own words
SCENARIOS FOR TASK “Doctor, what is wrong with my child?”

GROWTH AND HEREDITY FRAMEWORK

- You have just finished reading a book called *The Family That Couldn't Sleep* by D.T. Max. According to this book the disease, Fatal Familial Insomnia or FFI, seems to be linked to another disease from which your aunt died from last year. Her condition was called Creutzfeldt-Jakob Disease. She was originally misdiagnosed with dementia and encephalitis. You need to talk to your family physician and then to a genetic counselor to find out if your side of the family can “catch” or inherit the disease. (*Teacher note: These diseases are prion diseases related to mad cow disease [bovine spongiform encephalitis] and can be inherited OR transmitted through direct ingestion.*)

- Your 16-yr-old daughter is 6' tall. After some discussion about her health and some probing by the) family physician into your family's history, you are referred to a genetic counselor. The physician suspects the possibility of Marfan's Syndrome. Your daughter is currently on the varsity basketball team, and the season has just gotten underway.

- You and your wife have just lost a child to Tay-Sachs disease. You were referred to a genetic counselor before deciding to have more children.

- You and your husband are in your early forties and have decided you would like to have another child. Your physician refers you to a genetic counselor to discuss concerns regarding Down's Syndrome.

- You and your partner are both African American. You have two children: the second child, a girl, is an albino; the first child, also a girl, is visually impaired. You would like another child and seek the advice of a genetic counselor.

- You have one child, age 3, that has cystic fibrosis. You would like to have another child and have been referred to a genetic counselor.

- You have just married. You and your spouse are healthy but your husband's brother has two children with sickle cell anemia and your sister has the same disease. You are thinking of having children and have sought the advice of a genetic counselor.

- Your oldest child has PKU that was diagnosed at birth. You would like to have another child and have been referred to a genetic counselor.
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- You have hemophilia; you and your spouse would like to have children. You are referred to a genetic counselor.
- You and your wife both have achondroplasia. You have just built a house to suit your needs. You would like to have a family and have been referred to a genetic counselor.
- Gloria, 19, is married to Robert, 21, and they wish to start a family. Both of Gloria's parents are healthy (Sonia, 39, and Todd, 40). However, Gloria's grandfather died at the age of 43 after being diagnosed with Huntington's Disease. Gloria and Robert have many questions and seek out a genetic counselor for information.
- Jim, 32, and Tammy, 28, have had two healthy children: Twila, age 3 and Terry, age 5. They have, however, recently discovered some background news about Tammy's family that concerns them. They have just found out that a brother of Tammy's, who was confined to a wheelchair by age 10, has Muscular Dystrophy. They would love to have a family of four children. Genetic counseling is available.
- Jim has a cousin with Klinefelter’s syndrome. He is soon to be married and wonders if the condition can be passed down to his children.
- In a biology class next door, a girl named Torey was born with Turner's syndrome and wants to talk to all the other biology classes about her syndrome and how it has affected her life and her family. Her parents are both teachers but neither is a science teacher. Her family physician and genetic counselor have both agreed to come and speak to your class.