1. Medical interventions are measures to improve health or alter the course of an illness and can be used to prevent, diagnose, and treat disease.
   - Prevention: vaccinations, hygiene, life-style choices, healthy diet/living, quarantine.
   - Diagnostics: X-rays, MRIs, CT scans, Bone scans, blood tests, urinalysis, biopsy.
   - Treatments: antibiotics, surgery, chemotherapy, radiation, rehabilitations, first aide.
   - Biopsy (treatment & diagnosis), physical therapy (treatment & prevention).

2. Bioinformatics, the collection, classification, storage, and analysis of biochemical and biological information using computers, can be used to identify disease pathogens.
   - Example: isolating and analyzing the DNA of a pathogen and comparing its DNA sequence to a database of known pathogen DNA (BLAST site).

3. Diagnostic tests for infectious diseases can provide qualitative results, indicating the presence or absence of disease, as well as quantitative results, indicating the concentration of the infectious agent or of an antibody produced in response to the disease agent.
   - Quantitative: known concentrations of antibody production to compare to our patients.
   - Qualitative: color change to indicate positive or negative results for our patient.

4. Antibody-based diagnostic tests, such as the ELISA assay, utilize fundamentals of human immune response to detect the presence of disease.
   - Antigen (foreign pathogen in your body); antibody (produced in response to the pathogen/antigen). Interact by the antibody flagging the antigen for white blood cells to destroy the antigen.
   - In an ELISA the antigen concentration can be measured; most often it is the antibody concentration that is measured. If individual has a high concentration of antibody they have been infected longer (Sue Smith - Patient Zero). Lower concentration more recent infection.
   - In the wells the antigen was conjugated to the surface, the patient samples were added and the antibodies if present bound to the antigen. Then a secondary antibody with the color indicator was added to bind to the initial antibody.

Lesson 2: Antibiotic Treatment Concepts:

1. Antibiotics disrupt the pathways that bacteria use to survive.
2. Bacterial cells use multiple pathways to gain resistance to antibiotics.

- Classes of antibiotics:

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillins (also called β-Lactam antibiotics)</td>
<td>belongs to a class of antibiotics called B-lactams, the class of drugs interferes with peptidoglycan cell wall structure. Human cells don’t have cell walls or peptidoglycan, so are not harmed by Beta-lactam drugs.</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>Broad spectrum antibiotics that disable bacteria by interfering with the cell’s ability to make proteins. Although human cells also make proteins, the protein-making cellular machinery is different in eukaryotic cells, so it is not harmed by Tetracyclines.</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>This class of antibiotics interferes with the bacterial cell’s ability to copy its DNA (genetic material); something that must be done before a cell can divide and multiply. Does not allow the enzymes that coil up the DNA to work. Eukaryotic DNA of human cells is packaged differently, so its replication is not disabled by Quinolones. Active against a wide variety of G+ and G-</td>
</tr>
<tr>
<td>Sulfa antibiotics (Sulfonamids)</td>
<td>Stop the growth of many G+ and G- They are structurally similar to PABA (a substrate used for folic acid making) Binds with an enzyme that normally binds with PABA and causes competitive inhibition Humans are not affected because we do not have the enzyme in our body.</td>
</tr>
</tbody>
</table>

3. Overuse and misuse of antibiotics will promote the selection of resistant bacteria.

- Overuse (over-prescription) or misuse (missing doses, not finishing antibiotics, doubling up after a missed dose) can cause the more resistant bacterial cells to survive and ultimately mutate so that the antibiotics are no longer effective.
- Conjugation: contact between bacterial cells to transfer genetic material.
- Transduction: transfer of genetic material by a vector (bacteriophage).
- Transformation: cell dies and explodes, the free DNA incorporates into another cell.
Lesson 3: The Aftermath: Hearing Loss Concepts:

1. Sound waves have two important properties: frequency (which the ear interprets as pitch - number of wavelengths or waves that pass a point in a specific amount of time) and amplitude (which the ear interprets as loudness).

2. Problems with one or more structures within the ear cause various types of hearing loss.
   - Drainage tubes: middle ear (eardrum).
   - Hearing aide: outer ear (canal).
   - Cochlear implant: inner ear (outside of head).

3. Hearing loss can be evaluated with several, simple hearing tests.
   - Sensorineural: deals with impulses sent to brain; on an audiogram there are deficiencies in both bone conduction and air conduction.
   - Conductive: deals with the pathway of sound (traveling); on an audiogram there are deficiencies in only air conduction.

4. There are a variety of interventions available to help people with hearing loss.
   - Drainage tubes, hearing aids, cochlear implants, antibiotics (ear drops).

5. There are bioethical concerns related to the use of cochlear implant technology.
   - Alienation from the deaf community; possibility of failure; destroys any residual hearing.

Lesson 4: Vaccination Concepts:

1. Vaccines are medical interventions that activate the immune system to recognize a disease antigen and produce antibodies necessary to defend the body.
   - The first vaccine developed was for smallpox by Edward Jenner (used cowpox to make the vaccine).

2. Many diseases have been eradicated by large-scale vaccination campaigns.
   - Herd immunity protects individuals that are not vaccinated because the majority of the population is vaccinated.
   - Without vaccination epidemics can occur (regional) or pandemics can occur (world-wide).

3. Vaccines can be produced in the laboratory by various methods, including recombinant DNA techniques.
   - Similar pathogen: example cowpox & smallpox.
   - Attenuated: example measles; weakened strain.
   - Killed: inactive form, example polio.
   - Toxoid: exposure to toxin produced by bacteria, example tetanus.
   - Subunit: use small portion of live pathogen, example Hep B.
   - Naked: gene from pathogen, example HIV.

4. Plasmids can be employed as an important tool in genetic engineering and can serve as vectors, vehicles for the movement of genetic information.
- Circular DNA; introduce a gene or portion of DNA for the plasmid to carry to a specific location in the body.
- Use of restriction enzymes, “scissors” to cut the DNA; DNA ligase as the “glue”.

- Must be cut with the same enzyme to produce complementary sticky ends.

5. Epidemiologists are dedicated medical professionals at the heart of the public health field who monitor the health of human populations, search for patterns in the development of both infectious and chronic illnesses assist in outbreak investigations, and design disease treatment and prevention strategies.
- Outbreak calculations/source of illness calculations.