# Bio-engineering for a Cure!

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**Target Grade**: 9th Grade Biology

**Time required:** 3-45 min class periods

- One 45min class to explain activity and student planning
- One 45 min class to build model
- One 45 min class to make modifications and present to teacher

**Standards:**

HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

**Materials Required:**

- 3D Printer and filament
- Aluminum foil
- Binder clips
- Cardboard
- Coffee straws
- Cotton balls
- Drinking straws
- Elastic Hair Ties

- Legos
- Paper clips small and large
- String
- Pipe cleaners
- Play-Doh
- Q-tips
- Tape
- Toothpicks

**Prior Knowledge Required** – before beginning this lesson, students should have a general understanding of cell parts and function.

**Assessment**

Formative

- Monitor student progress
- Questioning
- Students must present final product to teacher. Students must explain rubric requirements. Teacher will then ask questions and give feedback to help improve final assessment.

Summative

- Students will turn in model to teacher along with a Patton request

**Differentiation**

- Teacher may assign leveled groups
- Modifications can be made to any written or presentation requirements based on individuals IEP or 504 plan

# Bio Engineering for a Cure!

In this activity, you will assume the role of a bio engineer. Bio engineers use their knowledge of biology to design a myriad of technologies to improve people's lives who suffer from various diseases and disabilities

Define the Problem

Your task over the next few days will be to work together to create a bio engineered model of a cell organelle that reflects the changes needed to treat, improve quality of life, or cure the disease of your choosing within the engineering standards.

Example disorders: (Here are a few options. You are not limited to these but alternates must be discussed with teacher before building.)

| **Disorder** | **Cell Part Impacted** |
|---|---|
| Cystic Fibrosis | Endoplasmic Reticulum or Cell Membrane |
| Progeria | Nuclear Envelope |
| Muscular dystrophy | Cytoskeleton |
| Treacher Collins | Ribosomes |
| Achondrogenesis | Gogli Apparatus |
| Mitochondrial Disease | Mitochondria |
| Zellweger Syndrome | Peroxisomes |
| Tay Sach | Lysosomes |

- The cell part we have chosen is _____.
- The disorder we will try to remediate is _____.
- Our problem is (what's wrong with your organelle that is causing your disorder)
  _____
  _____
  _____
  _____.
- We predict we can solve this problem by
  _____
  _____
  _____
  _____.

Develop Solution –

To create your model you may use any combination of the list of materials below. Beware the materials you used come at a price. One part **must** be manufactured using the 3D printer. Like true bio engineers your goal is to develop a solution that works but is affordable to a consumer. Your groups total cost will be factored into your grade. (see rubric)

***Material Cost***- All materials must be bought as-is. (You can't go into the grocery store and buy 4 eggs – you must buy the dozen). You may make two trips to the "store" (teacher). The first trip is to buy all the supplies you think you will need. The second trip may include more purchases, exchanges and returns. Exchanges and returns will only be excepted if entire product is present. (i.e. – if you buy toothpicks you must return all 20).

***Materials and Cost***

* 3D Printer part $6 (MUST USE)
Aluminum foil (2"x2") $1
Binder clip (x2) $3
Cardboard (3"x2") $2
Coffee straw (x4) $2
Cotton balls (x5) $3
Drinking straw $1
Elastic Hair Tie $3
Legos (15 random) $5
Paper clips small or large(x 5) $1
String (1ft) $2
Pipe cleaner $1
Play-Doh (small cup) $3
Q-tips (x20) $ 2
Tape (Scotch, Masking or Painters) (6") $3
Toothpicks (x20) $2

Draw a labeled sketch of your model cell part (or entire cell).

Optimize

What works? What doesn't? How could you modify your model to make it better.(After you fill out this section you may make your 2nd trip to the "store".

_____
_____
_____
_____
_____
_____
_____.

Draw a sketch of your modification

***Submitting your Patent*** – To claim rights to your invention you must submit a patent for your work. Typically a patent request requires the following information. Your notes and sketches on the project. (go back through lab handout and make sure it is all correctly filled in and your sketches are clearly labeled) Answer the following questions in detail to support your patent request before sending it to the United States Patent Office – A.K.A – you teacher.

Does you modified organelle (or cell) solve your problem? Explain.

_____
_____
_____
_____
_____.

Could this product help people in the future? Why/ Why not?

_____
_____
_____
_____
_____.

Justify the cost of your materials to the consumer.

_____
_____
_____
_____
_____.

Rubric

| ***Criteria*** | ***Excellent*** | ***Good*** | ***Fair*** |
|---|---|---|---|
| Organelle representation | Organelle model and disorder thoroughly explained. It is evident that the group understands the function of the organelle and the impact that its malfunction has on the disorder. | Organelle model and disorder explain. It is evident that group did research on the organelle as well as the disorder | Organelle model is missing key components to show connection to disorder. |
| Solves problem caused by disorder | Model correctly solves problem and functions to show change in organelle | Model correctly solves problem in theory but does not properly work | Problem is addressed but not solved |
| Patent | Questions are answered correctly and in great detail. Sketches are clear and labeled. It is evident that content is understood. | Questions are answered correctly but lack important detail. Sketches are clear and label. | Questions are answered but key information is missing. Sketches present. |
| Build cost | Groups spent less than 25% of peers | Groups spent less than 50% of peers | Groups spent more than most peers |
| Teamwork | All group members worked together on project. Everyone showed respect and encouraged dialog within group. If there was an issue with the group it was respectful addressed with teacher. | Most group members work together. Ideas were discussed and some were put forth into action. | Group did not work together. Students did not address issues with teacher. |