Transformation

Bacterial Transformation and Green Fluorescent Protein

*Transformation* is an activity created by Learning Undefeated to help students explore the process of moving genes from one organism to another using genetic transformation. This lab also explores the use of the scientific method.

Genetic transformation literally means a change in an organism caused by the insertion of one or more gene(s) from another organism in order to change its traits or *transform* the organism. Genetic transformation occurs when a cell takes up a nucleic acid and expresses a protein or factor that would not normally be expressed. By creating this new protein scientists can study the functions of specific genes as well as use it as a tool. Genetic transformation is used in many areas of technology including agriculture, medicine, and is an everyday practice in basic laboratory research.

**LEARNING OBJECTIVES**

**Students will know:**

* What is transformation
* The use of bacteria as a genetic tool
* How genes are introduced into other organisms for scientific, agricultural, and medical use

**Students will understand:**

* How DNA plasmids are introduced into bacteria
* How genes are regulated
* How genetic markers are used

**Students will be able to:**

* Define wild-type vs. mutant phenotypes
* Locate the different genes on a pGlo plasmid
* Select for transformed bacteria
* Analyze the growth of bacteria
* Calculate the transformation efficiency

**UNIT PLAN**

**Pre-Laboratory Engagement (45-60 minutes)**

1. Students should visit the [Bacterial Transformation Lab](http://labcenter.dnalc.org/labs/transformation/transformation_h.html) website provided by the Lab Center at Harlem DNA Lab
   1. Students complete the background reading section and answer questions on the [student worksheet](https://drive.google.com/open?id=1zm_yImsLD-YI67Hce1yLd1lLmEEB9Kw2-Y5J7NuXdfc)
   2. Students watch the Transformation interactive and answer questions on the [student worksheet](https://drive.google.com/open?id=1GE1IimIOWoSmWj-FGTXDLbh-lqwPGBzu-vjh_ACugSw)
   3. Optional: Have students explore the rest of the website for more background and history
2. Students should complete the [Make a Plasmid activity](https://drive.google.com/open?id=15bmzNawjuoc50bNE2LLB-YJ4CRSYwEFy)
   1. Students cut out plasmid and insulin DNA sequences and must cut them at restriction sites so the two sections will ligate together.
      1. [DNA cutout sheet](https://drive.google.com/open?id=1BQHDd4WxZH8Aw_NXQp_eMns1aGulMXyF)
      2. [Student instructions](https://drive.google.com/open?id=1dOrG_nbSudISnX9--QuWekPsUBu_Zc26A5n9yQJu9LI)
   2. Optional: Have students answer questions on the student worksheet
      1. [Student worksheet](https://drive.google.com/open?id=1bV_AYralfkVqRVOpuuFgtAe7F49Jzqg3H98_OA9-M3o)
      2. [Answer Key](https://drive.google.com/open?id=1I0RCXTBWnAkwURwXBYNYxs-DAeFeQZTfxzjN1oXUNfM)

**Laboratory Activity (45 minutes)**

1. Students should watch lab activity video [Transformation Part One](https://vimeo.com/423232592) (5:42) and complete Part I of the student activity worksheet.
2. Students should watch [Transformation Part Two](https://vimeo.com/423286195) (13:50) and complete Part II, III, IV, and V of the student worksheet
   1. [Student Activity Worksheet](https://drive.google.com/open?id=1xr8EP80q5Yb0NlPsGOj_XqFQs5NU0lxRREGugw3X-gM)
3. After completion of the video students view the [worksheet walkthrough](https://vimeo.com/423234088) to help them answer the questions and learn the material.
   1. Video can be supplied before or after student work is submitted
      1. [Lab activity Worksheet KEY](https://drive.google.com/open?id=1kA_gnJhpRZm1evshWNTlaryj5f7Gind1692HbyLNyvg)
4. Optional: Students should perform a lab simulation of transformation using the [PBS Gene Cloning activity](https://www.pbslearningmedia.org/asset/biot09_int_geneclone/EN/) (Computers will need to be Flash enabled)
   1. Students should complete both [Making a Recombinant Plasmid](https://www.pbslearningmedia.org/asset/biot09_int_geneclone/EN/) and [Bacteria Transformation](https://www.pbslearningmedia.org/asset/biot09_int_geneclone/EN/) tabs
   2. Students answer questions about activity on [student worksheet](https://drive.google.com/open?id=1fK6zgPrZ9jx7xdvCCT3InuLctQoIM9Eu3ByOF3vu0Zk)
      1. [Simulation Worksheet Key](https://drive.google.com/open?id=1eLgUvIjQbJwdKNJN1G8eGpAQW0-yg3JYM3DF8b_41e8)

**Post-Laboratory Extension (30-60 minutes)**

1. Students should write an argumentative essay on the ethics of genetically modified organisms (GMOs) using references and proper MLA citations.
   1. Video references
      1. [Are GMOs Good or Bad? Genetic Engineering & Our Food](https://www.youtube.com/watch?v=7TmcXYp8xu4&feature=emb_title)
      2. [GMO and it’s Negative Effects](https://www.youtube.com/watch?v=ubkZz1_LX1E)
   2. Scholarly Articles
      1. [Genetically Modified (GM) Foods and Ethical Eating](https://onlinelibrary.wiley.com/doi/epdf/10.1111/1750-3841.13191)
      2. [Genetically Modified Foods and Social Concern](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3558185/)
         1. [Vocabulary List](https://docs.google.com/document/d/1rSNnnDm_Khz6wkL7kpgSu_aseJMBokbDbqhPVb4aurc/edit?usp=sharing)

**STANDARDS ALIGNMENT**

**NGSS CONNECTIONS**

**HS-LS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring

**TEKS CONNECTIONS**

**BIOL.2E** Plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

**BIOL.6A** Identify components of DNA, identify how information for specifying the traits of an organism is carried in the DNA, and examine scientific explanations for the origin of DNA

**BIOL.6D** Recognize that gene expression is a regulated process

**LOUISIANA STANDARDS FOR SCIENCE CONNECTIONS**

**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.