**Lesson Plan: “What is in the Food Colors?—DIY Gel Electrophoresis”**

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| Summary of Lesson Plan (max. 100 Words)  Include aspects of the lesson that are unique and innovative. | The separation of macro-molecules by size, shape, and/or charge is one of the most commonly used technologies in molecular biology. This usually involves separation of DNA/RNA or proteins for subsequent analyses and/or purification. This requires a matrix (gel) for molecules to travel through; usually agarose or polyacrylamide. A constant electrical current forces molecules to move in one direction. Apparatus for doing these separations are expensive and not generally available outside of research labs. Our solution is a home-made apparatus demonstrating the principles of electrophoresis that is affordable and safe for classroom use. |
| List of Standards Addressed  Common Core, NC Essential Science, Next Gen, etc. (This should be list of all full standards addressed by the lesson) | NC Essential Standards Bio 3.3.1   * Summarize the process of gel electrophoresis as a technique to separate molecules based on size. Students should learn the general steps of gel electrophoresis – using restrictions enzymes to cut DNA into different sized fragments and running those fragments on gels with longer fragments moving slower than faster ones. * Interpret or “read” a gel.   Next Generation Science Standards Performance Expectations—Science & Engineering Practices   * Asking questions (for science) and defining problems (for engineering) * Planning and carrying out investigations * Constructing explanations (for science) and designing solutions (for engineering) * Obtaining, evaluating, and communicating information * Engaging in argument from evidence |
| Learning Objectives using Measurable Verbs (what students will be able to do) | * Students will be able to explain and carry out a simple process for separating mixtures. * Students will be able to explain the principle of separating macro-molecules by differences in size, charge, and shape. * Students will be able to apply what they learn from this lesson to the separation of other biomolecules, such as DNA. |
| Appropriate Grade Levels | 9-12 |
| Group Size/# of students activities are designed for | Groups of 4 or 5 students, up to 25 students total |
| Setting (e.g. indoors, outdoors, lab, etc.) | Lab setting |
| Approximate Time of Lesson (Break down into 20-50 minute periods) | **Total:** 90 minutes  **Engage**: 10 minutes.  **Explore**: 80 minutes. Students will read and implement the laboratory procedures, which includes 5” for loading the gel, 60” for running the gel, and 5” for disassembling the set-up and cleaning  **Explain**: This can be done while the electrophoresis is running  **Elaborate**: This can be done while the electrophoresis is running  **Evaluate**: Amount of time will vary depending on evaluation option selected. |
| Resources Needed for Students (e.g. scissors, paper, pencils, glue, etc.) | Gel-electrophoresis kit |
| Resources Needed for Educators (e.g. blackboard, Powerpoint capabilities, etc.) | Powerpoint capabilities; whiteboard for students to draw on; a video that explains the principle of gel-electrophoresis |
| Apps/Websites Needed | Gel-electrophoresis instructions and graphics (<http://www.tridiybio.org/>) |
| Lesson Activity (step by step description of activity) | Engage  Students are prompted to discuss the difference between “mixture” and “molecule”; why do we want to separate mixtures into pure components (molecules); and what properties of molecules can be used to facilitate this separation |
| Explore   * Load samples onto the gel as specified in steps 5 & 6 of “Procedures” in the instruction * Run electrophoresis as specified in steps 7—13 of “Procedures” |
| Explain  Let students watch a video on how gel-electrophoresis works. Students will share their prediction of the separation outcome; unexpected results; and plausible explanations. |
| Elaborate  Students will apply the principles of gel-electrophoresis into the separation of other biomolecules, such as DNA. Students will share their group discussion with other classmates |
| Evaluate  The instruction provides a list of questions which can serve as part of evaluation. |
| Final Product/Assessment (e.g. worksheet, presentation, poster, etc.) |  |
| Feedback Form for Teachers |  |

Images:

Appendices:

Background Reading for Teachers: