Girl Scout Gold Award Project

Lesson Plan Developer, Elizabeth Garfinkle
Girl Scout Ambassador

Science Advisor, Jessica Sanford
San Roque School Facilitator

English Language Learners Advisor, Cheryl Takahara
La Patera Elementary School Teacher

CureCancer

Extras
Dear Reader,

You have just opened a lesson plan modified for ELL (English Language Learners) students from Bio-Rad’s Secrets of the Rain Forest kit. This lesson will introduce your ELL students to the process of finding the cure for cancer along with the scientific method and lab techniques. All of the lessons are hands-on, clear, and make the advanced science vocabulary and concepts accessible to your ELL students. After the unit, your ELL students will “find the cure to cancer” and have a new understanding and confidence about science.

Enclosed is a suggested timeline, lab prep, unit summary, student booklets, vocabulary cards, ten individual lesson plans with assignments, a final reflection, diagrams, and projects (including a CD version of the entire unit). To use these materials, photocopy the desired pages from the unit booklets.

If you have any questions or comments, please refer to Bio-Rad’s Secrets of the Rain Forest manual or contact me directly.

Sincerely,

Elizabeth Garfinkle
Girl Scout Ambassador
CureCancer Unit Summary

CureCancer is a unit designed to teach science and make it accessible to English Language Learners (ELL). This unit achieves that through ten lessons that incorporate English Language Development Strategies in Science like group work, use of graphic organizers, activation of prior knowledge, use of academic language scaffolding, context clues through visual scaffolding, realia, manipulative, and materials, task-based or experiential learning, leveled questions, and multiple intelligence strategies.

**Group work in CureCancer:** Students collaborate with their peers and work in groups of two or more to complete the six labs and the final presentation about their "cure to cancer". Having ELL students participate in group work provides them with time to practice their English communication skills, learn new ideas from their peers, and expand their understanding of concepts.

**Use of graphic organizers in CureCancer:** To help ELL understand the difficult science concepts presented in CureCancer, graphic organizers are included in the unit’s activities. For example, to help the students understand the isolation process of the Green Fluorescent Protein (GFP), diagrams are included in their student booklets that allow them to color in the location of the GFP during a given step in the lab process. This will help them visualize and therefore comprehend the process of isolating a protein.

**Activation of prior knowledge in CureCancer:** ELL students are exposed to two different types of information in CureCancer: information they are familiar with and information they are unfamiliar with. To help them better understand the new information, activation of prior knowledge is applied to the lessons. In CureCancer, the front cover of the student’s booklet has pictures, some of which are probably familiar to the students and some of which are not. The first lesson has the students look at the front cover of their booklet and discuss with their peers and facilitator what the familiar pictures mean and also gives them an opportunity to ask questions about the unfamiliar pictures, which will become familiar after they have completed the unit.

**Use of Academic language scaffolding in CureCancer:** To build ELL student’s English vocabulary, a set of three to ten new vocabulary words are introduced at the beginning of lessons 1-6. This is done by the facilitator going over the new word, definition, and picture found on the

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1 Arizona Department of Education- Standards and Assessment
vocabulary cards included in each lesson. To improve their English writing skills and to instill the new word in their minds, the students write the definition of the new words in their booklets. This, along with usage of the words during and outside of class, will build their English and science vocabularies.

**Context clues through visual scaffolding in CureCancer:** New vocabulary and science concepts are taught using pictures. This helps the ELLS students learn English as well as the new vocabulary and science concepts in a productive way. They are able to follow along, learn, and succeed even if the spoken instructions are not clear to them. They can respond and ask questions using the same technique of drawing until they become familiar enough with the words and information that they can verbally communicate.

**Realia, manipulative, and materials in CureCancer:** All lessons in CureCancer are hands-on and activity based. ELL students get to work with different lab materials and tools and kinesthetically participate in models of science concepts.

**Task-based or experiential learning in CureCancer:** ELL students learn the science by participating in the actual labs or simulations. Through the hands-on learning, ELL students are able to learn and instantly use the new information.

**Leveled questions in CureCancer:** Questions based on the labs, vocabulary, and science concepts are asked after each lesson. The questions are standard, but exceptions and modifications are made to make the questions accessible to all levels of ELL students. For example, students have the option to dictate, write, draw, act out, or use any other method that works for them to answer the questions.

**Multiple intelligence strategies in CureCancer:** Projects and work completed in class are designed to let the ELL students find their passions and what they are interested in and good at and then implement that into their work. Projects are open ended as long as the key information is presented in some form, giving the ELL students the opportunity to do what they love as well as showing what they have learned.

**Grading in CureCancer:** Grading of the students in CureCancer is open ended, optional, and up to the facilitator. If the facilitator chooses to grade the students, they can grade them based on participation in class discussions and labs, review question answers, projects, the work done in their student booklets, etc. If the facilitator chooses not to grade the students, they should make sure that students are participating and completing their work for credit.
<table>
<thead>
<tr>
<th>DATE</th>
<th>LESSON</th>
<th>NOTES</th>
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</thead>
<tbody>
<tr>
<td>September 5, 2011-Monday</td>
<td>No School-Labor Day</td>
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<tr>
<td>September 6, 2011-Tuesday</td>
<td>Lesson 1. The Mysterious Green Fluorescent Leaves.</td>
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<tr>
<td>September 7, 2011-Wednesday</td>
<td>Not regular classes</td>
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<td>September 13, 2011-Tuesday</td>
<td>Lesson 5. Purification Phase 2- Bacterial Lysis</td>
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<tr>
<td>September 16, 2011-Friday</td>
<td>Lesson 6. Purification Phase 3- Protein Chromatography.</td>
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<tr>
<td>September 19, 2011-Monday</td>
<td>Lesson 7. DNA to Proteins Activity.</td>
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<tr>
<td>September 20, 2011-Tuesday</td>
<td>Lesson 8. The World of Genetics, Solving Ciphers.</td>
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<tr>
<td>September 27, 2011-Tuesday</td>
<td>Lesson 10. Dilemmas.</td>
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<tr>
<td>October 3, 2011-October 7, 2011.</td>
<td>Final Reflection, Closing, Grading, etc.</td>
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Contacts

Elizabeth Garfinkle, Lesson Plan Developer
EARGarfinkle@aol.com

Bio-Rad Laboratories
http://www.bio-rad.com/evportal/evolutionPortal.portal;JSESSIONID_EVPORTAL=J3GLM1wHTCzQY0w0MnywJByJ1k2bMDq3FyfsS93y2QkB2mHlWkD!-1256032115?_nfpb=true&_pageLabel=contact_us_page

Materials

Extras
Title Pages
Lessons 1-10
Final
Student Booklet
CD version of CureCaner
Bio-Rad’s Secrets of the Rain Forest Kit and Manual

Resources

Bio-Rad Laboratories

Bio-Rad’s Secrets of the Rain Forest Kit and Manual

Arizona Department of Education-Standards and Assessment
Lesson 2 1 hour and 15 minutes

Student workstations
- inoculation loops (1)
- poured agar plates (2)
- marking pen (1)

Facilitators workstation
- rehydrated bacterial library (1)
- 37 degrees C incubator oven (1)

To prepare (instructions found on pages 8-11 of Bio-Rad’s manual)
- prepare agar plates
- prepare liquid culture media
- rehydrate bacterial library
- prepare student and facilitator workstations

After lab (instructions found on page 26 of Bio-Rad’s manual)
- place the plates upside down inside the incubator overnight at 37 degrees C
- use next class time and do not refrigerate before use

Lesson 3 10 minutes

Student workstations
- streaked bacterial plates (2)
- inoculation loops (2)
- culture tubes (2)
- marking pen (1)
- test tube holder (1)

Facilitators workstation
- UV light (at least 1)
- incubator (1)

To prepare (instructions found on pages 11 of Bio-Rad’s manual)
- prepare student and facilitator workstations
- set up incubator
After lab (instructions found on page 30 of Bio-Rad’s manual)
- cap the tubes and place them in the incubator for 24 hours at 32 degrees C until next class period

**Lesson 4 10 minutes**

Student workstations
- microtubes (1)
- pipette (1)
- microtube rack (1)
- marking pen (1)
- beaker of water for rinsing pipettes (1)

Facilitators workstation
- TE buffer (1 vial)
- Lysozyme rehydrated (1 vial)
- Centrifuge (1)
- UV light (1)

To Prepare (instructions found on page 12 of Bio-Rad’s manual)
- prepare student and facilitator workstations
- rehydrate lysozyme

After lab (instructions found on page 34 of Bio-Rad’s manual)
- place the microtubes in the freezer until next class period

**Lesson 5 10 minutes**

Student workstations
- microtubes (1)
- pipette (1)
- microtube rack (1)
- marking pen (1)
- beaker of water for rinsing pipettes (1)
- HIC chromatography column (1)
- column end cap (1)

Facilitators workstation
- binding buffer (1 vial)
- equilibration buffer (1 vial)
- centrifuge (1)
- UV light (at least 1)
To Prepare (found on page 12 of Bio-Rad’s manual)
- prepare student and facilitator workstations

After lab (found on page 37 of Bio-Rad’s manual)
- place the tubes in the refrigerator until the next class period

Lesson 6 10 minutes

Students workstations
- collection tubes (3)
- pipette (1)
- microtube rack (1)
- beaker of water for rinsing pipettes (1)
- HIC chromatography column (1)
- Column end cap (1)

Facilitators workstation
- wash buffer (1 vial)
- equilibrations buffer (1 vial)
- TE buffer (1 vial)
- UV light (at least 1)

To Prepare (found on page 12 of Bio-Rad’s manual)
- prepare student and facilitator workstations

After lab (found on page 41 of Bio-Rad’s manual)
- Parafilm or Saran Wrap the tubes and place in the refrigerator until needed again for reference
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CureCancer

Lesson 1
CureCancer Lesson 1
The Mysterious Green Fluorescent Leaves

Learning Goals:

• Students should be able to explore new vocabulary words

• Students should be able to create their own versions of the story presented to them

Materials:

• Set 1 Vocabulary Cards
• Student Booklets
Procedure:

Pass out the students’ booklets. Have the students look at the cover and discuss with their peers about the pictures. Lead a short class discussion about what images look familiar and unfamiliar. Answer any questions.

Put set 1 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 2 of their student booklets. Assist students with note taking as necessary.

Have the students turn to page 3 of their student booklets. Read the story aloud as they follow along. Briefly discuss the story and answer any questions. Then have the students turn to page 4 of their student booklets. Go over the assignment and answer any questions. Let students work on assignment independently and assist when needed. Tell them that they will have half of the next class time to work on the assignment.

Closing: Clean up, collect booklets, and answer any questions. If time left over, have students look through their booklets or assist individual students.

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<tr>
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<tr>
<td>8:30am-8:45am</td>
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<td>Set 1 vocabulary cards.</td>
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<td>8:45am-9:15am</td>
<td></td>
<td>Reading/illustrated summary of story.</td>
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<td>9:15am-9:20am</td>
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<td>Closing.</td>
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CureCancer Lesson 1
The Mysterious Green Fluorescent Leaves

Learning Goals:

• Students should be able to explore new vocabulary words

• Students should be able to create their own versions of the story presented to them

Materials:

• Set 1 Vocabulary Cards
• Student Booklets
Procedure:

Pass out the students’ booklets. Have the students look at the cover and discuss with their peers about the pictures. Lead a short class discussion about what images look familiar and unfamiliar. Answer any questions.

Put set 1 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 2 of their student booklets. Assist students with note taking as necessary.

Have the students turn to page 3 of their student booklets. Read the story aloud as they follow along. Briefly discuss the story and answer any questions. Then have the students turn to page 4 of their student booklets. Go over the assignment and answer any questions. Let students work on assignment independently and assist when needed. Tell them that they will have half of the next class time to work on the assignment.

Closing: Clean up, collect booklets, and answer any questions. If time left over, have students look through their booklets or assist individual students.

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CureCancer

Lesson 2
CureCancer Lesson 2
Cloning

Learning Goals:

• Students should be able to independently finish their illustrated summary of the story read in the previous lesson

• Students should be able to collaborate with their group members and facilitator to complete the first lab of the unit

Materials:

• Set 2 Vocabulary Cards
• Student Booklets
• Refer to Lab Prep (found in Extras) for Lab Materials and Preparation
• Lab Instructions (found on page 25-26 of Bio-Rad’s manual)
• Review Questions (found on page 27 of Bio-Rad’s manual, answers on page 57)
Procedure:

Pass out the students’ booklets. Put set 2 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 5 of their student booklets. Assist students with note taking as necessary.

Split the class into two groups. Tell group 1 to finish their illustrated summaries. Assist group as needed. Tell group 2 that they are going to be doing the first science lab of the unit.

For group 2, pass out the lab instructions and/or demonstrate the lab instructions in front of the students. Let the students work and collaborate independently and assist when needed. After they have completed the lab, have the students turn to page 6 and complete the activity. Halfway through the class time, have the groups switch activities.

Closing: Clean up, collect booklets, and pass out review questions. Read the questions out loud to the class and lead a class discussion to answer the questions. Then have the students write down the answers discussed or have the students dictate the answers discussed and collect their papers.

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<tr>
<td>8:30am-8:45am</td>
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<td>Set 2 vocabulary cards.</td>
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<tr>
<td>8:45am-9:15am</td>
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<td>Group work time.</td>
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<td>9:15am-9:20am</td>
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CureCancer

Lesson 3
CureCancer Lesson 3
Screening

Learning Goals:

- Students should be able to observe the characteristics of animal and bacteria cells and discuss those characteristics with their peers and facilitator

- Students should be able to independently follow the lab instructions to complete the lab

Materials:

- Set 3 Vocabulary Cards
- Student Booklets
- Refer to Lab Prep (found in Extras) for Lab Materials and Preparation
- Lab Instructions (found on page 29-30 of Bio-Rad’s manual)
- Review Questions (found on page 31 of Bio-Rad’s manual, answers of page 58)
- Pictures of Animal and Bacteria Cells (1 of each per facilitator and 1 of each per student; 4 pages)
Procedure:

Pass out the students’ booklets. Put set 3 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 7 of their student booklets. Assist students with note taking as necessary.

Tell the class that they are going to do an activity about cells and then the next lab in the unit. Pass out the pictures of the animal and bacteria cells to each student. Tell the class that in front of them they have a picture of an animal cell and a bacteria cell. Have them discuss with their peers which one they think is the animal cell and which they think is the bacteria cell. Once they have discussed, ask them to raise the picture they think is an animal cell. Then ask them to raise the picture they think is a bacteria cell. Use the teacher edition pictures of the cells to show them the correct answers. Discuss why and answer any questions they have about cells. Ask the students to write down or dictate three similarities and three differences between the animal and the bacteria cell on page 8 of their student booklets. Assist students as needed. Clean up from the activity and tell students that now they are going to screen the colonies of bacteria that they cloned in the last lab. If students don’t remember what they did in the last lab or the definitions/concepts of those words, go over them again using the vocabulary cards and the notes in their booklets.

Pass out the lab instructions and/or demonstrate the lab instructions in front of the students. Let the students work and collaborate independently and assist when needed. After they have completed the lab, have the students turn to page 9 and complete the activity.

Closing: Clean up, collect booklets, and pass out review questions. Read the questions out loud to the class and lead a class discussion to answer the questions. Then have the students write down the answers discussed or have the students dictate the answers discussed and collect their papers.
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<td>8:30am-8:45am</td>
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<td>Set 3 vocabulary cards.</td>
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<tr>
<td>8:45am-8:55am</td>
<td></td>
<td>Cells activity.</td>
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<tr>
<td>8:55am-8:57am</td>
<td></td>
<td>Transition time.</td>
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<tr>
<td>8:57am-9:15am</td>
<td></td>
<td>Lab.</td>
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<tr>
<td>9:15am-9:20am</td>
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<td>Closing.</td>
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Animal Cell
Bacteria Cell

Teacher Copy
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CureCancer

Lesson 4
Learning Goals:

- Students should be able to identify the supernatant and the pellet after the microtube is placed in the micro centrifuge

- Students should be able to summarize the process of the lab and participate in it

Materials:

- Set 4 Vocabulary Cards
- Student Booklets
- Refer to Lab Prep (found in Extras) for Lab Materials and Preparation
- Lab Instructions (found on page 33-34 of Bio-Rad’s manual)
- Review Questions (found on page 35 of Bio-Rad’s manual, answers on page 59)
Procedure:

Pass out the students’ booklets. Put set 4 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 10 of their student booklets. Assist students with note taking as necessary.

Draw the diagram of the micro centrifuge on the board. Then explain the diagram, “The micro centrifuge is used to move heavier objects to the bottom and lighter objects to the top. The supernatant is the liquid left at the top and the pellet is a collection of material down at the bottom.” Discuss and answer any questions. Have students draw their own, labeled diagram on page 11 of their student booklets.

Pass out the lab instructions and/or demonstrate the lab instructions in front of the students. Let the students work and collaborate independently and assist when needed. After they have completed the lab, have the students turn to page 12 and complete the activity.

Closing: Clean up, collect booklets, and pass out review questions. Read the questions out loud to the class and lead a class discussion to answer the questions. Then have the students write down the answers discussed or have the students dictate the answers discussed and collect their papers.

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<td>Micro centrifuge activity.</td>
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<td>8:55am-8:57am</td>
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<td>Transition time.</td>
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<td>8:57am-9:15am</td>
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<td>Lab.</td>
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CureCancer

Lesson 5
CureCancer Lesson 5
Purification Phase 2 – Bacterial Lysis

Learning Goals:

• Students should be able to create a model of cell lysis using candy

• Students should be able to connect the model of cell lysis using candy to the actual cell lysis occurring in the lab

Materials:

• Set 5 Vocabulary Cards
• Student Booklets
• Refer to Lab Prep (found in Extras) for Lab Materials and Preparation
• Lab Instructions (found on page 36-37 of Bio-Rad’s manual)
• Review Questions (found on page 38 of Bio-Rad’s manual, answers on page 60)
• M and M’s (at least 5 per student)
• Paper Cups to Put M and M’s in (1 per student)
Procedure:

Pass out the students’ booklets. Put set 5 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 13 of their student booklets. Assist students with note taking as necessary.

Pass out paper cups with five or more M and M’s to each student. Tell them not to eat any yet. Tell them to discuss with their peers how an M and M could represent the process of cell lysis. Have them refer back to the vocabulary cards or their notes if necessary. Once they have discussed for a while, have the student share their ideas with the whole class. Then tell them the proper definition, “The M and M represents a cell. The candy coating is the cellular membrane and the chocolate represents the organelles. Your saliva, that is full of amylase, which is an enzyme that breaks down starches, will represent the lysis.” Have the students test this definition. Tell them to place one of the M and M’s in their mouths for a moment. Tell them to just gently suck on it, not to chew or swallow it. Ask them what part of cell lysis is being represented now. Tell them that they can swallow it once the entire candy coating is dissolved. Then ask them what part of cell lysis is being represented now. Let the student eat the rest of their M and M’s and answer any questions. Clean up and have the students do the activity on page 14 of their student booklets.

Pass out the lab instructions and/or demonstrate the lab instructions in front of the students. Let the students work and collaborate independently and assist when needed. After they have completed the lab, have students turn to page 15 of their student booklets and complete the activity.

Closing: Clean up, collect booklets, and pass out review questions. Read the questions out loud to the class and lead a class discussion to answer the questions. Then have the students write down the answers discussed or have the students dictate the answers discussed and collect their papers.
<table>
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<td>8:30am-8:45am</td>
<td>Set 5 vocabulary cards.</td>
</tr>
<tr>
<td>8:45am-9:15am</td>
<td>M and M lysis model activity.</td>
</tr>
<tr>
<td>9:00am-9:05am</td>
<td>Transition/break time.</td>
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<td>9:05am-10:00am</td>
<td>Lab.</td>
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<td>10:00am-10:10am</td>
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Lesson 6
Secrets of the Rain Forest Lesson 6
Purification Phase 3-Protein Chromatography

Learning Goals:

- Students should be able to **purify** the Green Fluorescent Protein (GFP)
- Students should be able to **identify** which collection tube(s) contain the Green Fluorescent Protein (GFP)

Materials:

- Set 6 Vocabulary Cards
- Student Booklets
- Refer to Lab Prep (found in Extras) for Lab Materials and Preparation
- Lab Instructions (found on page 39-41 of the manual)
- Review Questions (found on page 42 of the manual, answers on page 60-61)
Procedure:

Pass out the students’ booklets. Put set 6 vocabulary cards on the board. Go over the word, picture, and definition with the students. Have the students repeat back the word. Then have the students take notes on the word, picture, and definition on page 16 of their student booklets. Assist students with note taking as necessary.

Tell the students that today they are going to be doing the last lab of the unit, so today they are going to fully purify the GFP and potentially find the cure to cancer.

Pass out the lab instructions and/or demonstrate the lab instructions in front of the students. Let the students work and collaborate independently and assist when needed. After they have completed the lab, have the students turn to page 17 of their student booklets and complete the activity. During down times during the lab, have students share their work they have completed with their peers or lead a question and answer discussion.

Closing: Clean up, collect booklets, and pass out review questions. Read the questions out loud to the class and lead a class discussion to answer the questions. Then have the students write down the answers discussed or have the students dictate the answers discussed and collect their papers.

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<tr>
<td>8:30am-8:45am</td>
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<td>Set 6 vocabulary cards.</td>
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<tr>
<td>8:45am-9:15am</td>
<td></td>
<td>Lab.</td>
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<td>9:15am-9:20am</td>
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La Patera Elementary School Teacher

CureCancer

Lesson 7
CureCancer Lesson 7
DNA to Proteins Activity

Learning Goals:

- Students should be able to participate in the process that DNA goes through to create proteins
- Students should be able to collaborate with their peers to create a human model of the process of DNA to proteins

Materials:

- Student Booklets
- DNA to Proteins Model Comic (2 per student)
- Student Role Badges
- 2 Long Jump Ropes
- 4 Colored Snap Cubes, 4 Black Snap Cubes
- A Large Open Area
- DNA to Protein Video Clip (found at http://www.youtube.com/watch?v=983lhh20rGY)
Procedure:

Tell the students that today they are going to create a human model of the process of DNA turning into proteins. Show DNA to protein video clip so they can get an idea of the process and answer any questions they have.

Pass out badges to each student and have them read their job, and then pass out the comics. Go over the comic and each student’s role in the model. Answer any questions.

Take the students to a large open area and line them up according to the comic and proceed with the steps shown in the comic. After the model is completed with the help of the facilitators, have the students try to complete the model again by themselves. Let them participate in the model until they do it successfully without any help from the facilitators or as many times as they want.

Closing: Bring the students back into the classroom and clean up. Tell them that they can keep their badges and comics if they want. Pass out a new copy of the comic to each student. Have them write their own description of what is depicted in each box based on the model they all participated in. Briefly review the comic and the process DNA goes through to create proteins.

<table>
<thead>
<tr>
<th>Suggested Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total: 1 hour 40 minutes</td>
<td></td>
</tr>
<tr>
<td>8:30am-9:00am</td>
<td>Video clip/model prep.</td>
</tr>
<tr>
<td>9:00am-9:45am</td>
<td>DNA to Proteins model activity.</td>
</tr>
<tr>
<td>9:45am-10:10am</td>
<td>Closing.</td>
</tr>
</tbody>
</table>
**DNA Transcription and Protein Assembly Model**

1. **DNA Strand:**
   - DNA polymerase unwinds DNA by breaking its bonds.
   - mRNA strand is made.

2. **mRNA attaches to a ribosome.**
   - RNA polymerase binds.
   - Amino acids attach to mRNA.

3. **Protein parts are snapped together and a protein is made.**
Your job is to bring and put your cube together with a cube that the mRNA is holding once the mRNA is lined up behind the ribosome.
Your job is to stand across from each other and hold hands. You and the other DNA will be tied in a line together with a jump rope. When the RNAP and mRNA passes through you, you drop your hands to your side and wait.
Your job is to follow the RNAP and stand behind the ribosome once the RNAP leaves. You put your cube together with the cubes from the amino acids when they come to you.
Your job is to walk down the center of the DNA and make them drop their hands to their sides as you pass. Once the mRNA reaches the ribosome you leave.
Lesson Plan Developer, Elizabeth Garfinkle
Girl Scout Ambassador

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San Roque School Facilitator

English Language Learners Advisor, Cheryl Takahara
La Patera Elementary School Teacher

CureCancer

Lesson 8
Learning Goals:

- Students should be able to connect the cipher to the process of DNA to RNA to Amino Acids

Materials:

- Student Booklets
Procedure:

Pass out the student’s booklets. Tell the students that today they are going to learn how to write and decode messages in DNA writing. Have the students turn to page 18 of their student booklets and complete The World of Genetics, Solving Ciphers activity. Assist when needed. Encourage students to create their own words, sentences, or name written in DNA code.

Closing: Clean up and collect booklets.

<table>
<thead>
<tr>
<th>Suggested Time</th>
<th>Total: 50 minutes</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am-9:15am</td>
<td></td>
<td>The World of Genetics, Solving Ciphers Activity.</td>
</tr>
<tr>
<td>9:15am-9:20am</td>
<td></td>
<td>Closing.</td>
</tr>
</tbody>
</table>
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CureCancer

Lesson 9

CureCancer Lesson 9
Marketing-Ethics and Economics
Learning Goals:

• Students should be able to connect their previous knowledge of ethics and economics to the marketing of their new drug

• Students should be able to research the different groups involved in marketing a cure to cancer

Materials:

• Student Booklets
• Marketing-Ethics and Economics Activity (found on page 45 of Bio-Rad’s manual, answers on page 62)
• Access to computers
Procedure:

Tell the students that since they have “found the cure to cancer” now they have to make their cure accessible to people in need and that to do so, they will have to market their drug. Discuss with the students the types of companies they would have to approach and work with to market a cure to cancer. Have them visit the following websites to find out more information. Websites: FDA, http://www.fda.gov/; PETA, http://www.peta.org/.

Pass out worksheets and have students independently complete them. Assist when needed.

Closing: Clean up and collect completed worksheets.
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CureCancer

Lesson 10
Learning Goals:

- Students should be able to **collaborate** with their peers to find a solution to their dilemma and find a creative way of presenting it

- Students should be able to **present** their solutions to the class with their group members

Materials:

- Student Booklets
- Dilemmas (found on pages 47-48 of Bio-Rad’s manual)
- Materials to create posters, videos, presentations, etc.
Procedure:

Pass out the students’ booklets. Have them turn to page 22 of their student booklets. Go over the Solutions to Dilemmas Presentation Guidelines assignment as a class and decide on the due date and presentation date. Let the students get into groups or assign groups and let them choose or assign their dilemma. Have the students collaborate with their group members to read and understand their dilemma and then let them begin working on their presentations. Assist groups and students when needed.

Closing: Clean up and collect booklets.

<table>
<thead>
<tr>
<th>Suggested Time</th>
<th>Total: 50 minutes</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am-8:45am</td>
<td></td>
<td>Introduction to Assignment.</td>
</tr>
<tr>
<td>8:45am-10:00</td>
<td></td>
<td>Assignment working time.</td>
</tr>
<tr>
<td>10:00am-10:10am</td>
<td></td>
<td>Closing.</td>
</tr>
</tbody>
</table>
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CureCancer

Final
CureCancer Final Reflection

Learning Goals:

- Students should be able to communicate their knowledge and comments from participating in CureCancer

- Students should be able to creatively respond to the reflection

Materials:

- Student Booklets
Procedure:

Pass out the students’ booklets. Have them turn to page 23 of their student booklets. Go over the reflection and answer any questions. Let the students work independently and assist when needed. Give them as much time as needed and encourage them to work hard, be creative, and put a lot of time and effort into their answers to the reflection.

Closing: Clean up and collect booklets/projects.

<table>
<thead>
<tr>
<th>Suggested Time</th>
<th>Total: 50 minutes</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am-8:45am</td>
<td></td>
<td>Introduction to reflection.</td>
</tr>
<tr>
<td>8:45am-10:00</td>
<td></td>
<td>Reflections work time.</td>
</tr>
<tr>
<td>10:00am-10:10am</td>
<td></td>
<td>Closing.</td>
</tr>
</tbody>
</table>
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CureCancer

Student Booklet
CureCancer Lesson 1 *The Mysterious Green Fluorescent Leaves*

**Vocabulary**

Bacteria:

Cancer:

Cell:

Diagnosis:

Fluorescent:

Gene:

Protein:

Green Fluorescent Protein (GFP):
CureCancer Lesson 1 The Mysterious Green Fluorescent Leaves

The Mysterious Green Fluorescent Leaves Story

Tisha was hiking through the Rain Forest looking for special plants when she met a young boy named Ramon. He told her a story about an old medicine man, who lives in his village, that has mysterious leaves.

Ramon said that his sister had been diagnosed with stomach cancer, but his family couldn’t pay for the treatment. So they brought her to the old medicine man who made a small cut in his Ramon’s sister’s arm and placed his mysterious leaves on it.

A few months later Ramon’s sister went to the doctor. She was told her stomach cancer was cured. Ramon went back to the medicine man to thank him for the cure, but he found him very ill. Before Ramon could talk to him more about the mysterious leaves, the old medicine man died.

Ramon told Tisha that he still had a few leaves left. He gave them to her and Tisha brought them back to Biotex, a science lab that works on cures to diseases.

At Biotex, Tisha finds that the mysterious leaves glowed bright green under a special light. After more work, she finds that the bright green glow is because the leaves have a special protein in them. She concludes that the protein must have been what cured Ramon’s sister’s stomach cancer.

To make more of the protein, she took the DNA from the leaves and put it into harmless bacteria. The bacteria now has the potential cure to cancer. The last step is to isolate the protein from the DNA in the bacteria, and she needs you to do so.

Biotex has enough money and time to isolate the protein, but Tisha recently received a call from Ramon that he too has stomach cancer. So Tisha is in a hurry to find the cure to cancer and market it before it is too late for Ramon.

For the next month, you will be working with a simulation of the harmless bacteria with the protein to hypothetically find the cure to cancer.
CureCancer Lesson 1 *The Mysterious Green Fluorescent Leaves*

**The Mysterious Green Fluorescent Leaves Story Assignment**

Write a summary of the Mysterious Green Fluorescent Leaves story you just read.

Include illustrations and color.

Use as many of the new vocabulary words as you can.
CureCancer Lesson 2 Cloning

**Vocabulary**

Agar:

Clone (Cloning):

Colony:

DNA:

Inoculation Loop:

Petri Plate:

Green Fluorescent Protein (GFP):
CureCancer Lesson 2 Cloning

Where is the GFP now?

Color in the Green Fluorescent Protein (GFP) on the agar plate.
CureCancer Lesson 3 Screening

**Vocabulary**

Culture Tubes:

Incubator:

Ultra Violet Light (UV Light):

Green Fluorescent Protein (GFP):
CureCancer Lesson 3 Screening

3 Similarities/ 3 Differences-Animal cells vs. Bacteria cells Activity

Observations of an Animal Cell:

Observations of a Bacteria Cell:

3 Similarities:
1.
2.
3.

3 Differences:
1.
2.
3.
CureCancer Lesson 3 Screening

*Where is the GFP now?*

Color in the Green Fluorescent Protein (GFP) in the test tube.
CureCancer Lesson 4 Purification Phase 1 – Bacterial Concentration

Vocabulary

Concentration:

Lysozyme:

Micro:

Pipette:

Purification:

Green Fluorescent Protein (GFP):
CureCancer Lesson 4 *Purification Phase 1 – Bacterial Concentration*

**Introduction to the Centrifuge Activity**

Draw a labeled diagram of the centrifuge.
CureCancer Lesson 4 Purification Phase 1 – Bacterial Concentration

Where is the GFP now?

Color in the Green Fluorescent Protein (GFP) in the micro tube.
CureCancer Lesson 5 Purification Phase 2 – Bacterial Lysis

Vocabulary

Column:

Lysis:

Green Fluorescent Protein (GFP):
CureCancer Lesson 5 Purification Phase 2 – Bacterial Lysis

M and M Candy Activity

Draw a diagram of an M and M and label the candy parts.

Draw a diagram of an M and M and label the corresponding cell parts.
Where is the GFP now?

Color in the Green Fluorescent Protein (GFP) in the micro tube.
CureCancer Lesson 6 Purification Phase 3 – Protein Chromatography

**Vocabulary**

Chromatography:

Collection:

Equilibration (Buffer):

TE (Buffer):

Wash (Buffer):

Green Fluorescent Protein (GFP):
**Where is the GFP now?**

Color in the Green Fluorescent Protein (GFP) in the columns. Draw a box around the column that contains the “cure to cancer”.
CureCancer Lesson 8 The World of Genetics, Solving Ciphers

Solving Ciphers

Before you begin solving your cipher, you will need to know these pieces of information:

1. The general flow of genetics is DNA (deoxyribonucleic acid) to RNA (ribonucleic acid) to proteins.
2. Transcription is when RNA is turned into DNA.
3. Translation is when RNA is turned into proteins.
4. Proteins are compounds made of amino acids.

Now it is time to solve your cipher. The strand of letters below are in DNA code. You need to assign each nucleic acid with its pair.

Adenine (A) pairs with Thymine (T)  
Cytosine (C) pairs with Guanine (G)

The letters are now in RNA. Example: CGA (dna code)-GCU (rna code), u=t

Now start at the beginning and break the letters up to groups of 3.

Example: GCU

Then use table 1, attached, to find the corresponding amino acids.

Example: GCU-Alanine (Ala)

Then use table 2 to assign each amino acid to a letter of the alphabet.

Example: Alanine (Ala)-A

Then write all of the new letters in the original strand and read your solved cipher. Example: A

CTATTACGA
CureCancer Lesson 8 The World of Genetics, Solving Ciphers

Solving Ciphers
<table>
<thead>
<tr>
<th></th>
<th>U (also known as T)</th>
<th>C</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U</strong></td>
<td>UUU <strong>Phenylalanine</strong> (Phe)</td>
<td>UCU <strong>Serine</strong> (Ser)</td>
<td>UAU <strong>Tyrosine</strong> (Tyr)</td>
</tr>
<tr>
<td></td>
<td>UUC Phe</td>
<td>UCC Ser</td>
<td>UAC Tyr</td>
</tr>
<tr>
<td></td>
<td>UUA <strong>Leucine</strong> (Leu)</td>
<td>UCA Ser</td>
<td>UAA</td>
</tr>
<tr>
<td></td>
<td>UUG Leu</td>
<td>UCG Ser</td>
<td>UAG</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>CUU <strong>Leucine</strong> (Leu)</td>
<td>CCU <strong>Proline</strong> (Pro)</td>
<td>CAU <strong>Histidine</strong> (His)</td>
</tr>
<tr>
<td></td>
<td>CUC Leu</td>
<td>CCC Pro</td>
<td>CAC His</td>
</tr>
<tr>
<td></td>
<td>CUA Leu</td>
<td>CCA Pro</td>
<td>CAA <strong>Glutamine</strong> (Gln)</td>
</tr>
<tr>
<td></td>
<td>CUG Leu</td>
<td>CCG Pro</td>
<td>CAG Gln</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>AUU <strong>Isoleucine</strong> (Ile)</td>
<td>ACU <strong>Threonine</strong> (Thr)</td>
<td>AAU <strong>Asparagine</strong> (Asn)</td>
</tr>
<tr>
<td></td>
<td>AUC Ile</td>
<td>ACC Thr</td>
<td>AAC Asn</td>
</tr>
<tr>
<td></td>
<td>AUA Ile</td>
<td>ACA Thr</td>
<td>AAA <strong>Lysine</strong> (Lys)</td>
</tr>
<tr>
<td></td>
<td>AUG <strong>Methionine</strong> (Met)</td>
<td>ACG Thr</td>
<td>AAG Lys</td>
</tr>
<tr>
<td><strong>G</strong></td>
<td>GUU <strong>Valine</strong> Val</td>
<td>GCU <strong>Alanine</strong> (Ala)</td>
<td>GAU <strong>Aspartic acid</strong> (Asp)</td>
</tr>
<tr>
<td></td>
<td>GUC (Val)</td>
<td>GCC Ala</td>
<td>GAC Asp</td>
</tr>
<tr>
<td></td>
<td>GUA Val</td>
<td>GCA Ala</td>
<td>GAA <strong>Glutamic acid</strong> (Glu)</td>
</tr>
<tr>
<td></td>
<td>GUG Val</td>
<td>GCG Ala</td>
<td>GAG Glu</td>
</tr>
</tbody>
</table>

<p>|        | <strong>G</strong>               |         |                         |
| <strong>G</strong>  | UGU <strong>Cysteine</strong> (Cys) |         |                         |
|        | UGC Cys             |         |                         |
|        | UGA                 |         |                         |
|        | UGG <strong>Tryptophan</strong> (Trp) |         |                         |
|        | CGU <strong>Arginine</strong> (Arg) |         |                         |
|        | CGC Arg             |         |                         |
|        | CGA Arg             |         |                         |
|        | CGG Arg             |         |                         |
|        | AGU <strong>Selenocysteine</strong> (S) |         |                         |
|        | AGC S               |         |                         |
|        | AGA <strong>Arginine</strong> (Arg) |         |                         |
|        | AGG Arg             |         |                         |
|        | GGU <strong>Glycine</strong> (Gly) |         |                         |
|        | GGC Gly             |         |                         |
|        | GGA Gly             |         |                         |
|        | GGG Gly             |         |                         |</p>
<table>
<thead>
<tr>
<th>Letter</th>
<th>Amino acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>alanine</td>
</tr>
<tr>
<td>B</td>
<td>asparagine</td>
</tr>
<tr>
<td>C</td>
<td>cysteine</td>
</tr>
<tr>
<td>D</td>
<td>aspartic acid</td>
</tr>
<tr>
<td>E</td>
<td>glutamic acid</td>
</tr>
<tr>
<td>F</td>
<td>phenylalanine</td>
</tr>
<tr>
<td>G</td>
<td>glycine</td>
</tr>
<tr>
<td>H</td>
<td>histidine</td>
</tr>
<tr>
<td>I</td>
<td>isoleucine</td>
</tr>
<tr>
<td>K</td>
<td>lysine</td>
</tr>
<tr>
<td>L</td>
<td>leucine</td>
</tr>
<tr>
<td>M</td>
<td>methionine</td>
</tr>
<tr>
<td>N</td>
<td>asparagine</td>
</tr>
<tr>
<td>P</td>
<td>proline</td>
</tr>
<tr>
<td>Q</td>
<td>glutamine</td>
</tr>
<tr>
<td>R</td>
<td>arginine</td>
</tr>
<tr>
<td>S</td>
<td>serine</td>
</tr>
<tr>
<td>T</td>
<td>threonine</td>
</tr>
<tr>
<td>U</td>
<td>selenocysteine</td>
</tr>
<tr>
<td>V</td>
<td>valine</td>
</tr>
<tr>
<td>W</td>
<td>tryptophan</td>
</tr>
<tr>
<td>Y</td>
<td>tyrosine</td>
</tr>
<tr>
<td>Z</td>
<td>glutamine</td>
</tr>
</tbody>
</table>
CureCancer Lesson 10 Dilemmas

Solutions to Dilemmas Presentation Guidelines

Create a poster, video, comic, or any other visual presentation with your group of the solution to your assigned dilemma. Your presentation can take almost any form, but it needs to include the following components:

- Paraphrased dilemma
- Defined vocabulary
- Pictures/logos of companies, products, organizations
- Your groups solution to your dilemma

Due Dates

Presentation Due:

Group Presentations:

Notes
CureCancer Reflection

Reflection Guidelines

Answer the reflection questions on the next page. You can:

Write
Draw
Dictate
Create a poster
Create a movie
Create a PowerPoint
Anything else you can think of

Your reflection project should:

Have your answers in a complete form.
Be able to be understood by someone else.
Be informative and creative.

Due Date:

Notes:
CureCancer Reflection

Reflection Questions

1. How did you “find the cure to cancer”?

2. What is your favorite science vocabulary word? Why?

3. What is your favorite science tool you used in the labs? Why?

4. What was your favorite part of CureCancer? Why?

5. What was your least favorite part of CureCancer? Why?

6. What are most proud of? Why?