Biologists and Graph Interpretation Network

Cancer Genetics and an Interview with a Deaf Biomedical Researcher

A BioGraphI Module Lesson Guide for Instructors

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Course Information
Department/Program: Biology
Level: Major-level
Course type: Lecture
Delivery mode: In Person
Students: Majors
Number of students: Any
Estimated duration of activity: 1 class period; two assignments

Expected date or dates of implementation
Fall 2024

Purpose/Background
In this lesson, learners will learn about cancer genetics and understand and interpret graphs showing QTL data, survivorship curves and other data. Then, learners view and reflect on an interview with deaf post-doctoral researcher Megan Majocha who is doing this research in cancer genetics at the National Institutes of Health.

List of materials needed for the lesson

- Lesson Guide (this document)
- Presentation Slide Deck
- Class Activity Slide Deck: Interpreting Graphs
- BioGraphI Interview with Dr. Megan Majocha [American Sign Language with English subtitles]
- Formative Assessment: Video Reflection Homework [Recommended: upload into LMS]
- Summative Assessment: Quiz [Recommended: upload into LMS]

About BioGraphI modules

This lesson is a BioGraphI module. BioGraphI modules address data literacy while fostering diversity in undergraduate biology classrooms. They are lessons about graph and data interpretation, featuring the scientific contributions of biologists who are members of historically excluded groups (HEGs). They include video interviews with these biologists, allowing students to hear directly from HEGs about their discoveries. For more information about how the BioGraphI project is advancing inclusion in biology and improving data literacy, visit our webpage.

Student Learning Objectives

The BioGraphI Student Learning Outcomes (LOs) describe what students can expect to gain by the end of the BioGraphI lesson. They are written in a format that can be shared directly with students.

Quantitative learning objective(s)

1. Interpret graphs and/or data figures related to the concepts from this lesson
2. Reflect on your perceptions about using graphs or figures in biology.

Diversity/equity/inclusion learning objective(s)

3. Reflect on your perceptions of people who do biology.
4. Compare your own interests and/or identities to those of people who do biology.

Content learning objective(s)

5. Know some basic terminology of cancer cells.
6. Know the basic genetic changes that happen in cancer cells as they progress and evolve.
7. Understand QTL and survivor curves and their applications in cancer genetics.
8. Analyze and evaluate QTL data and survivor curves.

Assessments

To help the BioGraphI Project to measure the effectiveness of our modules in improving data literacy and fostering diversity in biology classrooms, we invite your students to participate in a voluntary, anonymous pre-/post-lesson survey (Geneseo IRB #202021048). This survey is designed as an opportunity for reflecting on the Quantitative and D/E/I learning objectives above and administered via LimeSurvey. Click
Instructions for access to BioGraphI PrePost-Lesson Student Survey to request a survey to be set up for your students, at least 7 to 10 days in advance of your class meeting date.

Objective(s)	Formative Assessment	Summative Assessments

1-2 for Quantitative	BioGraphI Student Pre-Lesson Survey (link for instructions to access survey) Quiz [Deploy on LMS]	BioGraphI Student Post-Lesson Survey (link for instructions to access survey) Exam given over LMS asking students to interpret a different QTL graph - provided for by instructor
3-4 for DEI	BioGraphI Student Pre-Lesson Survey (link for instructions to access survey) Quiz [Deploy on LMS]	BioGraphI Student Post-Lesson Survey (link for instructions to access survey) Video Reflection Homework
5-9 for Content	Quiz [Deploy on LMS] Link to additional quantitative assessment tools that could be adapted	[Exam given over LMS - provided for by instructor]

Lesson context

Learning goals of unit

This unit focuses on molecular genetics and biotechnology, with these goals:

- LO-1 Understand key concepts in molecular genetics including the processes of the central dogma, mutations and mutagenesis.
- LO-2 Understand key concepts in the development and progression of cancer from normal cells to late metastasis.
- LO-3 Interpret data from a biotechnology experiment, given context and supporting details.
- LO-4 Identify potential connections and commonalities between students and scientists.

Prerequisite skills or knowledge

Students should already know and understand:

- The cell cycle, and be familiar with cell cycle checkpoints and be aware of the existence of DNA repair mechanisms and apoptosis
- What mutations are, their typical effects on genes, and how they normally occur

Preparation for lesson

Prior to the lesson, **Read:**

- Wikipedia: Cancer
- Wikipedia: Oncogene
- Wikipedia: Quantitative Trait Locus (QTL)

Lesson sequence

Each row of this table is a step of the activity. Column headings reveal what the instructor, interviewee, and students do at each step.

Information from instructor (live in-class)	**Information from scientist (within pre-recorded video interview)**	**Student follow-up or transition activity**
Prior to class, assign preparation activities	N/A	**Activity**: Students complete pre-lesson survey for BioGraphI project (combination of reflective writing prompts and closed-ended questions) • *Purpose*: prepare for class; pre-lesson reflection on data literacy and perceptions of scientists; LO-1 Understand key concepts in molecular genetics including the processes of the central dogma, mutations and mutagenesis; LO-2 Understand key concepts in the development and progression of cancer from normal cells to late metastasis. Students also complete background reading homework from Wikipedia, as listed above, or from another source if the instructor has a preferred textbook.
Show graphs on a Google Slide	N/A	**Activity:** Open and preview (but do not complete) the Class Activity Slide Deck: Interpreting Graphs. Students will make reasonable guesses to what

		the graph is about. • *Purpose*: Warm-up and icebreaker, rewards creativity, normalizes errors (nearly impossible to be correct)
Play background video segment	Dr. Majocha will give background information about her research project in cancer genetics, and explain some fundamental concepts important for understanding her project (the genetic changes that cancerous cells accumulate as they become increasingly malignant). • *Vocabulary that will be presented:* tumor, benign, malignant, cancer, carcinogenesis, metastasis, anaplasia, tumor load, tumor latency, genomics, oncogenomics	**Activity:** Students will watch the background information being presented by Dr. Majocha • *Purpose*: LO-2 Understand key concepts in the development and progression of cancer from normal cells to late metastasis. **Optional**: This could be followed by a short class discussion or instructor-led Q&A session. • *Purpose*: This makes sure that students understand the background material.
Class Activity		**Activity:** As a class or in break-out groups, open and interpret the graphs in the Class Activity Slide Deck: Interpreting Graphs. Students will make reasonable guesses to what the graph is about. • *Purpose*: LO-2 Understand key concepts in the development and progression of cancer from normal cells to late metastasis; LO-3 Interpret data from a biotechnology experiment, given context and supporting details.
Brief pre-interview class discussion	N/A	**Activity**: The instructor asks the class: what questions do you have about [scientist]'s path to this work/where they are today? Share out.
Play interview video segment	Dr. Majocha, in an interview with Dr. Braun, will describe her experience	**Activity:** Students will complete the Video Reflection Homework.

	as a Deaf woman graduate student and scientist.	• *Purpose*: LO 4 - Identifying potential connections and commonalities between students and scientist. **Optional**: This could be followed by a short class discussion, following the same prompts from the Video Reflection Homework.
Post-module activities and assessment	N/A	**Activity**: Students complete the Quiz [Deploy on LMS] [summative assessment] Students complete the post-lesson survey for BioGraphI project (combination of reflective writing prompts and closed-ended questions) • *Purpose*: LO-2 Understand key concepts in the development and progression of cancer from normal cells to late metastasis; LO-3 Interpret data from a biotechnology experiment, given context and supporting details; LO-4 Identify potential connections and commonalities between students and scientist

Alignment to Universal Design for Learning Guidelines

UDL Guideline	**Lesson Alignment**
Multiple means of Engagement	Recruiting interest: Students will reflect upon themselves as compared to the scientist. Self-regulation: Students reflect on their dispositions and knowledge of scientists and graph interpretation before and after the

	lesson
Multiple means of Representation	Perception: Captions are provided on the interview video. Google Slides offers automatic captioning for presenter. Alt text for images provided in Google Slides. Interview conducted in American Sign Language with both voice-over and captioning. PowerPoint slides are shown as white/yellow text over a black background for maximum accessibility for visually impaired students.
Multiple means of Action and Expression	Expression & communication: Multiple types of media are used in the lesson (visual, audio, text). The learning activity includes a mixture of watching, group work and quizzes. The Reflection assignment is a video assignment, a different modality from the usual written assignment, that may help reinforce learning for some students.

Implementation notes

Students have more difficulty than we would expect in interpreting graphs, possibly because the graphs themselves are not of the common types seen in introductory science classes and in newspapers, etc (e.g. column, line, pie). Therefore, we created a Graph Interpretation classroom activity to help guide students through graph interpretation.

References/resources

1. Ha N-H, Long J, Cai Q, Shu XO, Hunter KW. The Circadian Rhythm Gene Arntl2 Is a Metastasis Susceptibility Gene for Estrogen Receptor-Negative Breast Cancer. PLOS Genetics 2016 Sep 22. doi: 10.1371/journal.pgen.1006267
2. Majocha MR, Jackson DE et al. Resf1 is a compound G4 quadruplex-associated tumor suppressor for triple negative breast cancerPLOS Genet. 2024 May 9. doi: 10.1371/journal.pgen.1011236

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Transcript of interview

21:13-21:42
Derek Braun (DB):
Hello! I'm here at NIH.
I came to NIH to interview Megan Majocha
She is a former student and Gallaudet graduate
now studying for a Ph.D. at Georgetown in collaboration with NIH
I'm excited to be here to talk with Megan
I will ask her some questions and get her perspectives

Megan Majocha (MM):
Hi! My name is Megan
I'm now in a partnership with NIH and Georgetown, as a graduate student here at NIH

21:42-22:31
DB:
What kind of scientific questions fascinate you?

MM:
The scientific questions I'm really interested in
are mostly related to epigenetics
we sign it as [shows the ASL sign for epigenetics]
DNA itself does not change
The environment, and many different things [in the environment] can influence gene expression.
It's really fascinating to me
Because it can be inherited down through the generations
Grandparents can pass it down all the way to unborn babies
through several generations
and how it has a role in cancer
is really fascinating
treatments could target epigenetics
rather than the baseline genetics itself

22:31-23:45
DB:
I'm curious about when and how you knew you wanted to become a scientist?

MM:
Growing up, I always knew I wanted to study science
but I didn't know in what, specifically. Science is broad
but by the time I entered Gallaudet, I knew I wanted biology
but biology is still a broad field
I took a few courses and I was really attracted to genetics
I took two genetics courses at Gallaudet
I then knew that I wanted to specialize in a genetics-related research
but I still didn't know what topic
near graduation, I approached my advisor
You! You were my advisor!
We discussed opportunities, and what to do next
You said that NIH had a post-baccalaureate opportunity
I had originally envisioned going straight to graduate school
but, I agreed that it was important to get my feet wet a little bit
and experience the research field
and I had no experience in genetics-related research
and so I took the opportunity to come here to NIH
as a post-bac for one year
and I fell into cancer genetics research
and so I knew then that I wanted to get my Ph.D. in this field

23:45-24:51
DB:
As a scientist, do you identify as deaf?
As a woman? Or otherwise?
How do you identify, and how does that feel for you?

MM:
I identify as deaf, as a scientist
and as a woman, too
but, I don't really think about the woman part [of my identity].
more that I'm deaf, because that plays a very big role
to deal with accessibility,
over the past few years, that's been very challenging
interpreters change over every day
frequently the interpreters don't know science
This has a big impact on my learning process and on my training.
It's very... [Interpreter] agencies don't really understand
Interpreter agencies will place an unfamiliar interpreter
But, now, I've learned from this experience, that you need to advocate for yourself.
If you want something, negotiate.
Make a list of arguments for why they should accommodate your needs

That's what I've really learned
And now I get the accommodations that I really need.

24:51-25:49
DB:
Can you tell me about a moment when you felt like you belonged in the field of science
That you have an identity as a scientist?

MM:
I knew that I belonged in science in college.
But it all really started in high school
when I was taking more science courses than was necessary for graduation.
I realized then my love for science
But I didn't feel like I developed an identity, that I belonged in science until college, when I took a few internships
Because doing research itself made me realize that
I'm doing research! I've taken the scientist's role!
Now, in graduate school, I just know that I belong in science
when my supervisor and I can chat about science
in casual, everyday conversations
and I can understand what we're talking about
that makes me feel like, yes, I belong in science

25:49-26:32
DB:
What does a typical everyday routine look like for you?

MM:
My days are very varied
and very flexible, and that's one thing I love about this field
The research field
Each day, my experiments are different
Sometimes, on that day, I will have no experiments
and so I will spend it reading the literature
I typically work every day, Monday through Friday
and sometimes during the weekend, only if I really have to
But I try to avoid doing that
Typically I work from 9-5. Sometimes I have a shorter day and will read the literature
Other days the experiments will run very long
Sometimes I work maybe 40 hours a week, sometimes 20, and sometimes 60
It really varies every day

26:32-27:06
DB:

How do you balance your work life with your other interests?
How do you keep this balance?

MM:
I have two dogs and just got a new puppy
and one cat
They play a big role in my work/ life balance
My hobbies are hiking, exploring, and photography, and that sort of thing
so I really value that time
and also reading books
so I try to balance by setting boundaries
when work is done, I go straight home. I try to go home before dinnertime
That gives myself time to disconnect and rewind
and spend time with the pets
this really helps me
And, they help me wake up early, then I go right to work
That scheduled routine helps a lot

27:26-28:01
DB:
Where are you from? What did your upbringing look like?

MM:
I grew up in Pittsburgh, Pennsylvania
I attended WPSD - Western Pennsylvania School for the Deaf
and also I was mainstreamed into the public schools, half-and half, throughout middle school and high school
I'm from a third-generation deaf family
My grandparents are deaf, my parents are deaf, and I am deaf
I have two siblings. Both are CODAs [hearing children of deaf adults]
After I graduated from WPSD and the public high school, I attended Gallaudet University where I majored in Biology
after I graduated, I came here, to NIH, to do my graduate studies

28:01-28:33
DB:
How do you keep your motivation up while doing research? I know the process is long.

MM:
It's challenging!
But, I think about the things about my research that I love
It's about treating patients
Patients with cancer
Treatments haven't been improving with the times. They are stagnating.

We need to find new treatments. Better treatments, for patients. That motivates me.
That motivates me and inspires me to persist with the research

28:33-28:56
DB:
What is the most important advice that you have to give my students?
What do you want them to know?

MM:
If any opportunity arises, grab that opportunity!
Because that opportunity won't wait for you. Opportunities come and go.
Then they will disappear forever
And so, grabbing those opportunities will help guide you through your journey

28:56-30:32
DB:
What do you do when it so happens that you're unsure how to analyze your data?

MM:
I usually chat with other lab members
They can be post-bacs, graduate students, post-docs, or staff scientists here
We usually discuss the data. I'll ask them to look at my data and we will look at it together
We'll go over my experimental plan, experiment design
We'll look at the results, and compare them with what I had expected to see
and discuss how we should interpret the data
And then I'll bring it to discuss with my supervisor
We will then discuss what my my next plans are
and my future experiments
My lab has weekly lab meetings on Mondays
in the morning
to go over our data
Everyone has to mention something
We go through everyone in order
If someone has no results or experiments to share, then they share their updates
What your plan of action is for this week
[At the meeting] we see everyone else's advice
Their thoughts, and their input
After that is done, I also have a 1-on-1 meeting with my supervisor, who is the PI
in the lab
It's a 30-minute one-on-one meeting right after lab meeting
We talk about my future plans, because we had already discussed my data during the lab meeting
so during the one-on-one we discuss my next steps
relating to my career and personal development

and my training
and so it is really beneficial