

Key: Yellow highlight = required component

DNA microarrays to nanoarrays (←put your title here!)

Subject Area(s) Biology, Science and Technology (Select from [TE Subject Areas](#))

Associated Unit DNA microarrays

Lesson Title DNA microarrays to nanoarrays

Header

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Grade Level 12 (9-12)

Lesson # 4 of 4

Lesson Dependency DNA Microarrays Lessons 1-3

Time Required 45 minutes

Summary

In the previous lessons, students learned the fundamentals of DNA microarray technology for analysis of gene expression. This lesson highlights the growing field of nanoarrays for higher volume analysis. Students also learn about other nanotechnologies being developed and how these may change their daily lives.

Engineering Connection

Biomedical engineers work with both DNA microarrays and nanoarrays for many types of genetic tests. Previously, microarrays allowed scientists to perform many gene expression tests at a time. The development of nanoarrays increases this capacity by several orders of magnitude.

Engineering Category = 1

Choose the category that best describes this lesson's amount/depth of engineering content:

1. Relating science and/or math concept(s) to engineering
2. Engineering analysis or partial design
3. Engineering design process

Keywords

DNA, gene expression, nanotechnology, mRNA, microarray, nanoarray

Educational Standards (List 2-4)

Source, year, standard number(s)/letter(s), grade band and text (its unique ID# is optional)

[State STEM Standard](#) (required)

exas: Science [2010] [...show](#)

- Subchapter C. High School (9-12) [...show](#)

[\(64 lessons/activities/units aligned\)](#)

- Biology (9-11) [...show](#)

[\(9 lessons/activities/units aligned\)](#)

- Science concepts. The student knows the mechanisms of genetics, including the role of nucleic acids and the principles of Mendelian Genetics. The student is expected to: (9-11) [...show](#)
(2 lessons/activities/units aligned)

Current Standard:

- describe how techniques such as DNA fingerprinting, genetic modifications, and chromosomal analysis are used to study the genomes of organisms. (9-11)

Current Standard:

- recognize that gene expression is a regulated process; (9-11)
(no curriculum aligned)

[ITEEA Standard](#) (required)

- The Nature of Technology (K-12)
 - Standard 1. Students will develop an understanding of the characteristics and scope of technology. (K-12)
 - In order to comprehend the scope of technology, students should learn that: (K-12)

Current Standard:

- F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (6-8)

- Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. (K-12)
 - In order to appreciate the relationships among technologies and other fields of study, students should learn that: (K-12)

Current Standard:

- G. Technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. (9-12)
 - In order to appreciate the relationships among technologies and other fields of study, students should learn that: (K-12)

Current Standard:

- J. Technological progress promotes the advancement of science and mathematics. (9-12)

[NGSS Standard](#) (strongly recommended)

[CCSS Standard](#) (strongly recommended)

Pre-Requisite Knowledge

-have basic understanding DNA transcription and translation and how these processes relate to gene expression

-prior completion of DNA microarray lessons 1-3

Learning Objectives

After this lesson, students should be able to:

- Explain nanotechnology and give an example of its application in biomedical and bioengineering

Introduction / Motivation

Have you heard of the term nanotechnology? What does it mean to you and how have you seen it used?

Nanotechnology can be used for everything from tiny cancer fighting robots to clothes that won't stain.

We'll explore some of the interesting applications of nanotechnology and then look at how nanotechnology is used in the fields of bio and biomedical engineering; with a primary focus on DNA nanoarrays.

We'll finish with a brainstorming session of a device or test you would like to create that would require bio-nanotechnology.

Lesson Background & Concepts for Teachers

This lesson is the conclusion of a unit on microarray technology for evaluation gene expression.

See for <http://gcat.davidson.edu/Pirelli/index.htm> detailed conceptual background.

Image Insert Image # or Figure # here [use Figure # if referenced in text]

<p>Figure 1 Image file: ___? ADA Description: ___? <i>(Write as if describing the image to a blind person; do not repeat any caption content.)</i> Source/Rights: Copyright © ___? Caption: Figure 1. ___?</p>

Vocabulary / Definitions

Word	Definition
DNA microarray	a collection of microscopic DNA spots attached to a solid surface. Scientists use DNA microarrays to measure the expression levels of large numbers of genes simultaneously or to genotype multiple regions of a genome.
DNA nanoarray	a collection of nanoscale DNA spots used to measure the expression levels of large numbers of genes simultaneously or to genotype multiple regions of a genome.
nanotechnology	the manipulation of matter on an atomic, molecular, and supramolecular scale. the manipulation of matter with at least one dimension sized from 1 to 100 nanometers

Associated Activities

Biotechnology and gene expression: basic microarrays

Biotechnology and gene expression: Calculating with microarrays

Biotechnology and gene expression: hierarchical cluster analysis

Lesson Closure

Conduct a brainstorming session of devices or tests that require nanotechnology and would help the fields of bio, biomedical, chemical or environmental engineering.

Assessment

Pre-Lesson Assessment

Descriptive Title: Prompt Question

Have you heard of the term nanotechnology? What does it mean to you and how have you seen it used?

Post-Introduction Assessment

Descriptive Title: ____?

Lesson Summary Assessment

Descriptive Title: ____?

Homework

Descriptive Title: Nanotechnology presentation

Have student research an emerging bio-nanotechnology and write a short article summary.

Lesson Extension Activities

Have students prepare presentations to try to “sell” their nanotechnology to the class. The students can take a class vote for best technology.

Additional Multimedia Support

<http://gcat.davidson.edu/Pirelli/index.htm>

http://www.ted.com/talks/paul_rothemund_details_dna_folding#t-359919

<https://www.youtube.com/watch?v=WOqEk440JZ8>

<https://www.youtube.com/watch?v=XZVH7CASrBk>

<http://www.completegenomics.com/technology/>

<http://www.nanowerk.com/spotlight/spotid=12717.php>

<http://medicalphysicsweb.org/cws/article/research/54839>

References

<http://gcat.davidson.edu/Pirelli/index.htm>

<http://www.biodesign.asu.edu/news/nanotechnology-innovation-may-revolutionize-gene-detection-in-a-single-cell>

<http://www.nature.com/nnano/journal/v2/n10/full/nnano.2007.293.html>

<http://www.sciencemag.org/content/327/5961/78.full>

Attachments

Other

Redirect URL

Contributors

Rose Sobel

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Classroom Testing Information