
DNA Microarray Terminology Activity Instructor Guide

Notes to Instructor

This activity is a review of the terminology associated with the applications, operation, interpretation, and fabrication of DNA microarray. Participants should read the primary knowledge (PK) unit before doing this activity in order to get an understanding of what DNA Microarrays are, and the terminology associated with them.

This activity is part of the *DNA Microarray Learning Module*.

- Knowledge Probe (KP or pre-assessment)
- DNA Microarray PK
- DNA Hybridization Activity
- **DNA Microarray Terminology Activity**
- DNA Microarray Model Activity*
- The DNA Microarray - An Ethical Dilemma? Activity
- DNA Microarray Assessment

*A DNA Microarray Kit is available to support this learning module. The kit is required for the DNA Microarray Model Activity. To order a kit, please visit the SCME website (<http://scme-nm.org>)

Description and Estimated Time to Complete

In this activity you demonstrate your knowledge and understanding of the terminology associated with DNA (Deoxyribonucleic acid) microarrays – their applications, operation, interpretations, and fabrication. If you have not reviewed the unit DNA Microarrays, you should do so before completing this activity. This DNA Microarray unit provides the background information needed to best understand the terms and concepts presented in this activity.

This activity consists of a crossword puzzle, matching table, and Post-Activity Questions that provide a better understanding into the world of DNA Microarrays. You are to complete the crossword puzzle OR the matching table, AND the Post-Activity questions. You could do all three if you choose.

Estimated Time to Complete

Allow at least two hours to complete this activity.

Introduction

In order to understand DNA Microarrays, you need to have an understanding of DNA, RNA (Ribonucleic acid), DNA transcription and reverse transcription, and hybridization. WOW – now that’s a mouth full.

- Deoxyribonucleic acid (DNA) is a long polymeric molecule (found in most cells) that functions as the carrier of genetic information.
- Transcription produces a RNA complementary to the original DNA when a double-stranded DNA (dsDNA) divides. This RNA is called the messenger RNA (**mRNA**).
- Reverse transcription makes a copy DNA from the mRNA. The cDNA is used by DNA microarrays in the target samples.
- DNA hybridization is when denatured DNA molecules are cooled down in the presence of ssDNA molecules from another source. If the original ssDNA strands have sequences that are complementary to the introduced ssDNA strands, they can form dsDNA hybrid molecules with one strand from each (an original ssDNA and the source ssDNA).

To understand the DNA microarray, one must understand the terminology associated with it; otherwise, it’s like navigating a new city without a map – you get lost.

Activity Objectives and Outcomes

Activity Objectives

- Identify the specific term associated with a definition or statement related to DNA and DNA microarrays.
- Explain the relationship between this terminology and the understanding of how a DNA microarray works and is fabricated.

Activity Outcomes

At this end of this activity you will have a better understanding of DNA microarray terminology and the various concepts related to DNA microarrays.

Resources

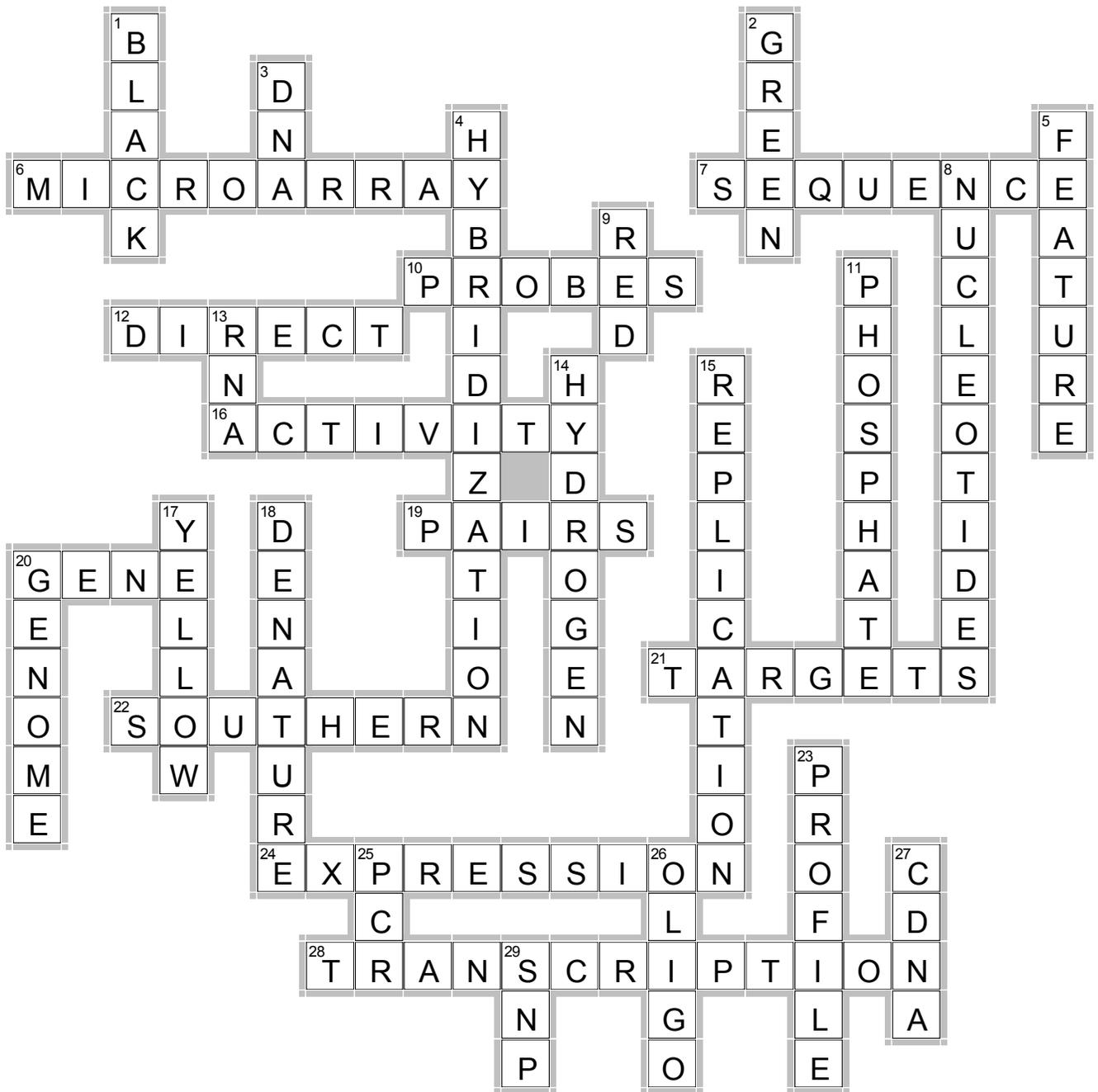
SCME [DNA Microarray Primary Knowledge unit](#)

Documentation

- Completed crossword puzzle or matching table.
- Answers to the Post-Activity Questions.

NOTE: Be sure to include ALL sources and references to data and graphics when applicable.

Activity: DNA Microarray Terminology / Answers



EclipseCrossword.com

Questions	Answers
ACROSS	
6. A micro-sized lab-on-a-chip (LOC) with a two-dimensional array printed onto a substrate. The array is used to assay (analyze) large amounts of biological materials in a sample solution.	Microarray
7. In a DNA molecule, the order of the nucleotide bases.	Sequence
10. ssDNA molecules on a DNA microarray used to capture target molecules in a sample.	Probes
12. A type of DNA microarray used to detect a specific gene, gene mutations, or deletions of chromosomal DNA.	Direct
16. Expression profiles identify the on/off _____ of genes within a cell or organism.	Activity
19. Base _____ consist of the pairing of complementary nitrogenous bases and form the steps of the DNA helix.	Pairs
20. A length of DNA sequence that contains hereditary information or an organism.	Gene
21. The molecules in a sample solution that are to be assayed or analyzed using a microarray.	Targets
22. A blot or a technique used to detect a specific DNA sequence in a DNA sample, to locate a gene within an entire genome.	Southern
24. Gene _____ microarrays measure cDNA from many different genes at the same time. Can be used to study how cells react to external changes.	Expression
28. The process of creating a RNA copy from a DNA sequence.	Transcription
DOWN	
1. When analyzing a DNA microarray result, the color that indicates no activity between the probes and the targets in either control or test sample.	Black
2. When analyzing a DNA microarray result, the color that indicates activity between the probes and the control sample ONLY.	Green
3. A long linear polymer formed from nucleotide pairs and associated with the transmission of genetic information.	DNA
4. A process of combining two complementary ssDNA, from two different sources, into a single dsDNA molecule.	Hybridization
5. An address in a DNA microarray containing thousands of the same ssDNA probe molecules.	Feature

8. Molecules, that when joined together, make up the structural unit of RNA and DNA.	Nucleotides
9. When analyzing a DNA microarray result, the color that indicates activity only between the probes and the targets from the test sample.	Red
11. Sugar and _____ groups form the ladder or rails of the DNA helix.	Phosphate
13. A molecule consisting of a long, usually single-stranded chain of nucleotides with the bases adenine, guanine, cytosine, and uracil.	RNA
14. The two strands of a DNA molecule are held together by _____ bonds.	Hydrogen
15. The process in which each strand of a double-stranded DNA molecule serves as template for the reproduction of two identical DNA molecules.	Replication
17. When analyzing a DNA microarray result, the color that indicates probe-target activity between both the control and test samples.	Yellow
18. To change the molecular structure and characteristics of a molecule by chemical or physical means. Also to divide a dsDNA into two ssDNAs.	Denature
20. An organism's genetic material which is made up of molecules of DNA and found in the nucleus of eukaryotic cells and in the cytoplasm of prokaryotic cells.	Genome
23. A gene expression _____ is developed from information about all messenger RNAs (mRNAs) that are made in various cell types.	Profile
25. A laboratory technique that can amplify the amount of DNA from a tiny sample to a large amount within just a few hours.	PCR
26. The abbreviated form of the term that represents a short fragment of single-stranded DNA typically 5 to 50 nucleotides long.	Oligo
27. ssDNA that is complementary to a mRNA that has been synthesized by reverse transcription.	cDNA
29. A change in a single nucleotide in the DNA sequence or when two DNA sequences are identical except for one nucleotide (e.g., A-C-T-C-A-G and A-C-G-C-A-G)	SNP

DNA Terminology Match Activity: Match the following terms to their definitions.

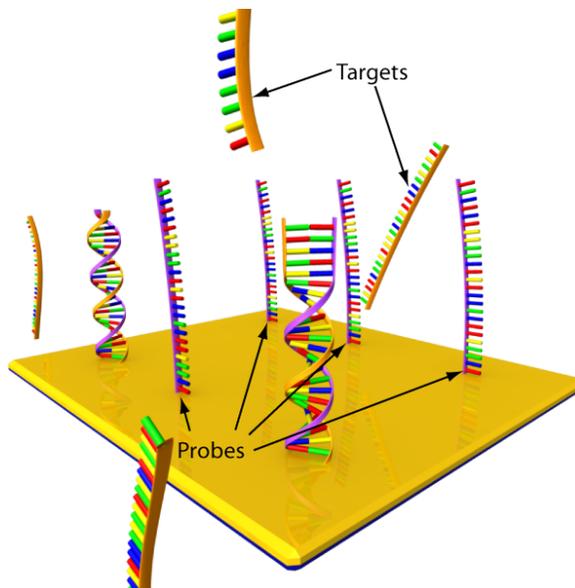
Answer	Terms	Definitions
K	Genes	A. A process of combining two complementary ssDNA from different sources into one dsDNA
G	Alleles	B. A process in which ultra violet light and masks are used to fabricate micro-size devices.
P	Gene Sequence	C. A control that uses each feature in an array to make a comparison of the DNA in the test and control samples.
T	Nitrogenous bases	D. When a gene's mRNA copies to cDNA.
H	A Nucleotide	E. A short nucleic acid polymer, typically 20 – 50 nucleotides long.
N	mRNA	F. The use of UV light to degrade the blocking agent on top of a nucleotide base in the feature of an array.
D	Reverse Transcription	G. One member of a pair or variation of a gene that occupy a specific position on a specific chromosome.
S	cDNA	H. A base with a sugar and at least one phosphate
A	Hybridization	I. In a microarray, the type of controls used to verify the overall performance of the array and analytical technique.
E	Oligonucleotide	J. An address of a microarray that contain hundreds or thousands of the same oligonucleotide.
Q	DNA hybrid	K. The basic biological unit of heredity.
M	Gene expression arrays	L. When a base attaches to a deprotected base in a feature of a DNA microarray.
J	Microarray feature	M. Arrays that detect the “expression levels” in a sample – when mRNA copies to cDNA.
I	Positive and negative control	N. A molecule created during DNA transcription
C	Direct comparison control	O. A patterned component used to identify specific features that are to be deprotected with UV light during microarray fabrication.
U	Direct detection arrays	P. Order of base pairs in a DNA segment: A-T, T-A, C-G, A-T, C-G, G-C, T-A
B	Photolithography	Q. A dsDNA made of ssDNA from two different sources
F	Deprotect (microarray fabrication)	R. The addition of a blocking agent to the nucleotide bases used to build the oligos of a DNA microarray.
R	Protect (microarray fabrication)	S. A ssDNA that is a copy of a mRNA
L	Addition (microarray fabrication)	T. Adenine, thymine, Guanine, and Cytosine
O	Mask	U. A microarray that detects specific genes or gene mutations within a sample.

Post-Activity Questions / Answers

1. Below is a graphic illustrating a single feature of a DNA microarray. Using DNA and DNA microarray terminology, explain each element (i.e., base, ssDNA, dsDNA, probes, and targets) of the graphic and what “action” is and is NOT taking place.

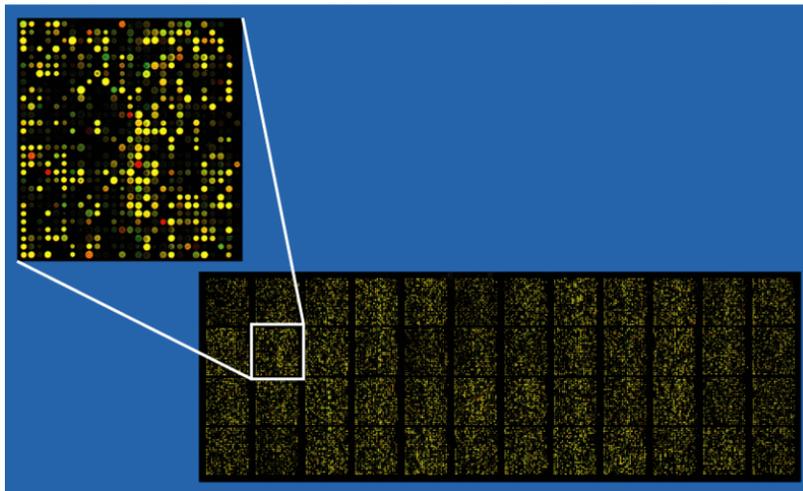
Answer:

The gold represents the substrate on which, in this case, six (6) synthetic oligonucleotides (oligos) of the same sequence are fabricated. These oligos are shown as ssDNA “probes”. The “targets” are ssDNA from a sample (either a test sample or control sample) that may or may not be complementary DNA (cDNA) to the probes. The graphic does illustrate three (3) cDNA targets that have annealed or are in the process of annealing with a probe to form a dsDNA (DNA hybridization). The remaining targets do not match with the probes on this feature and move on to another feature, looking for a match.



2. Using the terminology associated with DNA microarrays, explain what is being illustrated in these pictures and what the various squares, dots and colors represent.

The rectangle is a slide of 48 DNA microarrays (48 squares). The extended image shows a specific microarray that is being illuminated using laser light showing the various activities of different features in the array.



Each dot is a feature or address of a specific DNA sequence. Each color represents the “activity” of each feature between the probes and targets. Red indicates hybridization with targets ONLY in the test sample. Green indicates hybridization with targets ONLY in the control sample. Yellow represents hybridization with targets from both samples while black represent no hybridization with targets from either sample.

3. Read the article linked below and answer the following:
- Briefly explain how DNA microarrays are being used in this application.
 - Why does the presence of a specific gene NOT guarantee anything? In other words, if a person has the ACTN3 gene for “*explosive bursts of strength*”, why doesn’t the presence of the gene **guarantee** that the person will excel in that ability?
 - What other athletic abilities do you think might be genetic (passed down from one generation to another)?

[Could gene test tell if kids could be sports stars?](#) (Lindsey Tanner, Associated Press, March 8, 2011)

(Link: <https://bit.ly/2KPjVgZ>)

Summary

DNA microarrays use synthetic ssDNA (oligonucleotides) fabricated on a substrate to identify specific genes or DNA sequences in a sample (direct detection) or to identify the activity of DNA in a sample (gene expression profiling). DNA microarrays use DNA transcription and reverse transcription to make the copy ssDNA molecules used in the control and test samples for DNA microarray testing.

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