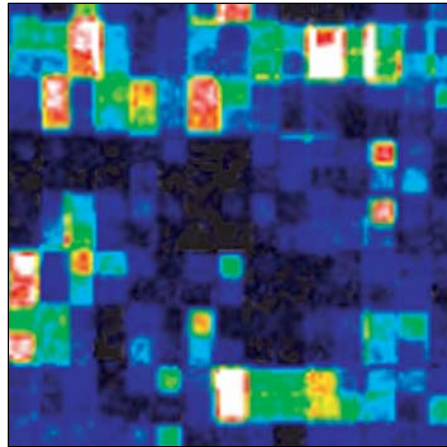


# *GeneChip® Microarrays*



## **Introduction, Goals, & Overview**

### **Introduction**

DNA Chips, Genome Chips, Bio chip, and cDNA arrays are all similar terms for one the most incredible and influential technologies in the area of genetic research known today – the GeneChip microarray. These microarrays allow scientists to perform genome wide experiments in a fraction of the amount of time it took even just five years ago. Disease diagnosis, gene and drug discovery, agriculture, and toxicology studies are just some of the few areas and applications to get a huge boost from this new technology. If the work involves the DNA or the genetics of a cell, GeneChip microarrays can be used. Recent microarrays have been involved in the studies of the genetics of flies, mice, grapes, maize, human cancer cells, malaria, and AIDs.

The amount of research using these GeneChip microarrays has greatly increased in the past two years and continues to grow. If you were do any basic search on the internet you will get hundreds of articles focusing on the use of these chips in some new genetics discovery. These chips are not a simple a fad! And just as with any influential scientific technology, the more aware and knowledgeable the public is about it, the better society will be with handling the future challenges that come along with the advancement.

This is what this GeneChip microarray curriculum module is all about. It is to be used to help teach science students from multiple levels of Life Science classes about the function and usage of these microarrays. Its' focus is to involve students in various activities that bring this topic to them in different exciting, yet challenging ways. Is this curriculum for all science teachers? No, but if you teach regular Biology, Biology Honors, AP Biology, Biotechnology or a Genetics class, most or all of this curriculum is something you can use in your classroom.



## Goals

Like most teachers, you are probably worried about the high level nature of this technology. Can your students actually learn this material enough to understand how GeneChip microarrays work and gain knowledge about their impact? And just as important: can you? The answer is yes! Do not be intimidated by the high level nature of the topic. The material is presented in a manner that will allow you to fully understand the structure, function, and application of all types of GeneChip microarrays. And like anything else, once you've learned the material, you can mold it to fit the level of your students while still making sure to teach the overall main ideas.

If you move over on the main page to the "Teacher's Guide" and go to "Implementing the Module" you will find suggestions on how to use this module in all different types of classes. You don't have to be an Advanced Biology or Biotechnology teacher to use this module. One of the goals of this curriculum module is to help you get over any fears you have about such an advanced topic and help you to implement a wide range of activities to both interest and challenge your students. Here are the rest of the goals of this module for your students:

- (1) to understand the structure of a GeneChip microarray
- (2) to understand the function of the three main types of microarrays: Gene Expression, Genotyping (SNPs), and Resequencing
- (3) to learn about the various applications of all three types of microarrays
- (4) to be able analyze and interpret data from experiments and scenarios that use these arrays and make use of evidence to come up with solutions to them
- (5) to learn how GeneChip microarrays are manufactured
- (6) to review and apply the basics of DNA and genetics such as DNA structure and function, Transcription, Translation, and the function of genes.
- (7) to think critically and constructively about the ethical issues that advanced genetic analysis (using tools such as GeneChip microarrays) can have on our society, making sure to look at both sides of the issue
- (8) to analyze scientific data as an individual and as within a group
- (9) to strengthen abilities to communicate and present to a small as well as a larger, class-sized groups using scientific terminology and ideas
- (10) to show scientific understanding in a variety of ways including: answering questions (orally and on paper), building models, and presenting in small groups as well as to a larger class



## **The Activities**

The following is a list of all the activities that make up this entire module. It also includes a brief description of each lesson. Again, there are many ways to implement these activities. Some can be part of homework, and others done in class, while others could be adapted to a lecture or a more student driven activity. The idea is to be flexible with what best fits your class and the ability level of your students.

### ***Activity #1***

An introductory activity in which the students get into small groups and read through recent short newspaper or internet articles that focus on some of the applications of GeneChip microarrays. Each student in the group gets a different article and once they are done reading, they report back to their group on what the article was about and their thoughts and opinions on the article.

### ***Activity #2***

This activity mainly involves student's reading and answering questions. The reading is broken down into three parts, each focusing on one of the three types of microarrays. This is a key part of the rest of the module as it presents how the microarrays function, what they can be used for, and how to analyze their results. This activity is set up as a one or two day homework assignment, but could easily be adapted into a teacher lecture with follow up questions or to another student group activity where each student reads a small portion of the reading, answers the questions and reports back to the group (sometimes called a jigsaw).

### ***Activity #3***

This is two part activity that focuses on how GeneChip microarrays are manufactured. Though it is not an easy concept, the process is incredible and is sure to amaze and challenge the students. The first part of the lesson is another reading with a question set. Again, this could be approached as a homework assignment or in class work. The second part is a fun, creative activity where the students show their understanding of the manufacturing process by using simple household and office items to build a model of how microarrays are manufactured. The finished model is then presented to the class.

### ***Activity #4***

A two day activity that focuses on analyzing data, this lesson is designed to challenge the students to take what they learned about GeneChip microarrays from activity #2 and use this understanding to analyze a scientific scenario that uses microarrays as part of the research. The students work in groups to analyze and interpret the data and come to a conclusion on what is happening in the scenario. Each scenario is based on real life research using the microarrays. The second part of the activity involves the students putting together a presentation that explains to the class about the situation they had to analyze and what their results indicate. Once again, this activity is flexible. The scenarios range in their difficulty, so a teacher could use only one, a few, or all of the scenarios.



### *Activity#5*

In this final, culminating activity, the focus is on the ethical issues of advanced genetic analysis tools such as GeneChip microarrays and their effect on our society. The students start off by analyzing a hypothetical situation or question in a group and reporting back to the class about the pros or cons (or both). The teacher then leads a class discussion around the topics. A debate could easily be set up around both sides of each topic. Lastly, the students get back into groups and pretend that they are on an ethical committee for a biotechnology company that makes GeneChip microarrays. They need to come up with an ethical statement for the company that explains their company's position and opinions about the ethical implications of their technology.

