



# New Fellow Education Transfer Plan Cover Sheet

Title of ETP	GeneChip Microarrays – How They Work and How They Are Used
Name of IISME Fellow	Robert K. Zaccheo
Fellow's year-round email	Rob_Zaccheo@sjusd.org
Sponsor Company	Affymetrix
Name of Mentor	Katie Tillman-Buck
National Board Certificate Area	Adolescence and Young Adult Science

I, the IISME **Fellow** named above, affirm that the ETP I am submitting is my own work, that I acknowledged sources where appropriate, and that I avoided including any proprietary information of the Sponsor Company. By my submission I am assigning to IISME my entire copyright in the ETP. I understand IISME is simultaneously granting me a license to use the ETP for pedagogical purposes.

---

Signature	Date
-----------	------

Category	<i>Curriculum</i> Subject: Math <b>Science</b> Technology _____ Level:    Elem      Middle <b>High</b> Other _____ <i>Staff Development</i> Describe _____ <i>Other</i> Describe _____
----------	--

Objectives	The following are the objectives of the unit: *to learn about the structure and function of GeneChip microarrays *to learn how to analyze GeneChip microarray results *to learn how GeneChip microarrays are manufactured *to work as a group to analyze results of various experiments using GeneChip microarrays and present results to the class *to think about and discuss ethical issues around the applications of GeneChip microarrays to our society
------------	--

Abstract (50 words or less)	Students will learn about how GeneChip microarrays can be used to help with research into areas such as cancer, agriculture, diagnostics, and medicine. They will learn about the complicated structure and function of GeneChip microarrays, how they are manufactured and how to analyze results of experiments using them. During all of this, students will review important concepts of DNA structure and function and deeper genetic topics that go way basic beyond Mendelian genetics. As a final part of the unit, students will discuss in groups and in a class the many ethical issues that such technology brings to our society. The unit will challenge them and open their eyes to an amazing technology that exists today and will impact our society in the future. The unit is designed to help them learn to work well in groups, apply what
-----------------------------	--

they learn by analyzing complex data and communicating their understanding to others.

**Describe how your ETP aligns with the National Board Standard stated in your proposal.**

*VIII. Conceptual Understanding - Science teachers use a variety of instructional strategies to expand students' understanding of major ideas of science*

\*the unit described in this ETP uses many methods – lectures, group and discussions, model building, readings, and the analyzation of data to not only have students learn about GeneChip microarrays, but also review and expand on their understanding of DNA structure and function and genetic concepts such as genotype, mutations, and polymorphisms

*IX. Contexts of Science – Science Teachers create opportunities for students to examine the human contexts of science . . . and impacts on society*

\*the unit described in this ETP will challenge the students to apply what they have learned about GeneChip micorarrays to other areas of society and think deeply about the implications of this technology has on our world

Describe the connection between your ETP and the Summer Fellowship.

My Summer Fellowship is to develop a curriculum unit around the technology of GeneChip microarrays for Affymetrix. This unit will be placed on the Affymetrix website for any teacher that would like to use the curriculum in their classroom. My ETP, therefore, is to implement the unit next year in May and evaluate its' effectiveness towards its' goals and make suggestions on changing it for future use.

Resources Needed

\*Internet Access (optional) – for Activity #1,2, and 3  
\*Copies of all students handouts – for Activity #1,2,3,and 5  
\*Overhead Transparencies of Key Diagrams for lecture on GeneChip microarrays – for Activity #2  
\*Various small items for building GeneChip microarray models (paper clips, candy, aluminum foil, etc.) – for Activity #3 (see teacher guide for full list)

Evaluation/Assessment Measures Used

\*Questions sets after Activity #2 and #3 will be used to assess understanding of the reading portions on Structure, Function, Analysis, and Manufacturing of GeneChip microarrays

\*Rubric #1 will be used to assess groups presentations in Activity #4 on their analysis of the results from a research situation

\*Rubric #2 will be used to assess individual and group participation and input during the Activity #5, the ethical discussion and debate

\*Brainstorm and List worksheets will be used to informally assess participation and input from Activity #1 (Article Share) and further assess group participation in Activity #5 (Ethical Discussion and Debate)

\*Exam – This unit is subunit of a larger unit on the Human Genome Project. A post exam will include questions on all aspects of GeneChip microarrays included in the five activities

Formatting specifications

PC \_\_\_\_\_ or Mac X  
Software used \_\_\_\_\_ Microsoft Word \_\_\_\_\_

Submitted Copy

Soft and hard copy due to peer coach by the end of the summer fellowship. Also, a copy of the cover sheet signed by a school site administrator submitted to IISME Oct.3, 2004 to receive \$300 grant.

I, the **Mentor** named above [please select one of the following],

- have read the attached ETP, and my comments, if any, appear below.
- have read the attached ETP, and, as outlined in the IISME-Company Fellowship Agreement, have reviewed it on behalf of the Sponsor Company, and have determined that the ETP does not contain any Sponsor-proprietary information. My additional comments, if any, appear below.

Comments:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**Administrator's** comments:

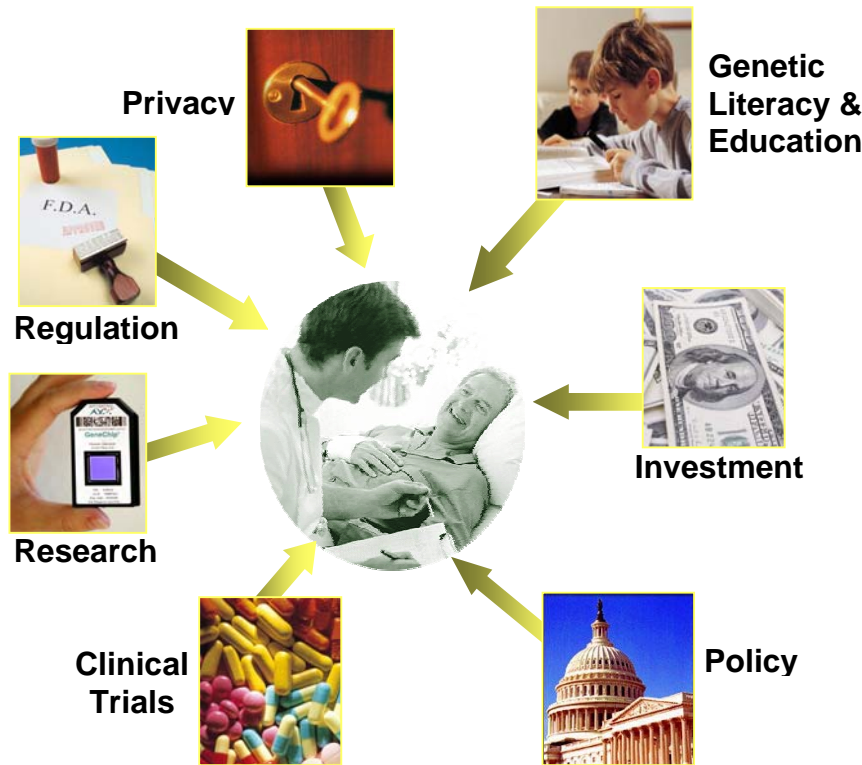
\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**Sample Activity #5 of 10 separate ones that will be posted on the web for teachers use.**

	Monday	Tuesday	Wednesday	Thursday	Friday
In Class	<p>* Intro. to unit</p> <p>* Reading and Discussion of Unit Outline and Goals</p> <p>*Activity #1 (Article Reading and Group Share)</p> <p>*General class discussion of what was learned about the application of GeneChip microarrays</p>	<p>*Lecture (using Power Point and Internet) on the structure and function of GeneChip microarrays and on the three different types of chips</p>	<p>*Review Questions #1-52 from Activity #2 Question Set</p> <p>*Lecture (using Power Point and Internet) on the manufacturing of GeneChip microarrays</p>	<p>*Do 2<sup>nd</sup> part of Activity #2 on GeneChip microarray manufacturing (model building and class presentation)</p> <p>*Introduce and start Activity #4 (GeneChip microarray research scenario analysis and presentation)</p>	<p>*Review Questions #1-18 from Activity #3 Question Set</p> <p>*Finish analysis of scenario data and put together presentation for class</p>
Homework	<p>*Read Sections #1-5 from Activity #2 and do Questions #1-27 from Student Handout I</p>	<p>*Read Sections #6-8 from Activity #2 and do Questions #28-52 from the Student Handout I</p>	<p>*Read Sections #1-3 from Activity #2 and do Questions #1-18 from Student Handout II</p>	<p>*Review reading and Question Sets from Activity #2 and #3</p>	<p>*Work on Presentations for next Monday</p>

# GeneChip Microarrays



## Part V – The Ethical Issues with Genomic Information

### Activity #5 – Discussion of Ethical Scenarios and Company Ethical Policy Statement

#### Introduction:

The use of GeneChip microarray technology can lead to a wide range of extremely powerful and useful genetic information to all areas of our society. Whether it is in medical research and drug manufacturing, insurance, reproductive technology, or public policy, the information this technology affects everyone in one way or another. It can change the way we live our lives! An educated and informed public is a key part of making sure this genetic information is used in the most ethical manner possible and for the benefit of all.

However, as with all technology, there is the possibility of abuse in a manner that complicates, discriminates or endangers the lives of others. Who has access to the

information? What about health issues? Should insurance companies have free access to the information? Employers? Once we are able to identify the function of genes, how much “tinkering” is too much? Should we be able to screen embryos for genetic defects? Could this be used to go beyond racial profiling and lead to a sort of genetic profiling? Can we predict the chances of someone getting a certain disease? What about being able to identify diseases we have no cure for? The questions go on and on . . .

In this activity, you will work in groups to analyze a given ethical scenario for either pros or cons (or both). You will discuss and brainstorm ideas with your group, then report out to the class. Under the teachers direction, a discussion and debate will occur around the topics. The object is not to “prove” anyone right or wrong, but to look at each issue from both angles and think about your own point of view about these topics. You will also act out a scenario where you are part of an advisory committee for a GeneChip company. You will have to come up with an ethical principle statement for the company.

### **Goals**

By the end of this lesson, you will:

- #1 Be more informed about the ethical issues surrounding the use of genetic information in society.
- #2 Look at the positives and negatives of the use of GeneChip microarrays
- #3 Begin to formulate some of your own opinions about the ethical dilemmas that  
GeneChip microarrays and other genetic testing methods bring to society
- #4 Think about how the ethical principles apply to a biotechnology company

### **Procedure**

- (1) Your teacher will organize the class into small groups.
- (2) Each group will be given a different ethical scenario to come up with a list of positives (pros) or negatives (cons) about the situation or a list of both.
- (3) You will be given 20 minutes to discuss the situation as a group and brainstorm a list. Be sure to go around the group and get everyone’s opinion / ideas.
- (4) Once you have come up with as many points as possible, discuss your list further and narrow it down to 4 to 5 key issues.
- (5) Choose a speaker who will report out to the class what your situation was and the list your group came up with.
- (6) After time is up, the teacher will go around the room and allow each group to report out and lead a class discussion around the topic.
- (7) Once each group is finished and the class has discussed each topic, you will break back into groups and pretend you are on the ethics committee for a company that

manufactures GeneChips. Your job is to come up with a “ethical principles” statement that explains your companies’ stance with the use of your technology in the areas of genetic information, genetic testing, and medical privacy.

- (8) The ethical policy statement should be 1 to 2 paragraphs and clearly explains your point of view. It doesn’t have to explain why, but rather what is the point of view.
- (9) You will be given 10 minutes to come up with the ethics policy statement.
- (10) Time permitting, once person in all groups are done, one person from each group will read their statements to the class. If possible, you will come up with a class statement that best addresses all the statements.

### **Rule During Discussions and Debates**

When doing your groups discussion and brainstorming and taking part in the class discussions, a few rules should be kept in mind. These are similar rules to anytime people are expressing their viewpoint on an issue and a discussion is occurring. These rules are there to make sure everyone feels comfortable and confident to share their point of view without being made to feel inferior or incorrect because of what they believe in. This type of discussions lead to debates, but the debate is not meant to prove a point of view or disprove another. Follow these rules to keep the talks going as smoothly as possible and give everyone the time to explain their ideas:

- #1 – Respect and Listen to everyone’s opinion
- #2 – Everyone is allowed the opportunity to talk
- #3 – Do not make any personal attacks, use specific names, or point to others
- #4 – When responding to another point of view, limit your response to no more than a few sentences to allow others to talk.
- #5 – Remember, the goal of this activity is not to prove anyone as wrong or right but simply to hold a discussion around all the possibilities

### **Ethical Scenarios for Discussion**

The following are a list of possible situations to be used in this activity. Not all of the scenarios may be covered, and there may be others that the teacher may assign.

- A – The latest genetic research has led to information about the prediction of diabetes. It has proven to be able to predict, with a 90% accuracy, whether a person will get diabetes at some point in their life. Hospitals would like to make this test a common test given to every patient. Insurance agencies would like to have free access to these test results, saying it will lower the cost for them and for their customers.
- B – The latest genetic research has led to the ability to detect if a person is highly likely to get a certain disease. It is over 90% accurate and can even predict the time period when a person could get this disease. However, despite the research, no cure or therapy is currently available for this disease.

C – Some of the newest genetic research has led to the discovery of a SNP profile that is correlated to violent criminal behavior. About 60% of those currently in jail for violent crimes have this pattern. This is compared to the general population where 10% of the people tested had this SNP pattern. Police agencies around the country are fighting to be able to test all people arrested for this genetic pattern and the government is thinking of profiling all people at birth.

D – A genetic test using GeneChips has been discovered that can show if a person has a strong risk of heart disease due to high cholesterol levels. The genetic test can be given to a newborn baby and is over 95% accurate. The test, however, can only be performed by a private company costs over \$5,000 and insurance companies have refused to cover the test due to high costs.

E – The newest GeneChip technology allows parents to pre-screen egg and sperm DNA for the 20 of the most common diseased genes. This can be done before InVitro fertilization, thus allowing parents to pick and choose which unfertilized egg and sperm to use in the process and almost guarantee the child is free from these 20 diseases.

F – A large meat production company is using GeneChip technology to study cow gene expression. They identified 10 key genes that lead to the production of the meat with the best flavor from cows that grow and develop quicker and with a strong immune system. They plan to use this research to perform in vitro fertilization and genetically alter cow embryos before artificial insemination of the female cows. They say this will allow them to increase production and lower cost of their product.

G – A large company recently started making it mandatory that all employees take a genetic test for certain diseases. They did not disclose what they were exactly testing for but said that the testing would be best for productivity of the company and lead to better profits and salaries for their employees.

H - The newest genetic research has led to a genetic test that looks at the susceptibility a person has for getting lung cancer. It basically can determine the chances of someone getting cancer depending on whether they were a non-smoker, light smoker, medium smoker, or heavy smoker. The test is actually cheap and, needless to say, the tobacco companies are very interested in the information.

I – A company has recently discovered a genotype that is strongly correlated to athletic ability. They took 1000's of high level amateur and professional athletes and did

genetic profiling of their genotypes for specific SNPs. They are now looking for specific genes that could be related to athletic ability.

Group Names \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Date \_\_\_\_\_ Per \_\_\_\_\_

**Student Handout:**  
**Activity #5 - Ethical Scenarios Brainstorm and List Sheet**

**Directions:** For each part of this activity, your group will record down your brainstorm ideas or statements made. One person will be designated the recorder and is responsible for writing down all the groups ideas and turning in the paper. One paper is filled out per group.

**Part 1 – Ethical Scenario (Pro, Cons, or both)**

Brainstorm List of Scenario \_\_\_\_\_.      Pro    Con    Pro & Con    (please circle)

**\*\*when done please circle your groups top four or five ideas or points\*\***

**Part 2 – GeneChip company “Ethical Policy Statement”**

Write the ethical policy your group comes up with in the space below. Make sure the statement is at least one paragraph long and is clearly written.