Supporting Online Material for

Genome Consortium for Active Teaching (GCAT)

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This PDF file includes:

Genome Consortium for Active Teaching (GCAT) Fosters Genomics Education

Supplemental Online Material

Logistics for GCAT Materials

GCAT members pay $50 for the first microarray per species per semester, and $20 for each additional microarray to cover the costs of shipping and scanning. Microarrays cost up to $300 each to purchase from suppliers. GCAT has purchased yeast and human oligonucleotides for microarray printing at Washington University.

Each spring, faculty request arrays for the coming academic year (SOM Figure 1) and GCAT then obtains and distributes microarrays to participating campuses for student use. Students and faculty are responsible for probe isolation (RNA or genomic DNA), probe labeling, hybridization, and delivery of microarrays to a centralized scanner. Tested protocols and teaching aids are available from GCAT. Commercial organizations have also supported GCAT with labeling kits and software at reduced costs.

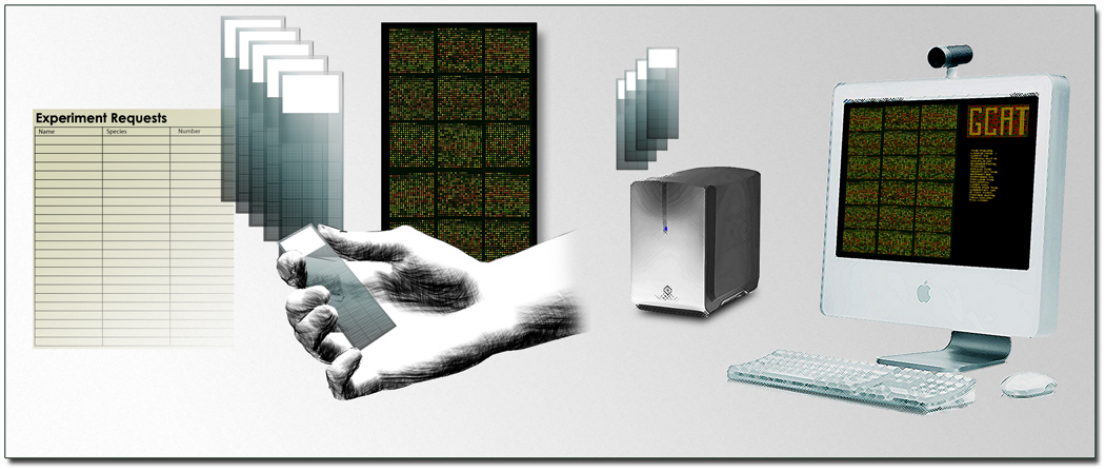

Figure 1. GCAT obtains, distributes, and scans microarrays while students perform experiments and analyze data. Scanned images are available by FTP within 24 hours of shipping.

Distributed Community

The GCAT-L listserv (http://www.bio.davidson.edu/projects/GCAT/GCAT-L.html) provides an effective means for collective trouble-shooting and developing professional relationships. Working as a community maximizes efficiency and produces a sense of belonging to a larger effort that transcends a single campus. To date, over 220 subscribers participate in this forum.

GCAT has launched a wiki (http://gcat.davidson.edu/GcatWiki/index.php/Main_Page) where community members can allow their students to create content. Students can post their results, protocols, experimental designs, etc. This community forum puts students in charge of the site to

develop it as they feel best communicates their work to others. The wiki is password protected for authoring, but open to all GCAT community members.

Non-RNA Based Microarrays

GCAT recognizes that not every faculty member wants to work with RNA in their teaching labs. Therefore, we have developed two student-friendly methods for working with DNA microarrays that do not require any RNA isolation. The first uses the same whole-genome microarrays, but students perform comparative genome hybridization (CGH) which allows students to detect aneuploidy, quantitative changes in chromosomal DNA content. Many yeast deletion strains develop aneuploidy, and aneuploidy is a common factor in cancer development. Therefore, students can directly measure aneuploidy using CGH. Details are available on the GCAT web site <www.bio.davidson.edu/projects/GCAT/CGH/CGH.html>.

Other faculty might want their students to understand the process of producing DNA microarrays and have a very high probability of generating data. Therefore, we have developed teaching chips. Teaching chips are a set of 10 500 bp PCR products from yeast genes that have been cloned into plasmids that can be spotted onto glass slides, either by hand or using robotics. Ten pairs of oligonucleotides (61mers) have been designed that bind to one of the cloned PCR products and combined with the 3DNA protocol to generate dye ratios determined by the pipetting of the pairs of oligonucleotides. Using this protocol, students can design and print chips in one day, and produce detectable results in two more days. Surprisingly, the ratio of pipetted oligos does not match the measured ratio of dyes. This allows students to explore the caveats associated with microarray data. Details are available on the GCAT web site <www.bio.davidson.edu/projects/GCAT/DoItYourselfChips/Self_Chips.html>.

Introductory College and High School Microarray Simulations

Two of us (LJH and AMC) have developed hands-on, wet laboratory simulations for first year college or high school curriculum. This low-tech, inexpensive curriculum interactively teaches students that genes are differentially regulated and that mathematics (e.g. log transformation and correlation coefficients) helps extract biologically meaningful information. A pilot study conducted with over 10,000 students in Illinois and Maryland produced very favorable results in both student learning and excitement. Detailed information is available on the GCAT web site <www.bio.davidson.edu/projects/projects/GCAT/HSChips/HSchips.html>.

Synthetic Biology

An emerging field emphasizing undergraduate participation is synthetic biology, as exemplified by the 2005 intercollegiate Genetically Engineered Machines (iGEM) at MIT (*1*). Teams of students combine engineering with molecular biology to design biological devices that

test our understanding of complex biological systems and may produce new functions within cells. If you are interested in learning more, visit the BioBrick Registry (http://parts.mit.edu/) and the iGEM (http://parts2.mit.edu/wiki/index.php/Main_Page) web sites, hosted at MIT. This area of investigation is an inexpensive way to blend math and molecular biology. Student teams compete to build biological devices in a supportive community that fosters creativity and interdisciplinary approaches. Background readings are available on the GCAT web site <www.bio.davidson.edu/projects/GCAT/Synthetic/synthetic.html>.

References

1. Campbell, A. M. Meeting Report: Synthetic Biology Jamboree for Undergraduates Cell Biology Education. 2005. Vol. 4: 19 - 23.