

# Case It: Case-based Learning in Molecular Biology

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The screenshot shows a virtual laboratory interface with a menu bar at the top containing 'Quit', 'Notes', and 'Tutorial'. The main workspace is divided into two horizontal panels. The top panel contains a 'Heat block' (a black rectangular device with a blue label), a pipette, and a multi-well plate. The bottom panel contains a biohazard container, a central text box, and a microarray chip. The central text box is titled 'Case It! 6.06' and lists the following topics:

- DNA / protein electrophoresis
- Restriction digests / mapping
- Southern / Western / Dot blots
- Multiplex PCR and ELISA
- Bioinformatics analyses
- DNA chips (microarrays)

Below the list is a button that says 'Click here to begin...'. The bottom panel also features a power supply unit on the left, a gel electrophoresis apparatus in the center, and a 'MADE WITH macromedia' logo on the right.

National Association of Biology Teachers, Dallas, TX, 2012

# Overview

- Introduction to *Case It!* project
- Genetic disease cases with role playing
  - Huntington's disease example
- New – microarray cases (SNP and expression)
  - Breast cancer expression microarray
- Case It Mobile prototype
  - HIV cases with introduction to bioinformatics
- Open-ended research applications
  - HHMI SEA-PHAGES project

# Case It! Project

URL for Case It! Home Page:

<http://www.caseitproject.org>

- Includes tutorials and download links
- Access to case descriptions

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# Case It! Project

Electronic framework for analyzing and discussing case studies in molecular biology

- Genetic and infectious diseases and associated ethical issues
- Students gather background information on cases
- Analyze DNA and/or protein sequences using Case It! simulation
- Online poster sessions
- Role-playing

# Assessment

- Pre- and Post-testing
- Focus group interviews
- Rubrics to assess web posters and discussion
- Gains in content knowledge, confidence

# Techniques for DNA and protein analysis

## Case It! simulation

### Features of Case It! simulation

- DNA and protein electrophoresis
  - Restriction enzyme digestion and mapping
  - Southern blotting
  - Dot blotting
  - Polymerase Chain Reaction (single and multiplex)
  - ELISA
  - Western blotting
  - Microarrays (SNP and expression)
- Case studies in genetic and infectious diseases and other biology topics

# Case It! Simulation

## New features in version 6.06

- Bioinformatics tools
  - Open and save FASTA sequences
  - Connection to BLAST and other NCBI tools
  - Integration with MEGA software
    - Alignments
    - Tree building
  - Other
- Microarray simulation
  - SNP
  - Expression

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# Huntington's disease case

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Case scenario - from Case It web site

Restriction enzyme digestion and Southern blot  
or

PCR and gel electrophoresis

Sequence analysis - detect triplet base repeat,  
sequence alignment and BLAST to identify  
gene

## Sample case: Huntington's Disease

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Susan is a 23-year-old whose father, age 55, and paternal aunt, age 61, have been diagnosed with Huntington's chorea. A paternal uncle, age 66, appears to be unaffected by the disease. Susan wants to know if she inherited the mutated gene from her father so that she can prepare for that future if necessary. She arranges to undergo DNA testing for Huntington's. Her 17-year old brother, John, also decides to be tested after talking with Susan.

# Role playing

- Students present the results of their case analysis as a web poster
  - Includes a statement to the “family”
  - Wiki system provides group web posters with associated discussions

[caseitconferencing.wikispaces.com](http://caseitconferencing.wikispaces.com)
- Visit another group’s web poster and post questions in the role of a person in the case
- Authors respond to questions in the role of a genetic or health counselor

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# Breast cancer case

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- Woman diagnosed with breast cancer, without prior risk factors
- Microarray analysis used to determine potential for aggressive growth and invasiveness of tumor

# Breast cancer microarray case

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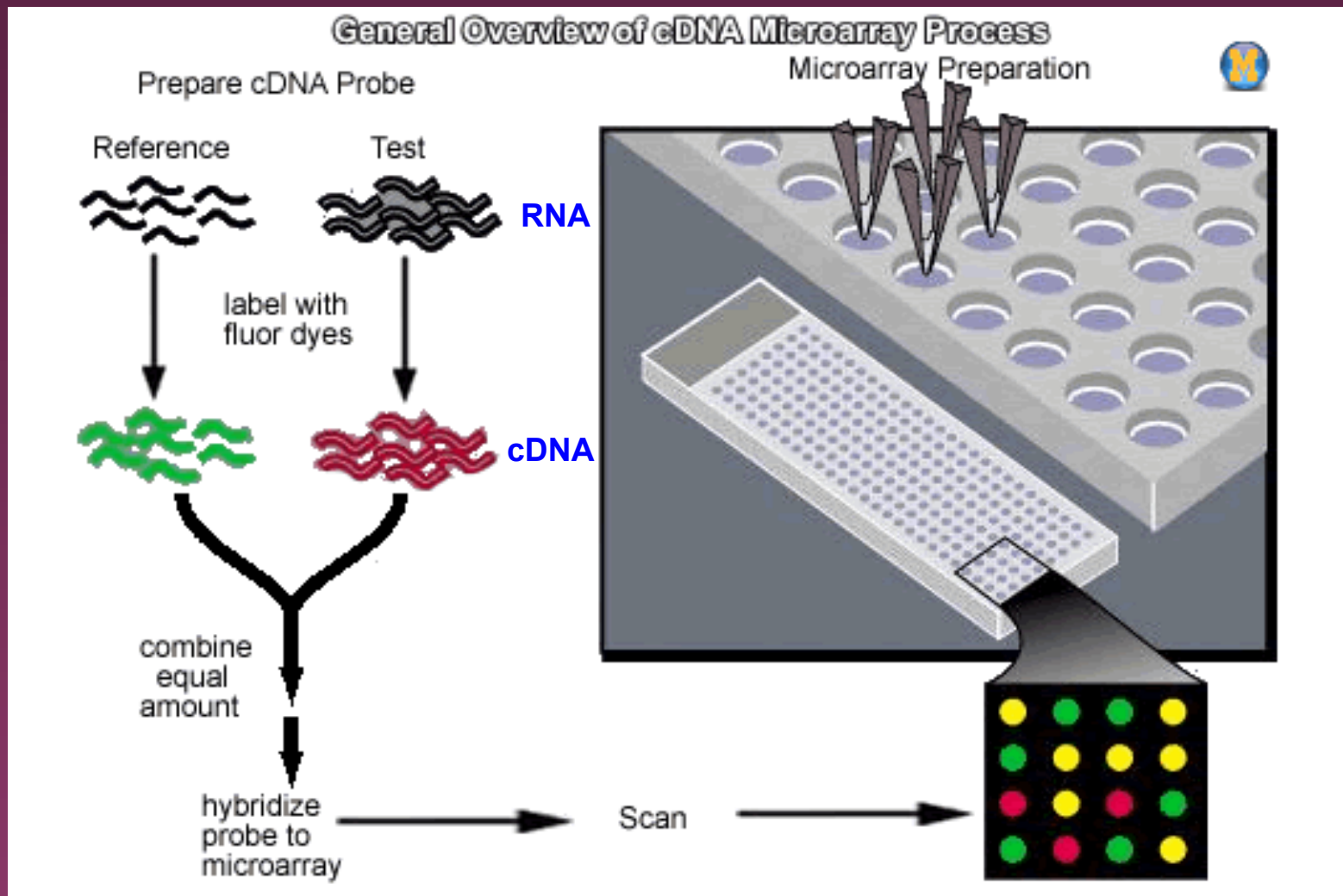
Sarah was devastated when she received a diagnosis of breast cancer. It did not seem to run in her family, so she assumed she did not have to worry about it. She is grateful for the support of her friends, especially Molly, who is a clinical lab pathologist. Molly is helping her think about the difficult decisions regarding how aggressive her treatment should be, in terms of surgery, chemotherapy, etc.

# Breast cancer microarray case

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Molly explains that the oncologist recommended running a lab test that uses a microarray to measure the expression of specific genes. The pattern of gene expression can predict how quickly the tumor cells will grow and whether they will respond to various treatments. Sarah is meeting with the oncologist to review the results, and she has asked Molly to go with her.

# Microarray method





# Breast cancer microarray

Genes associated with increased cell proliferation (or rapid growth) in breast cancer tumors:

- Ki-67, STK15, Survivin, Cyclin B1, MYLB2

Genes associated with increased tumor cell invasion:

- Stomelysin 3, Cathepsin L2

Genes associated with proliferation in response to estrogen:

- SCUBE2, PGR, ERBB2

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# *Case It! mobile*

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- Access to case scenarios and lab results from tablets, smart phones, and Macs
- See prototypes at [www.caseitproject.org/mobile](http://www.caseitproject.org/mobile)

# HIV Case studies

Case scenario - video and text (Anna case ), from Case It web site

ELISA test - initial screening (new autoloader feature)

Western blot to follow up ELISA results

PCR to amplify HIV DNA for viral load or sequence analysis

Sequence analysis to determine source of HIV infection

# Open-ended research

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- HHMI SEA-PHAGES project in General Biology course for freshmen
- Lab sequence replaced by phage research
  - Isolate mycobacteriophages from soil
  - Isolate phage DNA and analyze by restriction enzyme digestion
  - Select one phage to send for sequencing

# Open-ended research

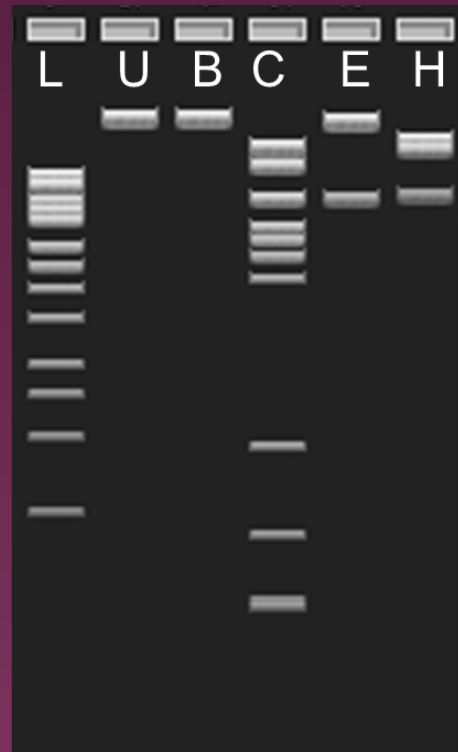
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- Spring semester – phage genomics
- Retrieve complete phage genome sequence
  - Annotate genes
  - Comparative genomics
  - Research projects on phage biology
- [www.phagesdb.org](http://www.phagesdb.org)

Abrogate lab gel



Abrogate virtual gel



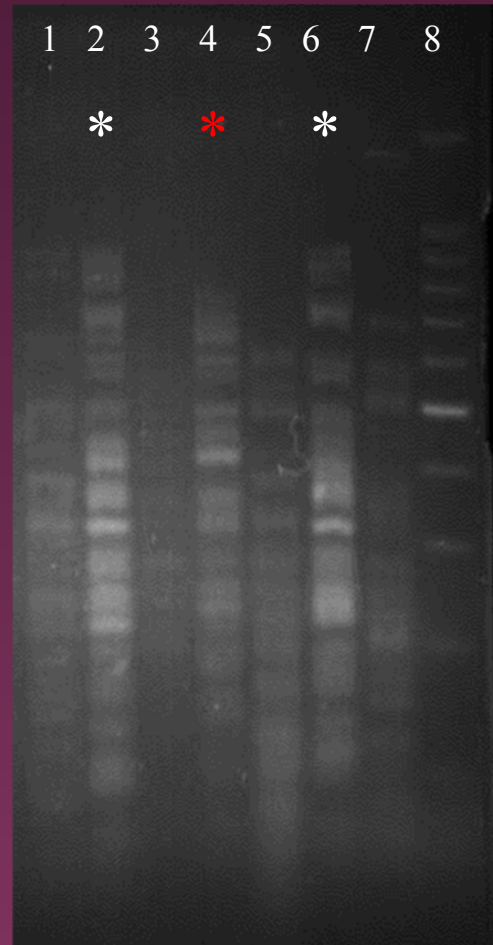
Bxb1 virtual gel



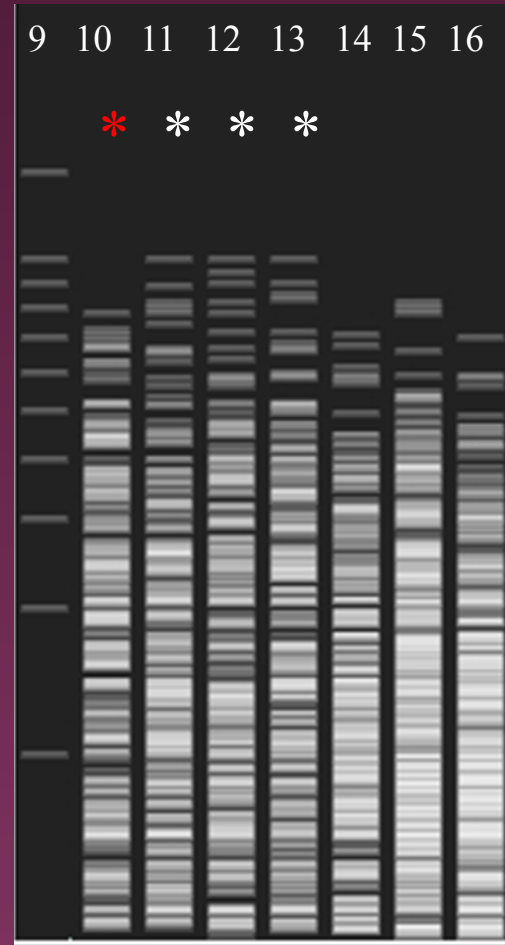
L=1 kb ladder; U=undigested; B=BamHI; C=ClaI; E=EcoRI  
H=HindIII



## HaeIII Lab Gels



## HaeIII Virtual Gel



- Ran separate in 2% agarose gel
- \* Indicates A1 phages
- \* Indicates Abrogate
- Abrogate significantly different from A1 phages

# Case It! Project

## Additional Collaborators

- Mary Lundeberg, Biology Department, University of Wisconsin-River Falls
- Chi-Cheng Lin, Computer Science Department, Winona State University
- Arlin Toro, Biology Department, Inter American University of Puerto Rico-San German campus
- Rafael Tosado, Medical Technology Program, Inter American University of Puerto Rico-Metropolitan Campus
- C. Dinitra White, Biology Department, North Carolina A&T State University