

## SEMESTER AT SEA COURSE SYLLABUS

**Discipline: Biology**

**Fall 2008**

**BIOL 349Z: Agriculture in the Age of Biotechnology – Local Opportunities and Global Challenges**

**Upper Division**

**Instructor: Michael P. Timko**

Suggested Pre-requisites: College level Biology or equivalent

### **Course Description**

The biotechnology revolution that began in the late 1970s held the promise to change the lives of virtually everyone on the earth by providing the scientific knowledge and economic incentive to create a stable and abundant supply of high quality, low cost food through bioengineering. However, public concerns and pressure on government regulatory agencies to properly evaluate the safety of bioengineered products stalled the development and use of bioengineered agricultural products and their promised impacts have yet to be fully realized. In this course we will examine the principles of bioengineering, their application to basic and applied agriculture, and the strategic goals (stabilized output, decreased cost, standardization of product) underlying their use. We will discuss the current status of agricultural bioengineering globally and in selected countries visited during our voyage and examine the scientific data, environmental and ethical concerns, and socio-economic considerations that influenced governmental decisions regarding national/regional investments in agricultural biotechnologies. We will explore how biotechnology has altered local and regional agricultural practices, influenced scientific and economic competitiveness within local, regional and global agricultural markets, and the societal impact investment in biotechnology has had on human health and environmental protection.

### **Course Objectives**

This course is designed for students with a broad interdisciplinary interest in the intersection of science and technology and socio-economics. In this course students will:

- 1) develop an understanding of the basic procedures and applications of genetic engineering to the development of agricultural products (plants and animals) used for human consumption;
- 2) compare national and region-specific attitudes toward the development and use of bioengineered organisms and derived food products;
- 3) develop an appreciation of the practical and societal constraints faced by countries and regions with respect to participation in the biotechnological revolution;
- 4) develop an understanding of how science, ethics, and economics intersect to shape decision making processes
- 5) gain an appreciation of the challenges and opportunities facing nations and regions as they make practical and ethical decisions about applying new scientific knowledge

### **Key Concepts**

- Basic biological principles - DNA as the carrier of genetic information: genes, genomes, the genetic code, transcription, translation, control of gene expression
- Genetic engineering - recombinant DNA technologies, gene transfer methods, transgenic organisms
- Functional analysis of genes: mutation and complementation, genetic and physical mapping of genes

## Course Syllabus by Lecture Topics

Leave Nassau, Bahamas

**B1 Topic: Welcome and introduction to course strategic goals and objectives**

**B2 Topic: Basic principles of genetics and bioengineering**

**B3 Topic: Roundup Ready Soy - Brazil's bargain with the devil?**

Arrive Salvador, Brazil

**B4 Topic: The Green Revolution - Success and failure**

**B5 Implementing a New Green Revolution in Africa: Bt cowpea, GM "Bogoya" bananas, and "super-sized" cassava**

**B6 Topic: Oysters on the edge of the desert**

**Quiz I: In class**

Arrive Walvis Bay, Namibia

**B7 Topic: South Africa: A chance to lead the continent**

Arrive Cape Town, South Africa

**B8 Topic: From the Bengal Famine to the Green Revolution**

**B9 Topic: Genetic engineering: The future for crops in India?**

**B10 Topic: From Just a Few Seeds – The Indian Cotton Industry**

**B11 Topic: Social Impact of New Technologies**

**Quiz II: In class**

**B12 Topic: The "Shrimp-Turtle" Dispute**

**First Response Paper Due**

Arrive Chennai, India

**B13 Topic: Malaysian Agriculture – Old Practices, New pressures**

Arrive Penang, Malaysia

**B14 Fish Farming and South Sea Seafood Wars**

**B15 Rice Exports, Globalization, and Child Labor**

Arrive Ho Chi Minh City, Vietnam

**B16 Topic: Feeding a Continent – The Biotechnology Surge in China**

Arrive Hong Kong -Shanghai, China

**B17 Topic: Securing a safe, abundant, high quality food supply for Japan**

**Second Response Paper due**

Arrive Kobe, Japan - Yokohama, Japan

**B18 Topic: Papaya and Delayed Ripening Tropical Fruits.**

**B19 Student Presentations**

**B20 Student Presentations**

**B21 Student Presentations**

Arrive Honolulu, Hawaii

**B22 Topic: Class Forum- Can biotechnology alleviate poverty and hunger?**

**B23 Topic: Looking into the Global Crystal Ball**

**Final Response Paper due**

**Final Long Essay Paper Due**

Arrive Puntarenas, Costa Rica

**A EXAM DAY - Quiz III**

Transit Panama Canal

Arrive Miami, Florida

## Course Syllabus - Reading Assignments

Required readings are designated by an asterisk. Students are expected to read this material before attending class and are responsible for learning the covered information.

Additional/supplemental readings are provided for the more inquisitive students wishing to pursue a topic in more depth and detail. Information from these reading will occasionally be referred to or discussed in the context of a lecture or group of lectures. Students will only be responsible for those aspects of these materials covered in class. These readings will be provided as pdf or word documents placed on the class home web page in advance of the class.

We will also be viewing of a number of films outside of class time during the course. These films are good topics for contemplation and discussion. These are not shown on the syllabus.

### Leave Nassau, Bahamas

#### **B1 Topic: Welcome and introduction to course strategic goals and objectives**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapters 1, 2

#### **B2 Topic: Basic principles of genetics and bioengineering**

Readings:

\*Barnum, S. 2005 Biotechnology. An Introduction, Chapter 3

Ford Runge, C. and Barry Ryan, M. S. 2004. The Global Diffusion of Plant Biotechnology: International Adoption and Research in 2004. A report prepared for the Council on Biotechnology Information, Washington, D.C.

<http://www.apec.umn.edu/faculty/frunge/globalbiotech04.pdf>

#### **B3 Topic: Roundup Ready Soy - Brazil's bargain with the devil?**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapters 6

\*Pocket K No. 10 Herbicide Tolerance Technology: *Glyphosate and Glufosinate*  
Global Knowledge Center on Crop Biotechnology (<http://www.isaaa.org/kc>).

\*Traxler, G. (2006) 'The GMO experience in North and South America', *Int. J Technology and Globalisation* 2(1/2): 46–64.

Beintema, Nienke M. Philip G. Pardey, and Flavio Avila, Chapter 10 Brazil: Maintaining the Momentum In: Pardey, P. G., J. M. Alston, and R. R. Piggott, eds. *Agricultural R&D in the developing world: Too little, too late?* Washington, DC:International Food Policy Research Institute. p.257

Rhodes, S. D. (2006) The Politics of Biotechnology Policy in South America's Agricultural Powers. Annual meeting of The Midwest Political Science Association, Palmer House Hilton, Chicago, Illinois. [http://www.allacademic.com/meta/p140438\\_index.html](http://www.allacademic.com/meta/p140438_index.html)

Anonymous, (2007) USDA Foreign Agricultural Service Commodity Report, March 2007, Record 2006/2007 Soybean crop in Brazil

Invasion of the forest snatchers, Greenpeace International,  
<http://www.greenpeace.org/international/news/invasion-of-the-forest-snatche#>

### **Arrive Salvador, Brazil**

#### **B4 Topic: The Green Revolution - Success and failure**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapters 6

\*Biotechnology and the Green Revolution, Interview with Norman Borlaug, An  
ActionBioscience.org

\*Hazell, B.R. Green Revolution, Curse or Blessing, International Food Policy Research Institute  
Brief

Green Revolution in Africa, Sustainable Development Department, Food and Agriculture  
Organization of the United Nations, FAO.

#### **B5 Implementing a New Green Revolution in Africa: Bt cowpea, GM “Bogoya” bananas, and “super-sized” cassava**

Readings:

\*Dano, E.C. (2007) Unmasking the New Green Revolution in Africa, Motives, Players and  
Dynamics, Third World Network (TWN), Church Development Service (EED) and African  
Centre for Biosafety; .ISBN: 978-983-2729-08-2

\*Mayet, M. (2007) The New Green Revolution for Africa. Trojan Horse from GMOs.  
Paper presented at a workshop Can Africa Feed Itself? – Poverty, Agriculture and environment –  
challenges for Africa” 6-9 June 2007, Oslo Norway ([www.canafricafeeditself.no](http://www.canafricafeeditself.no))

\*Nicholas Nordbrook, Green Revolution, the Old Fashioned Way. Africa Report, January 2008

The Oslo Declaration on the African Green Revolution. 2nd African Green Revolution Conference,  
Oslo, Norway, August 29 – September 1, 2007

[http://www.africangreenrevolution.com/library/attachments/en/the\\_oslo\\_declaration.pdf](http://www.africangreenrevolution.com/library/attachments/en/the_oslo_declaration.pdf)

Dyer, O. (2005) UN predicts that millennium development goals will be missed by a wide margin  
in Africa. BMJ 330: 1350.

Ihemere, U., Arias-Garzon, D., Lawrence, S., Sayre, R. (2006)

Genetic modification of cassava for enhanced starch production Plant Biotechnology Journal 4  
(4), 453–465. doi:10.1111/j.1467-7652.2006.00195.x

#### **B6 Topic: Oysters on the edge of the desert**

##### **Quiz I: In class**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapters 8

\*Africa’s Fish Industry, Eurofish Magazine 5:46, 2006

\*Staff Reports, From Fish to Oysters, The Namibian Economist, 27 July 2007

Biotechnology and biosafety in Namibia, A country study, Namibian Biotechnology Alliance,  
<http://www.unam.na/research/NABA/Index.html>

Arrive Walvis Bay, Namibia

**B7 Topic: South Africa: A chance to lead the continent**

Readings:

\*Burton, S.G. and Cowan, D.A. (2002) Development of Biotechnology in South Africa EJB Electronic Journal of Biotechnology ISSN: 0717-3458

\*Motari, M., et al. (2004) South Africa—blazing a trail for African biotechnology. Nature Biotechnology 22, DC37

Enterprise Africa, 'Policy comment no. 6: Seeds of Hope: Agricultural Technologies and Poverty Alleviation in Rural South Africa,' [http://www.enterprise-africa.org/Publications/pubID.2774/pub\\_detail.asp](http://www.enterprise-africa.org/Publications/pubID.2774/pub_detail.asp) (8 September 2006)

Ismael, Y., et al. (2002) Benefits from Bt Cotton Use by Smallholder Farmers in South Africa *AgBioForum*, 5(1): 1-5.

Arrive Cape Town, South Africa

**B8 Topic: From the Bengal Famine to the Green Revolution**

Readings:

\*Ganguly, S. From the Bengal Famine to the Green Revolution

**B9 Topic: Genetic engineering: The future for crops in India?**

Readings:

Swaminatham, M.S. Genetic Engineering and Food Security: Ecological and Livelihood Issues

\*Manjunath, T.M., A decade of commercialized transgenic crops – Analysis of their global adoption, safety, and benefits. \*\**The Sixth Dr. S. Pradhan Memorial Lecture delivered at Indian Agricultural Research Institute (IARI), New Delhi, on 23 March 2005.*

Department of Biotechnology, Government of India, Annual Report 2005-2006, Research and Development, Chapter 5

Now, a genetically engineered 'baingan bhārtha' Monday October 15 2007

**B10 Topic: From Just a Few Seeds – The Indian Cotton Industry**

Readings:

\*Zhang, et al (2004) Bt cotton in India. Current Science 86:25

Roy, D., Herring, R.J., and Geisler, C.C. (2007) Naturalising Transgenics: Official Seeds,

\*Loose Seeds and Risk in the Decision Matrix of Gujarati Cotton Farmers. Journal of Development Studies 43: 158-176

\*Private Revolution: King Cotton is back with a bang! The Economic Times 12 Oct, 2007

Bennett, R., Kambhampati, U., Morse, S. and Ismael, Y. (2006) Farm-Level Economic Performance of Genetically Modified Cotton in Maharashtra, India Review of Agricultural Economics 28: 59–71

Manjunath, T. M. 2005. Safety of Bt-Cotton: Facts Allay Fear. [www.agbioworld.org](http://www.agbioworld.org), 18 January 2005.

**B11 Topic: Social Impact of New Technologies**

**Quiz II: In class**

Readings:

Department of Biotechnology, Government of India, Annual Report 2005-2006, Research and Development, Chapter 5

In: Pardey, P. G., J. M. Alston, and R. R. Piggott, eds. *Agricultural R&D in the developing world: Too little, too late?* Washington, DC: International Food Policy Research Institute.

**B12 Topic: The “Shrimp-Turtle” Dispute  
First Response Paper Due**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapters 8

\*World Trade organization Reports, Environment Disputes 8, India etc versus US: ‘shrimp-turtle’  
[http://www.wto.org/english/tratop\\_e/envir\\_e/edis08\\_e.htm](http://www.wto.org/english/tratop_e/envir_e/edis08_e.htm)

Panagariya, A. The tide of free trade will not float all boats, Financial Times: August 3, 2004

Arrive Chennai, India

**B13 Topic: Malaysian Agriculture – Old Practices, New pressures**

Readings:

\*Making the palm oil “green”, by Tom Wright, Wall Street Journal (Europe), Vol XXV, No. 245, Jan 18-20, 2007

\*Pardey, P. G., J. M. Alston, and R. R. Piggott, eds. *Agricultural R&D in the developing world: Too little, too late?* Washington, DC: International Food Policy Research Institute. Keith O. Fuglie and Roley R. Piggott. Chapter 4. Indonesia: Coping with Economic and Political Instability

Othman, S.N., Mohamad, N., and Bakar, J.A.A. (2007) The Application of Biotechnology in Agriculture Based Product R&D at Government Based Research Institute in Malaysia, Portland International Center for Management of Engineering and Technology 5-9 Aug. 2007  
Page(s):2853 – 2856; Digital Object Identifier 10.1109/PICMET.2007.4349628  
Tengku Mohd Ariff Tengku Ahmad and Ariffin Tawang. *Effects of Trade Liberalization on Agriculture in Malaysia: Institutional and Structural Aspects* Working Paper No.34, The CGPRT Centre, 1999

Arrive Penang, Malaysia

**B14 Fish Farming and South Sea Seafood Wars**

Background Readings:

\*Debaere, P. Small Fish-Big Issues, The effect of trade policy on the global Shrimp Market.

Hardjamulia, A., et al. (2001) Aquaculture genetics research in Indonesia, p. 51-59. In M.V.

Gupta and B.O. Acosta (eds.) Fish genetics research in member countries and institutions of the International Network on Genetics in Aquaculture. ICLARM Conf. Proc. 64, 179 p.

PIFB (Pew Initiative on Food and Biotechnology) (2003). Future fish: issues in science and regulation of transgenic fish. PIFB, Washington, DC,

<http://pewagbiotech.org/research/fish/fish.pdf>.

**B15 Rice Exports, Globalization, and Child Labor**

Readings:

\*James, C., Global review of commercialized transgenic crops: 2002, ISAA Briefs No. 27, The International Service for acquisition of Agri-biotech Applications, Ithaca, NY, 2003.

\*Edmonds, E., and Pavcnik, N. Does Globalization Increase Child Labor? Evidence from Vietnam. NBER Working Paper No. 8760. <http://www.nber.org/>

\*Davis, M., Globalization reduces child labor in Vietnam, National Bureau of Economic Research. <http://www.nber.org/>

Arrive Ho Chi Minh City, Vietnam

**B16 Topic: Feeding a Continent – The Biotechnology Surge in China**

Readings:

\*Fan, S., Qian, K., and Zhang, X. Chapter 3 China: An Unfinished Reform Agenda, In: Pardey, P. G., J. M. Alston, and R. R. Piggott, eds. *Agricultural R&D in the developing world: Too little, too late?* Washington, DC:International Food Policy Research Institute. p.29

\*Huang J, Rozelle S, Pray C, Wang Q. (2002) Plant biotechnology in China. *Science* 295: 674–677.

Excerpts from *Agriculture Biotechnology in China. Origins and Prospects*. Karplus, V.J., and Deng, X.W. 2008. Springer, 166 p.

Arrive Hong Kong -Shanghai, China

**B17 Topic: Securing a safe, abundant, high quality food supply for Japan  
Second Response Paper due**

Readings:

\* Barnum, S. 2005 *Biotechnology. An Introduction*, Chapter 7

\*Venning, M and Yukawa, T. *Biotechnology in Japan*

Arrive Kobe, Japan - Yokohama, Japan

**B18 Topic: Papaya and Delayed Ripening Tropical Fruits**

Readings:

\*Botella J.R. Bigger, Firmer, Ripe. Biotechnological control of ripening in tropical fruits. *ISHS Acta Horticulturae 575: International Symposium on Tropical and Subtropical Fruits*

\*Gómez-Lim, M. A., Litz, R. E. (2004) Genetic transformation of perennial tropical fruits. In *Vitro Cellular & Amp; Developmental Biology – Plant* 40(5): 442-449.

**B19 Student Presentations**

**B20 Student Presentations**

**B21 Student Presentations**

Arrive Honolulu, Hawaii

**B22 Topic: Class Forum- Can biotechnology alleviate poverty and hunger?**

Readings:

\*Alteri, M.A. and Rosset, P. Ten reasons why biotechnology will not ensure food security, protect the environment, and reduce poverty in the developing world. AgBioForum 2(3&#4) 1999 ([www.agbioforum.org](http://www.agbioforum.org))

\*McGloughlin, M. Ten reasons why biotechnology will be important to the developing world. AgBioForum 2(3&#4) 1999 ([www.agbioforum.org](http://www.agbioforum.org))

\*Alteri, M.A., and Rosset, P. Strengthening the case for why biotechnology will not help the developing world. A response to McGloughlin. AgBioForum 2(3&#4) 1999 ([www.agbioforum.org](http://www.agbioforum.org))

Kwa, A. (2001) Agriculture in developing countries: which way forward? Trade-Related Agenda, Development and Equity (TRADE) South Centre, Geneva.

**B23 Topic: Looking into the Global Crystal Ball**

Readings:

\* Barnum, S. 2005 Biotechnology. An Introduction, Chapter 9 and pages 305-330

**Final Response Paper due**

**Final Long Essay Paper Due**

Arrive Puntarenas, Costa Rica

**B EXAM DAY - Quiz III**

Transit Panama Canal

Arrive Miami, Florida

## **Student Evaluation and Grading:**

Student performance and grading will be evaluated as described below.

Activity	Description	Value	Total
Exams	In class on days indicated	10 points each	30 points
Short Response Papers	Based on FDP, IDP, field activities	10 points each	30 points
Final Paper	One 15-20 page paper	20 points	20 points
Oral presentation***	Powerpoint/10 min	10 points	10 points
Class participation	(attendance, posing and answering questions that give evidence of understanding readings, participation in class discussions)	10 points	10 points
Total			100 points

Examinations - There will be three in class Exams administered throughout the course. These will be short and topical in nature, not cumulative.

Short Response Papers - Students will be required to write three 5-10 page papers discussing an aspect of world health/nutrition from a regional perspective. These short response papers are to be based on field activities (Faculty Directed Practica, Independent Practica). Students are expected to use primary or secondary sources of information (e.g., photos, interviews, measurements, government publications, etc) gathered during their practica and to provide specific references (6-10 minimum references).

Final Paper – Students will be required to write an essay of 15-20 pages on an aspect of agricultural biotechnology from a multi-regional perspective using primary or secondary sources of information (e.g., photos, interviews, measurements, government publications, etc) gathered during their practica from sites visited on our journey. The final essay should integrate knowledge acquired throughout the voyage and should include a minimum of 10 references.

Oral Presentation - Students will give an oral presentation of their final essay topic and its conclusions, integrating information accumulated throughout the voyage to provide a multi-regional / global perspective to the topic. The presentation will be Power Point based and 7-10 minutes in duration.

Class Participation - Student participation in class discussions is an essential component of the learning experience.

### Field Component:

Each student is expected to undertake a minimum of three practica. At least two of your practica need to be Faculty Directed Practica (FDP) led by me since during these outings we will experience first hand material discussed in the class. The third practica may be either a FDP led by me, another faculty member, or an Independent Practica (IND) of your own choosing and design. Your IND may be developed within the context of a regularly-scheduled SAS trip, or it may be a truly novel activity. Regardless of whether the student chooses an FDP led by another faculty member, participation in an SAS tour activity, or chooses to develop their own IND, they must meet with me prior to arriving in the port-of-call to discuss his or her approach, objectives, and goals.

For this course I plan to minimally offer FDP opportunities in at least three of the following ports: Walvis Bay, Namibia, Chennai, India, Penang, Malaysia and/or Hong Kong, China. You are encouraged to choose two/three from among this set. I will provide additional information in class about the nature and goals of these practica. Keep in mind that the three required "response papers" are based on your experiences during your field visits. Therefore, at the minimum students will be required to keep a written record of their field observations. Written information, photos, and other materials collected during FDP, IND, field visits will be used in the preparation of student's required oral presentation.

Some examples of appropriate Independent Practica topics are listed below:

Develop a project based on visits to local markets. Determine what is being sold and discuss with the vendors their knowledge of where their products arise. Are they the grower or just the middleman. Do they products they offer change based on what their clients tell them they prefer. How has their production costs influenced their prices.

Keep a field notebook in which you record the way in which food production occurs in several different countries along our voyage. What influence has the "Green Revolution" and the introduction of "GMOs" had in the effort to be self-sufficient in food production? What impact has it had on local rural farmers versus existing large-scale production. Most important, consider how the country's agricultural practices have affected the local/ regional ecosystem.

### **Required Textbook**

AUTHOR: Susan R. Barnum  
TITLE: Biotechnology. An Introduction  
PUBLISHER: Brooks/Cole , A Division of Thomson Learning Inc.  
ISBN #: 0-495-11205-4  
DATE/EDITION: 2005, Second Edition  
COST:

### **Reserve Texts and Other Materials**

AUTHOR: Robert Eugene Evenson, V. Santaniello  
TITLE: The Regulation of Agricultural Biotechnology  
PUBLISHER: CABI Publishing Agricultural biotechnology/ Law and legislation  
ISBN #: ISBN 0851996183  
DATE/EDITION: 2004, 320 pages

AUTHOR: Elenita C. Dano  
TITLE: Unmasking the New Green Revolution in Africa. Motives, Players, and Dynamics  
PUBLISHER: Third World Network (TWN), Church Development Service (EED) and African Centre for Biosafety  
ISBN #: 978-983-2729-08-2  
DATE/EDITION: 2007

AUTHOR: Mutsaers, H.J.W.  
TITLE: Peasants, Farmers, and Scientists  
PUBLISHER: Springer  
ISBN #: 978-1-4020-6165-3  
DATE/EDITION: 2007, XXVIII, 612 pages

AUTHOR: Karplus, Valerie J. and Deng, Xing Wang  
TITLE: Agricultural Biotechnology in China. Origins and Prospects  
PUBLISHER: Springer  
ISBN #: 978-0-387-71138-6  
DATE/EDITION: 2008, XXIV, 166 p

### **DVDs and Other Materials**

Our Daily Bread, A film by Nicholas Geyhalter, 92 minutes, Release Date 2006  
Deconstructing Supper, 2002, ISBN (DVD) 1-59458-087-1  
Food, 2000, ISBN (DVD) 1-59458-272-6  
We Feed the World, 2007, ISBN (DVD) 1-59458-652-7  
Risky Business, Biotechnology and Agriculture, 1996, ISBN (DVD) 1-59458-430-3  
Life Running Out of Control, 2005, ISBN (DVD) 3-935573-14-6