
HUNGER
innovators
Inspiring · Exploring · Trans ming

THE INNOVATORS:

Cutting-edge Discoveries
Transforming Lives, Fueling the Economy

Spring 2008

The Innovators:

February 7, Seattle

ARCS at Washington State University:

Enhancing Quality of Life Worldwide

Stephen A. Hines, D.V.M., Ph.D., DACVP
Professor, Veterinary Microbiology & Pathology
Berger Keatts Distinguished Professor
(Excellence in Teaching)
College of Veterinary Medicine

Crystal Montoya, ARCS Fellow
Ph.D. Candidate, Veterinary Microbiology & Pathology
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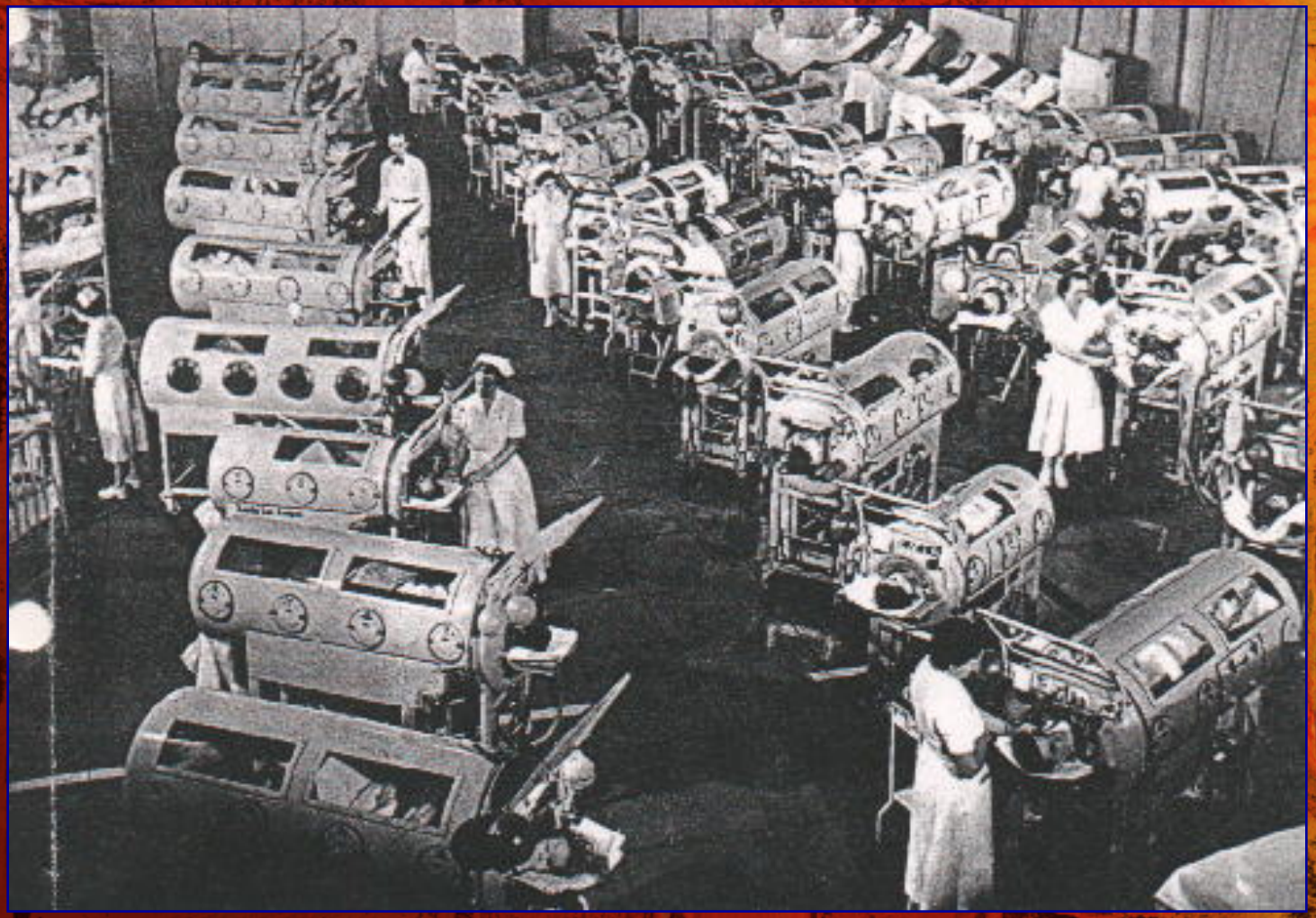
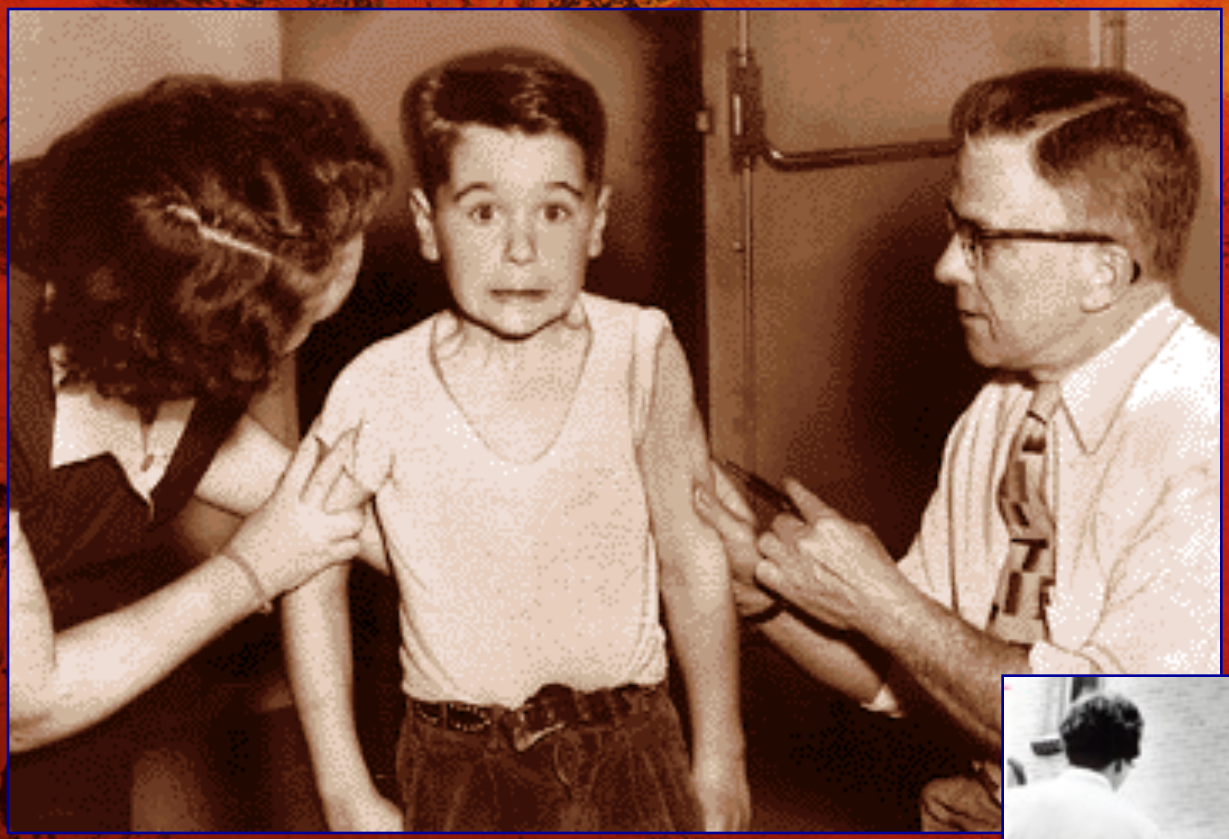
Preventing Infectious Diseases with the Next Generation of Vaccines

The world has changed… because of vaccines.



People in iron lungs during the age of polio.



Salk polio vaccine
circa 1958

Sabin oral polio vaccine
circa 1961

Disease Prevention

Disease	Annual Number of Cases* (peak year)	1998 Number of Cases*	% Decrease
Polio	16,316 (1952)	0	100%
Smallpox	48,164 (1900)	0	100%
Diphtheria	175,885 (1920)	1	100%
Measles	503,282 (1958)	89	99.8%
Mumps	152,209 (1968)	606	99.6%
Rubella	47,745 (1967)	345	99.3%

* United States

Available Vaccines:
By Year of Development or Licensure in the U.S.

1700-1799	1798	Smallpox
1800-1899	1885	Rabies
	1896	Typhoid
	1896	Cholera
	1897	Plague
1900-1959	1923	Diphtheria
	1926	Pertussis
	1927	Tetanus
	1927	Tuberculosis
	1945	Influenza
	1953	Yellow fever
	1955	Polio (Salk)
1960-1998	1960	Polio (Sabin)
	1963	Measles
	1969	Mumps
	1969	Rubella
	1970	Anthrax
	1975	Meningococcus
	1977	Strep. pneumon.
	1981	Hepatitis B
	1985	Haemoph. influ.
	1992	Jap. encephalitis
	1995	Hepatitis A
	1995	Varicella-zoster
	1998	Lyme disease

What's Left ?

"All the easy vaccines have already been made."

New and emerging diseases

Old diseases – re-emerging

Among the Diseases that Remain:

- Complicated, often chronic diseases – tuberculosis
- Moving targets – HIV
- Diseases affecting unique populations – infants & children
- Mucosal diseases – diarrhea

Veterinary Medicine

- Most new human diseases will emerge from animals
- Animal models of human disease

Scanning Electron Micrograph of
Mycobacterium tuberculosis

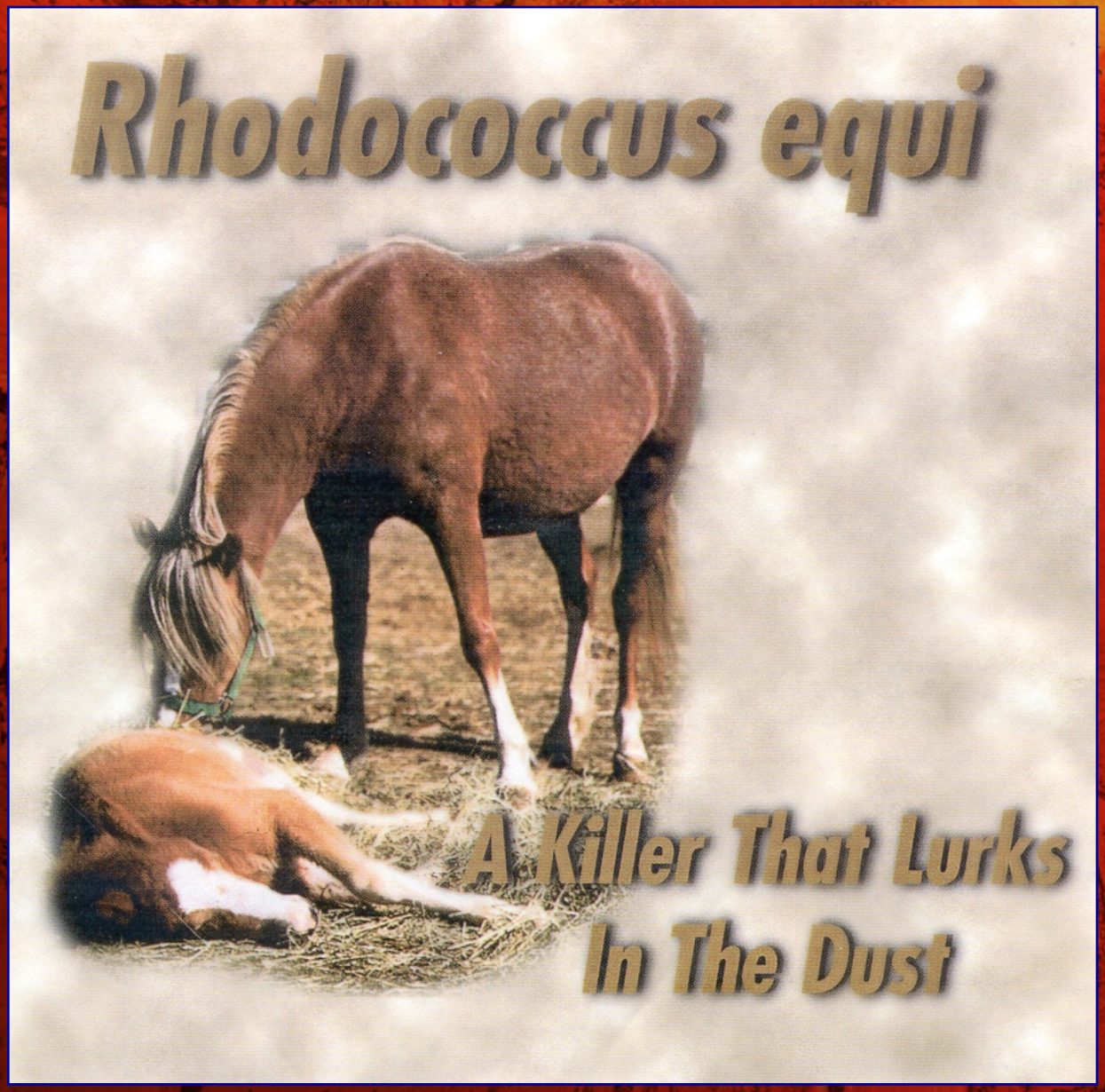


photo from “The Horse” magazine

Equine
Rhodococcal
Pneumonia

A “scourge”

Rhodococcus equi
An important cause of pneumonia in horses.

- A bacteria – closely related to *M. tuberculosis*
- "Babies" (foals) are uniquely susceptible
- Like *Mtb*, lives in cells in the lung
- Immune protection will be very similar to TB
- Opportunistic infection in HIV+ humans

Our Goals

- A vaccine
- Implications for
  - Tuberculosis
  - Neonatal vaccines (infants)
- Training the next generation of medical scientists (ARCS)

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My Research

Focuses on finding the difference between early-life and adult immune systems that makes foals susceptible to rhodococcal pneumonia while adults are immune to the disease.

To develop a vaccine that modifies the foal's immune response.

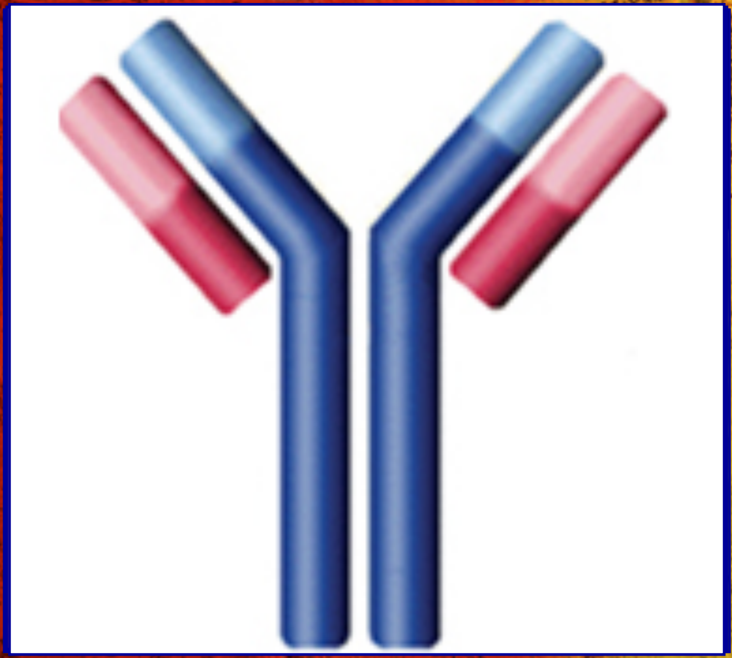
Questions to Answer

- Why are newborns susceptible to disease ?
- Are there specific cells in the immune system that behave differently?
- Can we change the behavior of the immune system in foals to control the disease?

The Immune System

Macrophages

http://encarta.msn.com

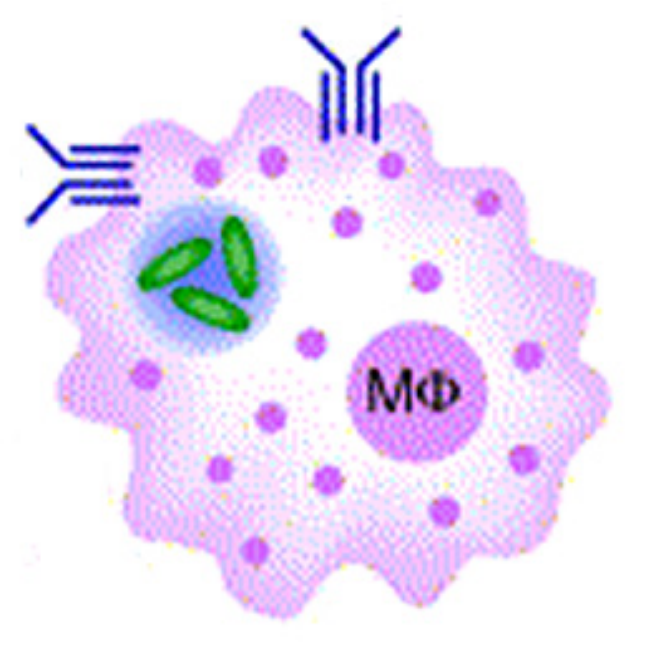


Antibody

www.mansfieldct.org

http://www.biosignatures.org/antibody/

Macrophages Normally Interact with Other Cells

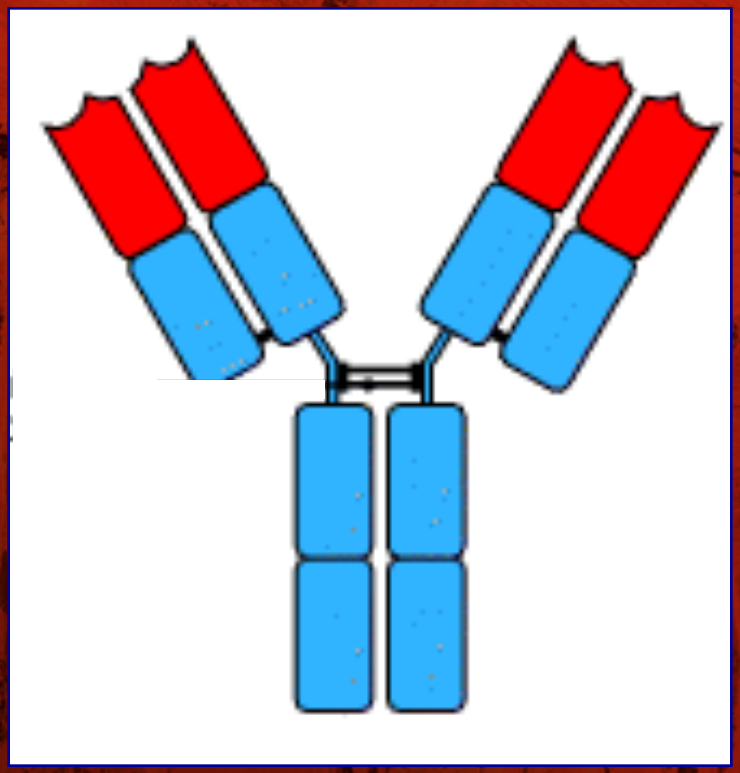


→ Cytokines

- Production of antibodies
- Recruitment and production of T killer cells
- Induction of fever

The Immune System

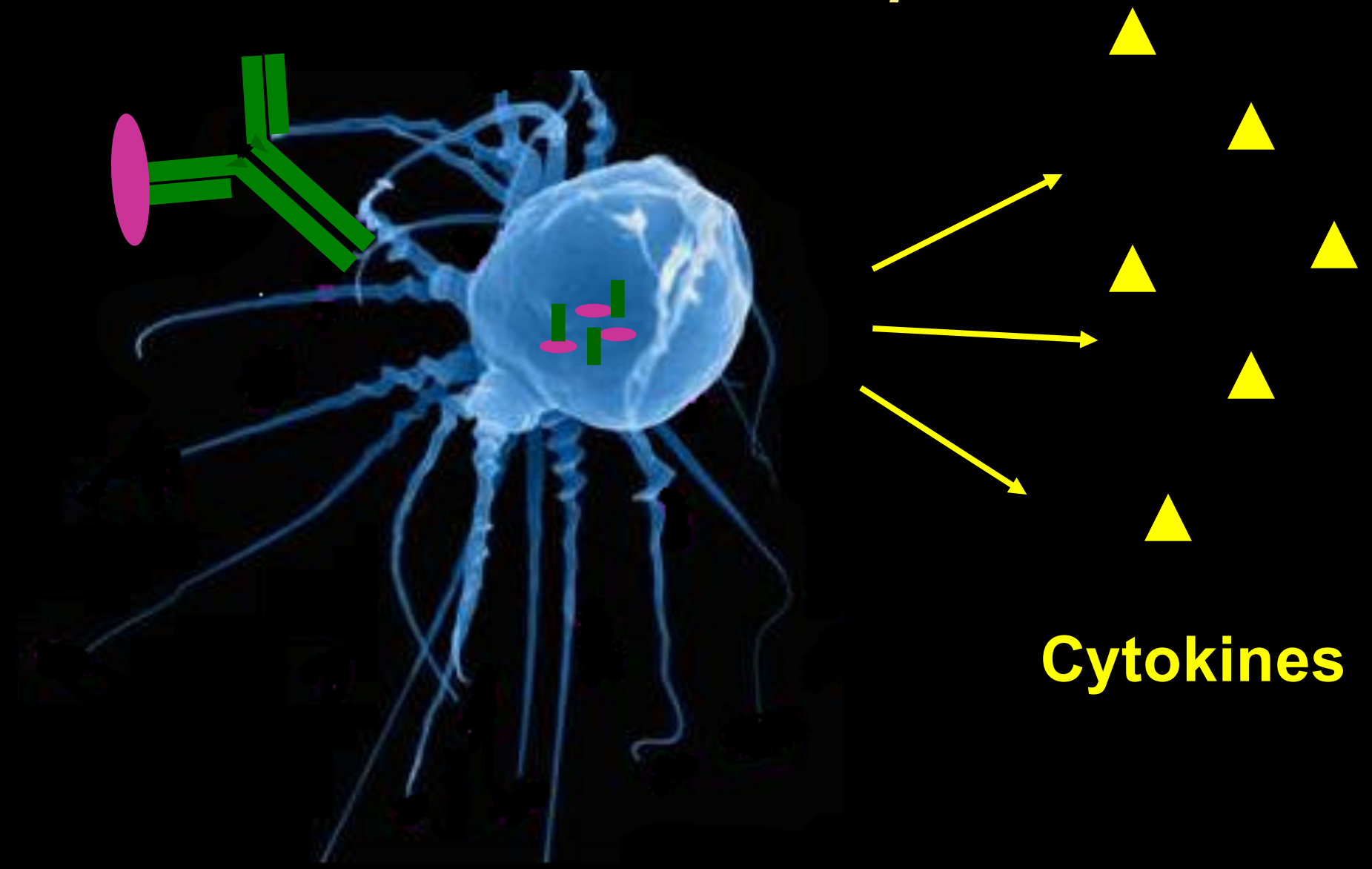
Antibodies



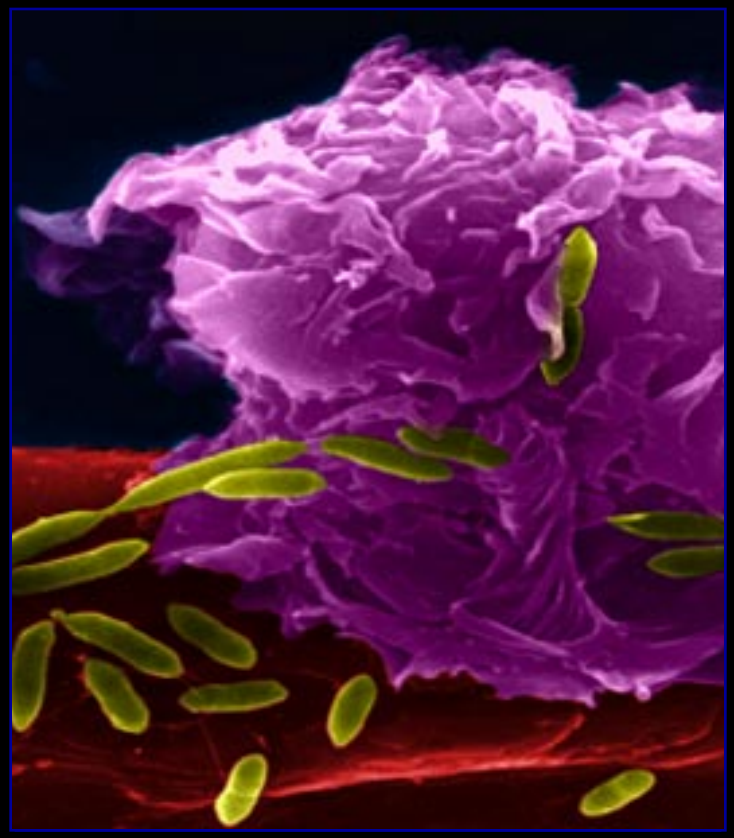
Janeway

- Found in the plasma of blood
- Identify foreign materials
- Bind
- Neutralize
- Tag particles for destruction

Macrophages Recognize Antibody Bound to *R. equi*



Macrophages



www.[illegible]/2005

The Next Step, Creating a Novel Vaccine

- Vaccinate the pregnant mothers with *R. equi*
- Mothers will produce antibodies to *R. equi*
- After the baby is born, nursing will provide the antibody to the baby

The Promise of Biotechnology:

A healthier world for humans and animals.

Sincerest Thanks to:

- Seattle Chapter of the ARCS Foundation
- Camille and Jim Uhlir
- Deb Alperin, Seth Harris, and Robson Dossa
- Morris Animal Foundation

Questions?

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ARCS at Washington State University:

Enhancing Quality of Life Worldwide

John Browse, Ph.D.

Regents Professor, Center for Reproductive Biology, Institute for Biological Chemistry

College of Agricultural, Human and Natural Resource Sciences

Laura Wayne, ARCS Fellow

Ph.D Candidate, NIH Protein Biotechnology, Molecular Plant Sciences

Institute of Biological Chemistry

College of Agricultural, Human and Natural Resource Sciences

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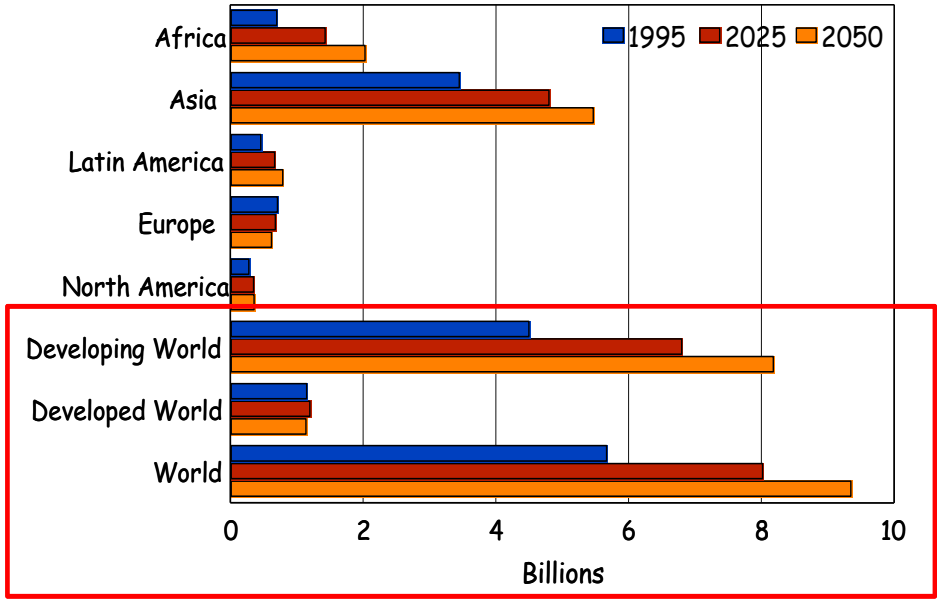
Changing Our World

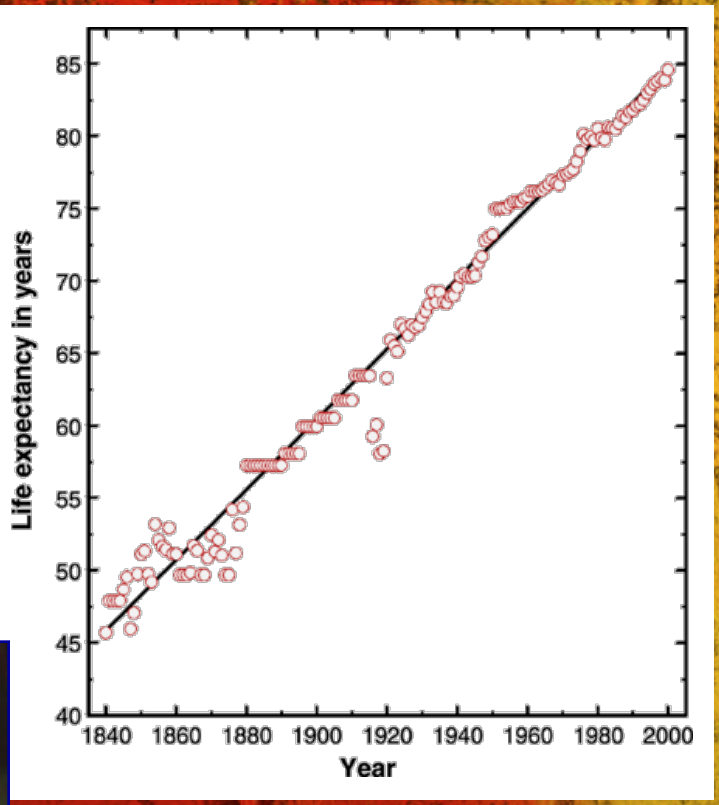
Using a Weed to Model the World's Oilseed Crops

Arabidopsis

We Have More People Living Longer



Science 282,420 (1998)

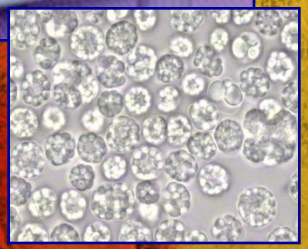


Improving Nutrition of Food Oils

Reducing saturated and trans fats

Increasing monounsaturated fats

Adding fish oil PUFAs to plant oils

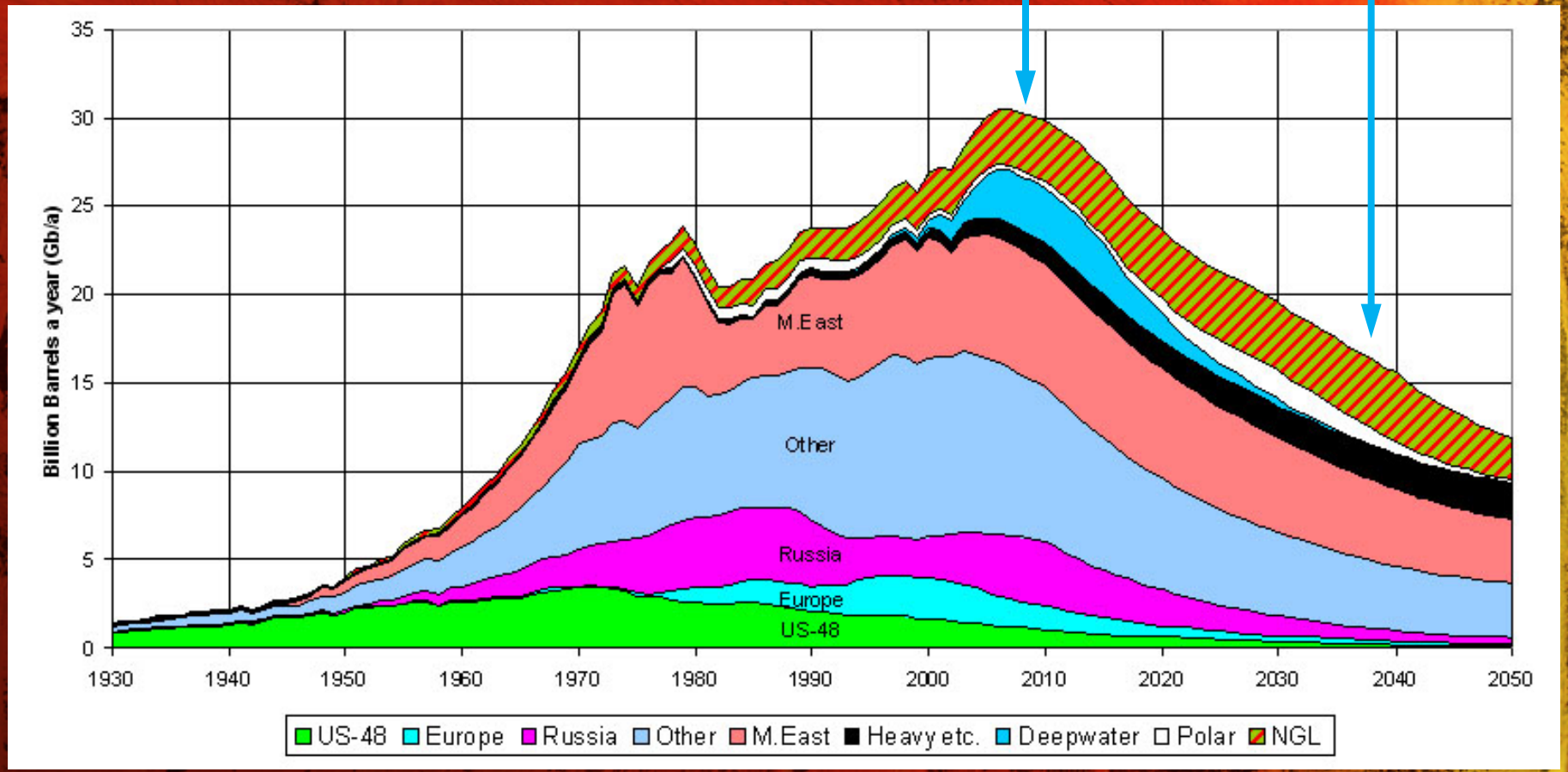


Rapidly Increasing Resource Needs

NASA / Reuters

Declining Resources

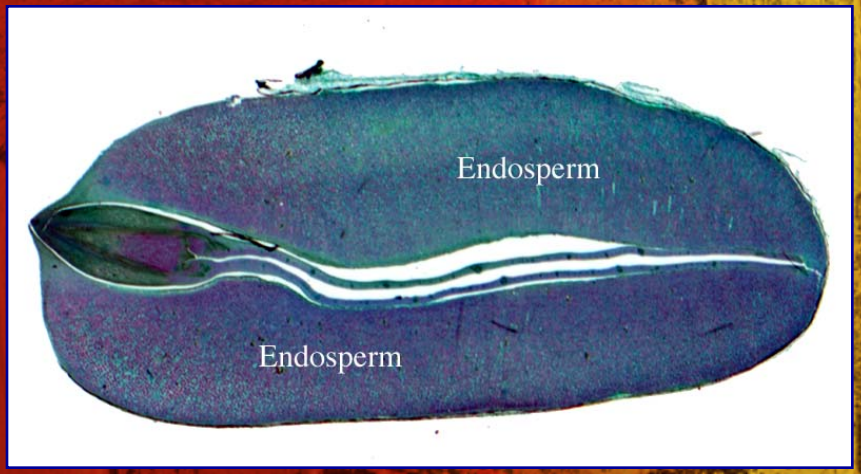
Petroleum Output will be halved in 30 years



Chemicals and Biofuels from Plants Throughout Washington

Plant Research and Engineering

One of the World's Top Oil Producers



Unusual Fatty Acids in Transgenic Plants

Fatty Acid	Level in Source	Level in Transgenic
Ricinoleic	90%	17%
Petroselinic	85%	<10%
16:1 Δ6	80%	<10%
Cyclopropane	40%	<5%
Acetylenic	70%	25%
Epoxy	60%	15%

The Journey Begins

- Science research is the engine for human advancement
- Our efforts contribute to a world wide research community
- To continue, we must educate and train the next generation of researchers
- Young scientists such as ARCS graduate student Laura Wayne

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Ph.D Candidate, NIH Protein Biotechnology,
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Castor Oil:
Renovating a Sustainable Household Item

Why Study Castor Oil?

- **Many industrially important uses**

Racing Oil

Lubricants

Laxative

Inks & Paints

Nylon/
Plasticizers

Cosmetics/
Emollients

Surfactants/
Detergents

A Novel Fatty Acid

Physical properties: a hydroxyl group (-OH)

Compound	Major Unit
Biological oils	Fatty acids

Examples:

Olive/canola oil Oleic acid (18 carbons)

"High-oleic" "monounsaturated"

Castor oil Ricinoleic acid (18 carbons)

Hydroxy group added by an enzyme called a hydroxylase

Castor Beans Ricinus Communis

- Castor beans contain the deadly toxin Ricin
  - Undesirable to grow in U.S.
    - Considered a noxious weed
    - Difficult to harvest
- Currently, the U.S. imports castor oil from India, China, and Brazil
- Therefore, it is advantageous to produce castor oil in other crop species
  - Create renewable products domestically!

Umbrella Assassination of Georgi Markov

Castor Oil Gene Transfer

Castor bean
Ricinus communis

Arabidopsis
Arabidopsis thaliana
(model plant, our version of the lab mouse)

Agricultural crops
Canola / rapeseed

Project Goals

- Castor beans contain 90% hydroxy fatty acids (ricinoleic acid)
- Currently, we have transgenic Arabidopsis (with castor hydroxylase) accumulating 17%
- Not yet a marketable yield

→ My Hypothesis:
Expressing accessory enzymes along with the castor hydroxylase will improve yield.

A tremendous thanks to…

- My Family & Friends who have cheered me on
- My Professors who have encouraged me
- ARCS who have spread the word…
  - SCIENCE ROCKS!
- But most of all, you believe in me

For more information:

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