

# **LENScience Teacher Professional Development Seminar Series**

## **Nutrigenomics in the Classroom**

This PowerPoint was prepared for a LENScience Teacher Professional Development Seminar held on Tuesday 17<sup>th</sup> March 2010.

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THE UNIVERSITY OF AUCKLAND  
NEW ZEALAND

Te Whare Wānanga o Tāmaki Makaurau



NATIONAL RESEARCH CENTRE FOR  
GROWTH AND DEVELOPMENT



LENScience Teacher Professional Development Series 2010

# Nutrigenomics in the Classroom

Jacquie Bay, Michal Denny, Lynn Ferguson



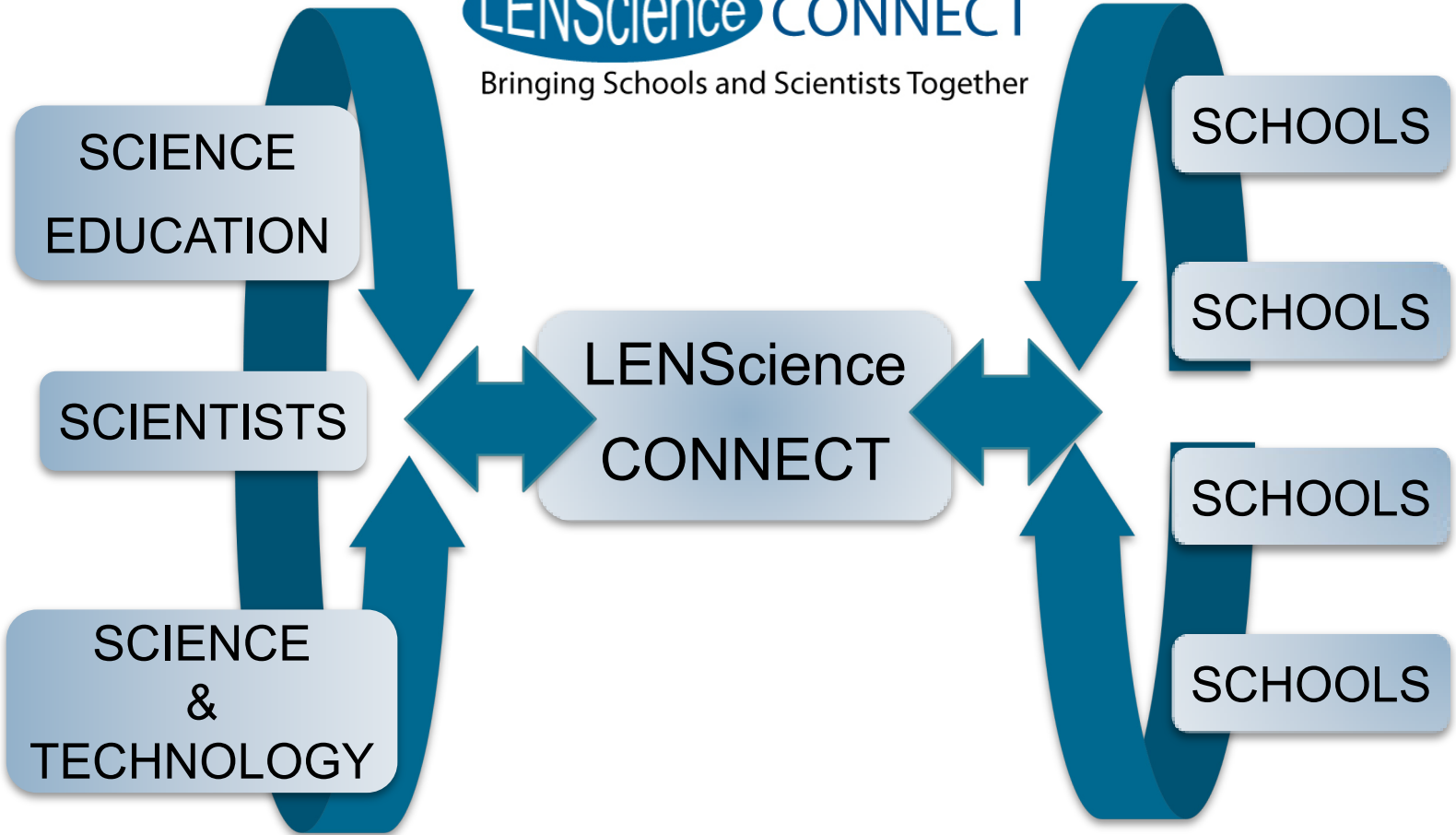


## Teacher Professional Development Series 2010



# LENScience CONNECT

Bringing Schools and Scientists Together



# LENScience CONNECT

100 NZ schools  
and growing...



Teacher PD Series 2010  
Regional Venues



# Nutrigenomics in the Classroom

Nutrigenomics – What, why and how?

Lynn Ferguson

An appropriate context for teaching?

Michal Denny

Folate: A controversial biological issue for NZ

Lynn Ferguson

Curriculum, Assessment and Support

Michal Denny

Question and Answer Session

Jacquie Bay

Live Chat throughout the workshop

Helen Mora

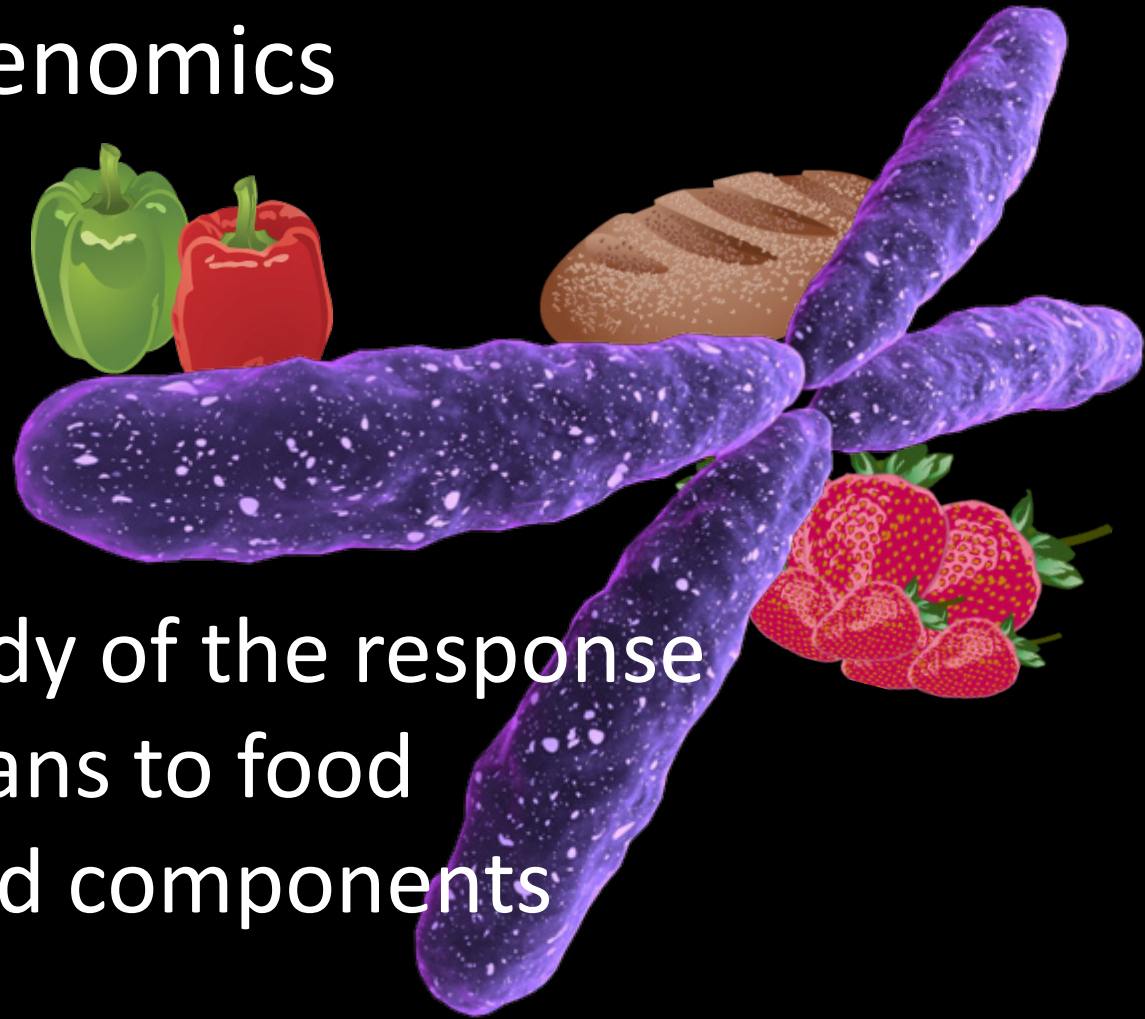
Matt Barnett

Technical Support

Anna Lehmann



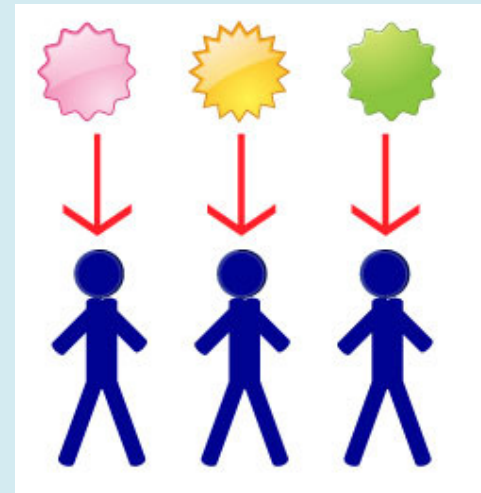
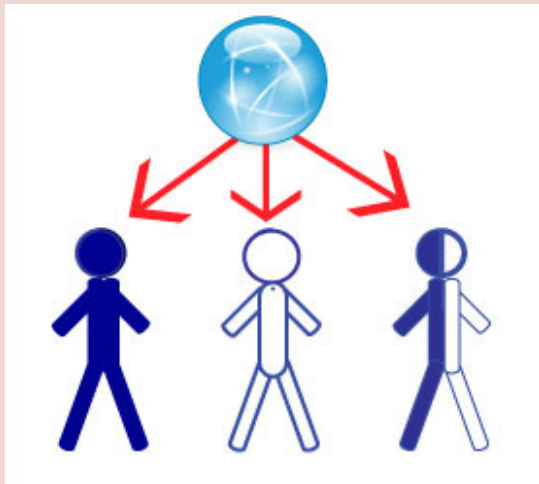
# Nutrigenomics



The study of the response  
of humans to food  
and food components

# Different Elements of Nutrigenomics

Effect of an *environmental* exposure on health and disease risk in people with different *genotypes*

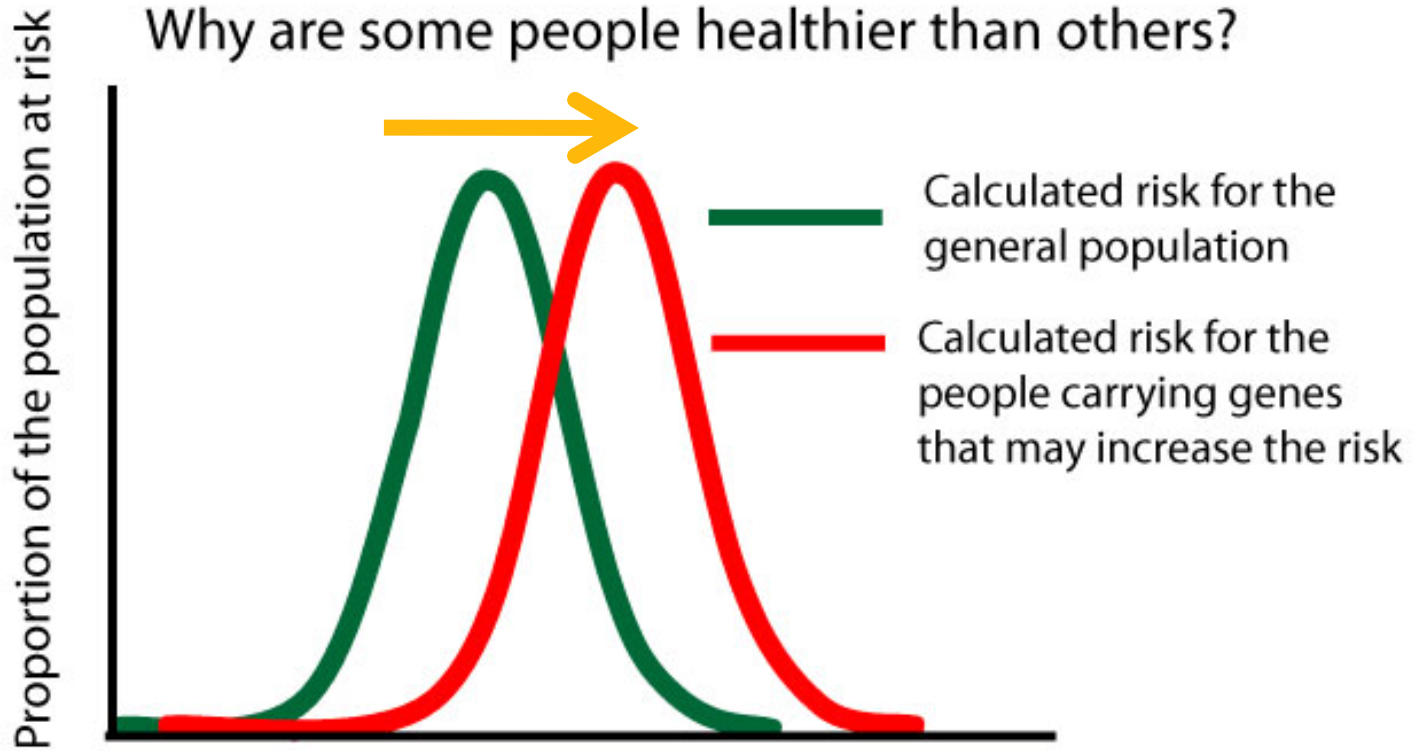


Effect of a *genotype* on health and disease risk in people with different *environmental* exposures

Ottman, *Prev. Med* 25, 764 (1996)

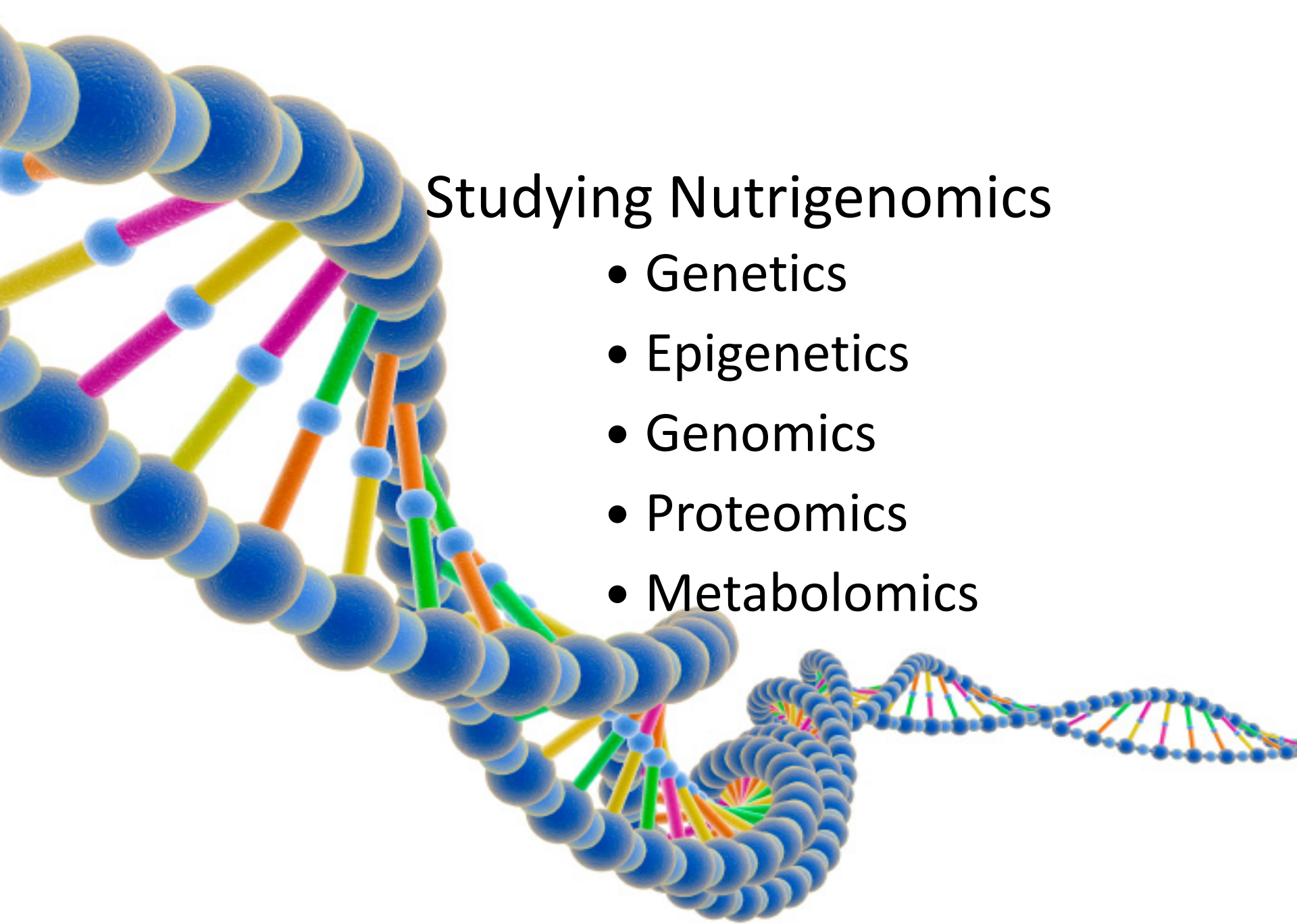


## Why are some people healthier than others?



# **The Goal of Nutrigenomics New Zealand**

To develop foods that can be matched to individual human genotypes to benefit the health of those individuals and enhance normal physiological processes.



# Studying Nutrigenomics

- Genetics
- Epigenetics
- Genomics
- Proteomics
- Metabolomics

# Genetics

- The study of human variability
- Methods
  - SNP detection

AACAGGA



AACGGGA





# Genetics

- The study of human variability
- Methods
  - SNP detection
  - Copy number variant detection



# Genetics

- The study of human variability
- Methods
  - SNP detection
  - Copy number variant detection
  - **Gene Chips**

# Genetics

- The study of human variability
- Methods
  - SNP detection
  - Copy number variant detection
  - Gene Chips
  - DNA Sequencing



# Epigenetics

- The study of heritable changes in gene function that occur without a change in the sequence of nuclear DNA.
  - X Chromosome inactivation
  - Gene silencing
- Mechanisms
  - DNA methylation
  - Chromosome remodeling

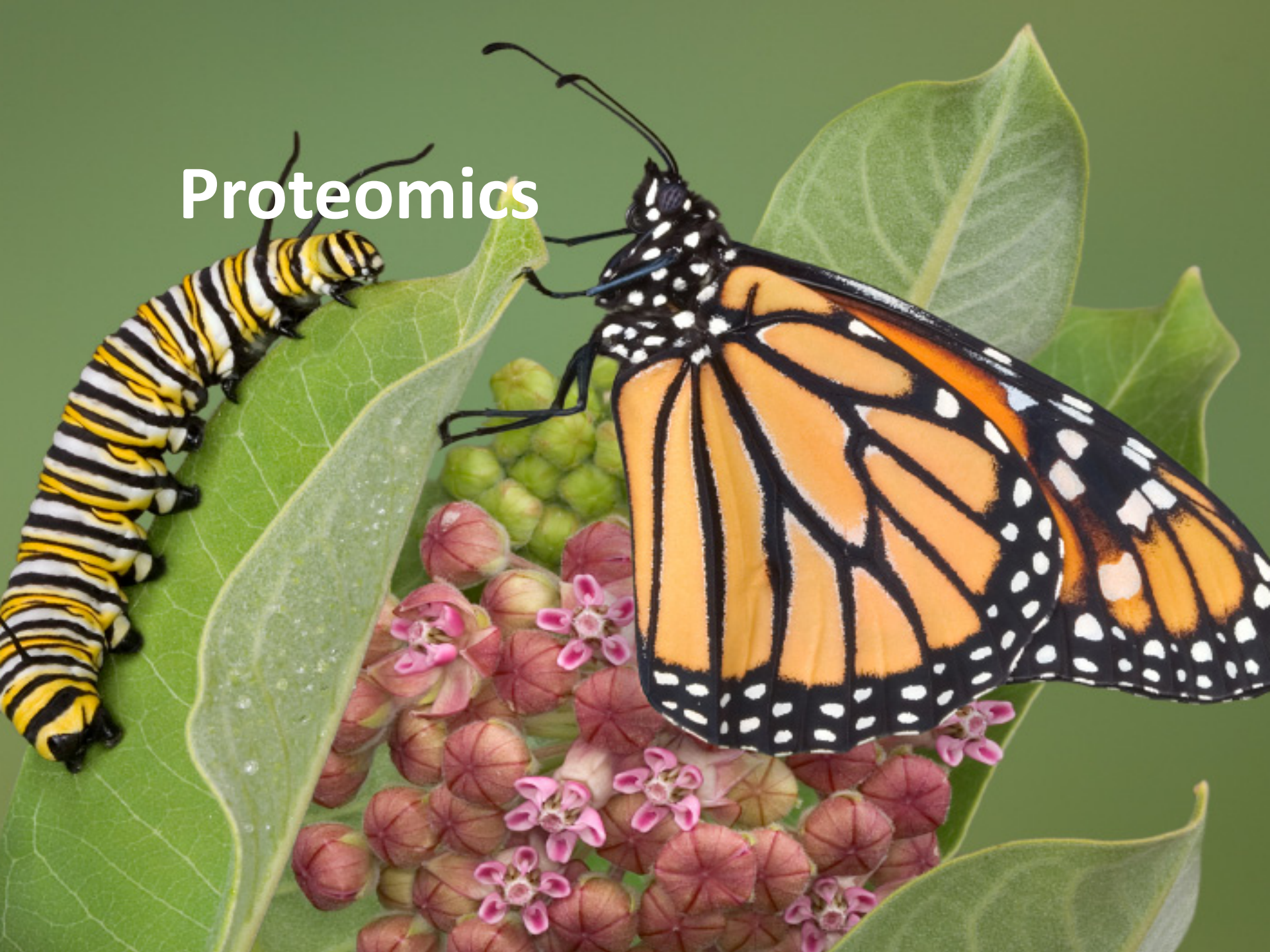




# Genomics

- The study of genomes
  - Patterns of Gene Expression
- Biotechnological Techniques
  - Microarrays
  - Gene Expression Verification via PCR
  - Bioinformatics

# Proteomics



# Proteomics

A monarch butterfly with orange and black wings is perched on a green leaf. To its left, a monarch caterpillar with yellow, black, and white stripes is also on the leaf. In the foreground, there are several small, pink, five-petaled flowers. The background is a soft, out-of-focus green.

- Human genome
  - 30,000 genes that generate about 500,000 proteins.
- Linear association between the genome, transcriptome and proteome does not exist.
- Using a “multi-omics” approach is important.

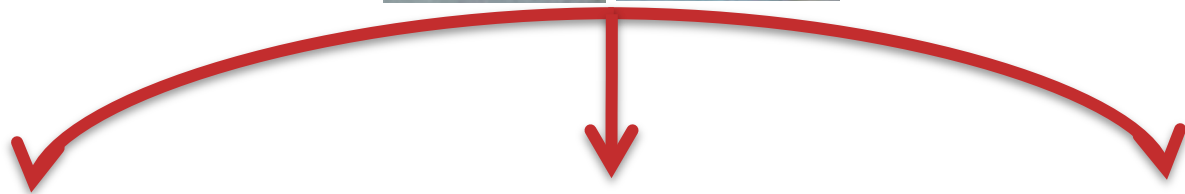


# Colon tissue



RNA extraction

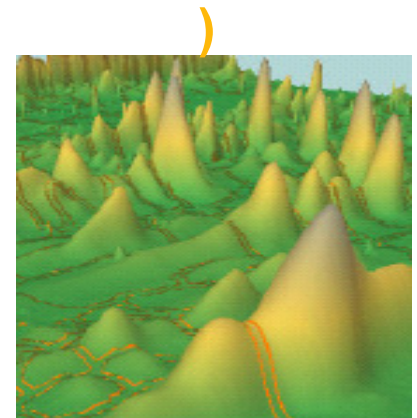
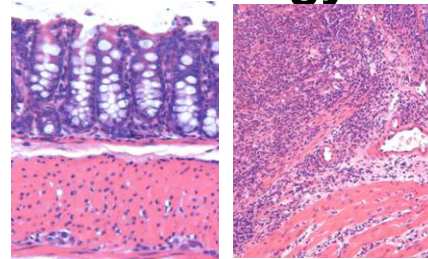
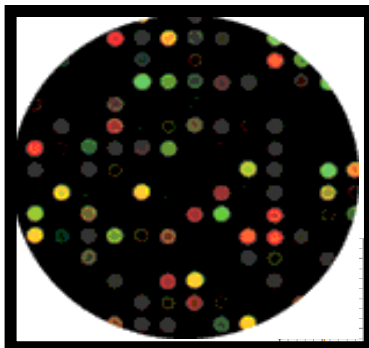
Protein extraction



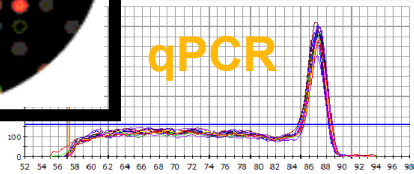
Microarrays

Histology

Proteomics



qPCR





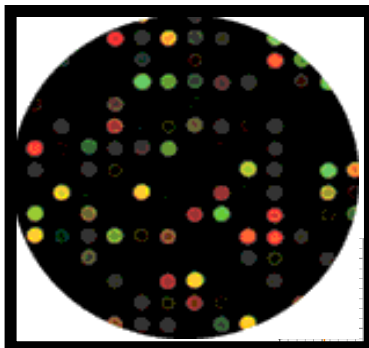
# Colon tissue



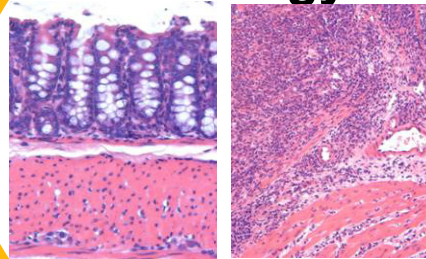
RNA extraction

Protein extraction

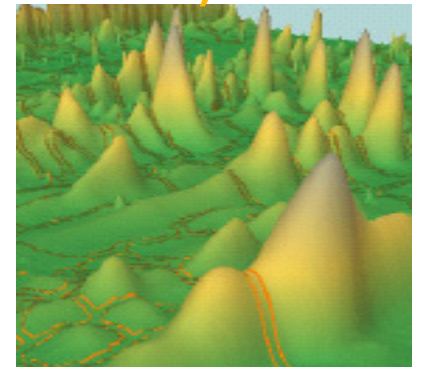
Microarrays



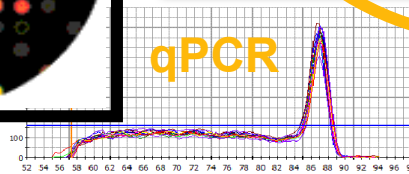
Histology



Proteomics



qPCR





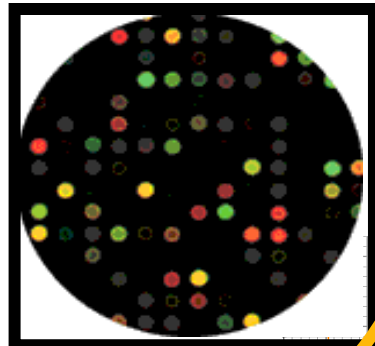
# Colon tissue



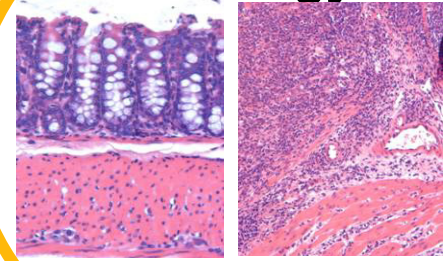
RNA extraction

Protein extraction

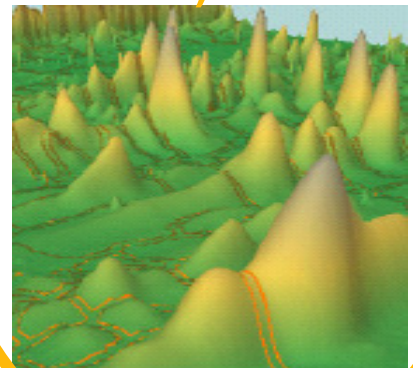
Microarrays



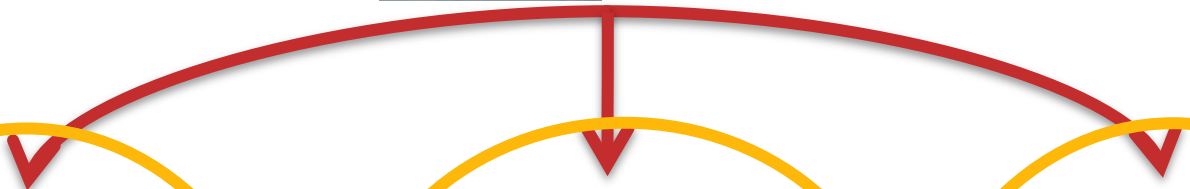
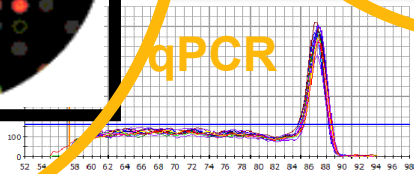
Histology



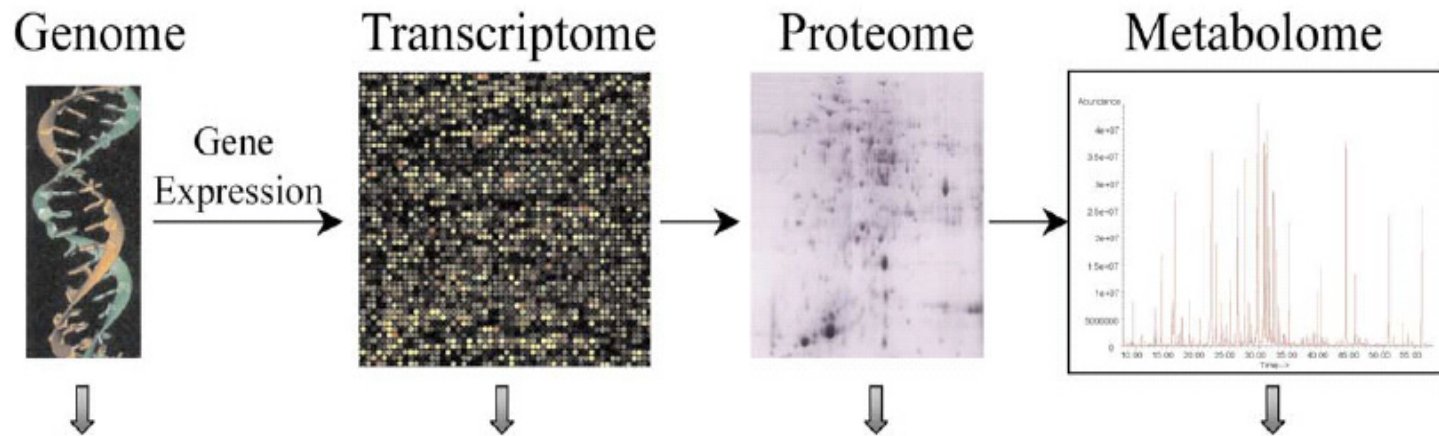
Proteomics



qPCR



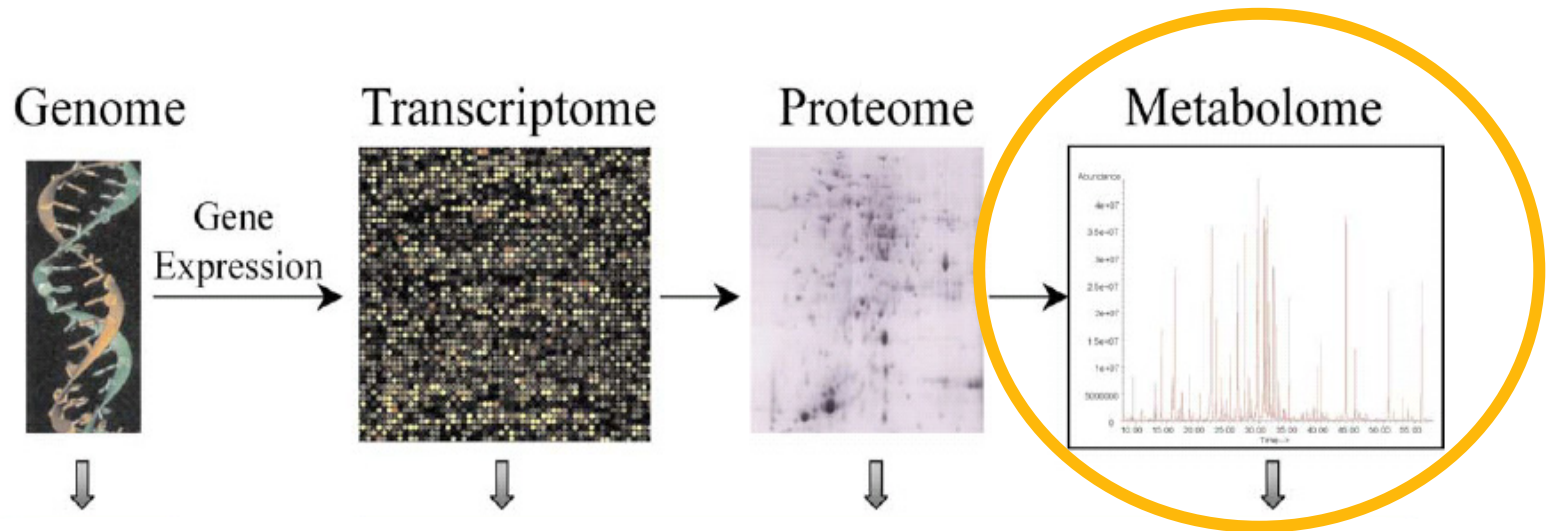
# Metabolomics



## Biomarker discovery

- Effects of foods on metabolism
- Metabolite markers showing effects of foods on our health

# Metabolomics

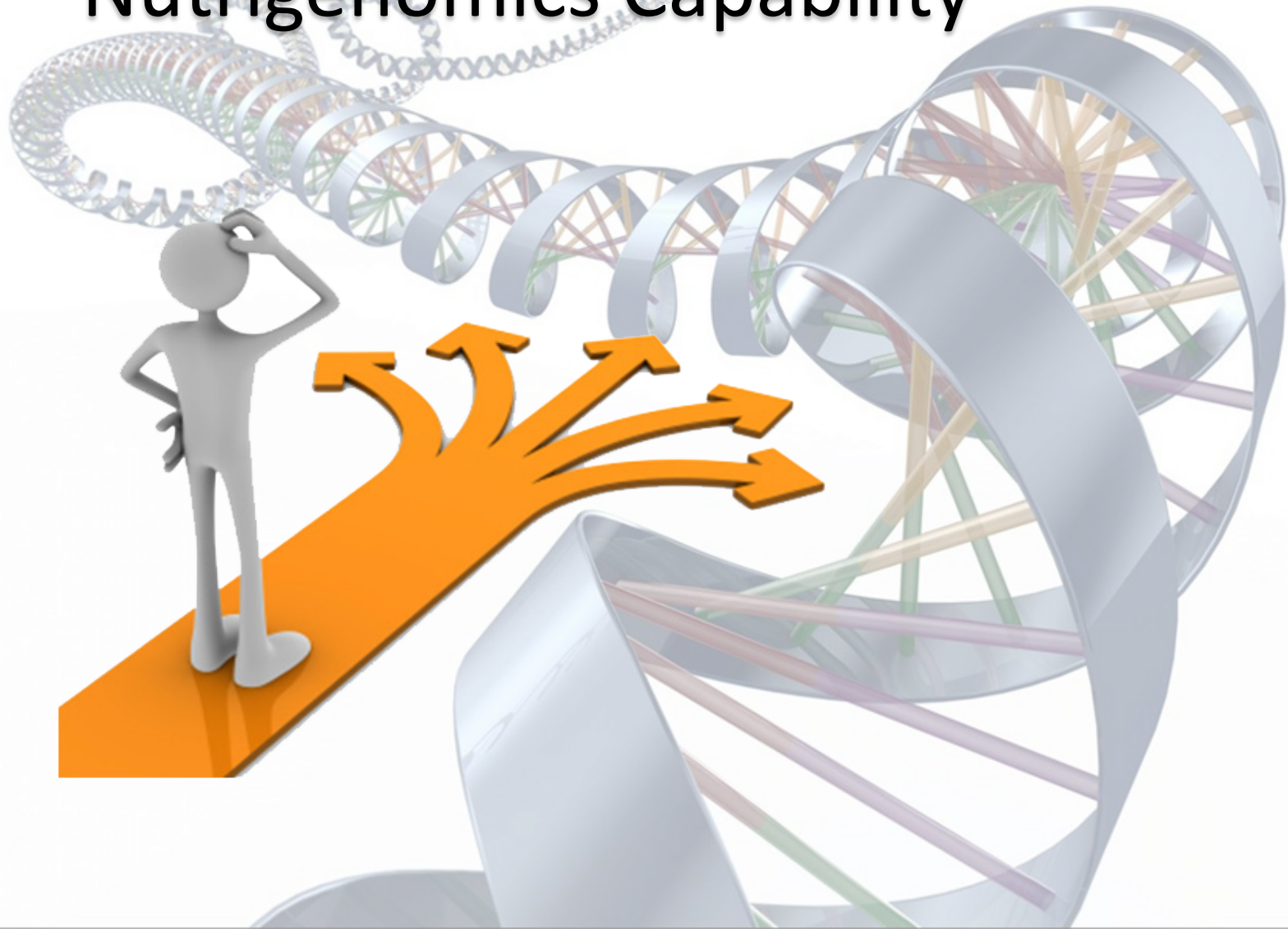


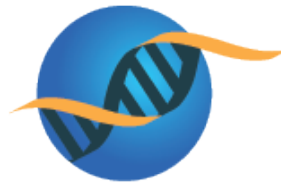
## Biomarker discovery

- Effects of foods on metabolism
- Metabolite markers showing effects of foods on our health



# Nutrigenomics Capability





# Nutrigenomics

NEW ZEALAND



Plant & Food RESEARCH

RANGAHAU AHUMĀRA KAI



THE UNIVERSITY  
OF AUCKLAND

NEW ZEALAND

Te Whare Wānanga o Tāmaki Makaurau

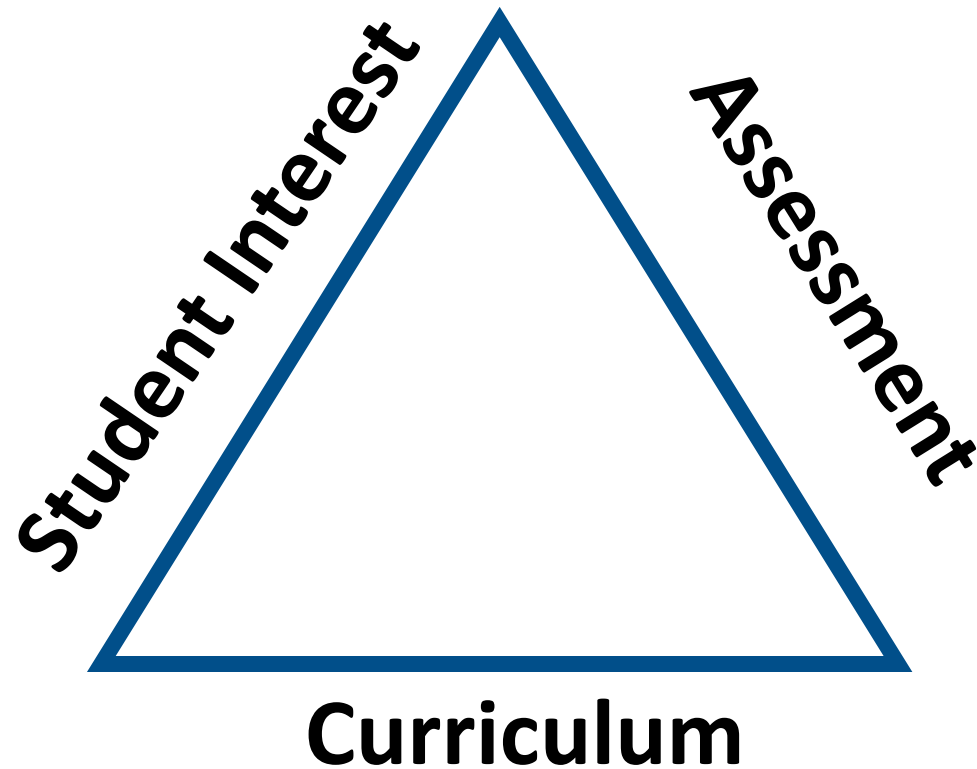
- Collaborative Research Programme
- Currently funded by the New Zealand government through the Foundation for Research, Science and Technology

FOUNDATION FOR  
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SCIENCE &  
TECHNOLOGY

Tūāpapa Rangahau Pūtaiao

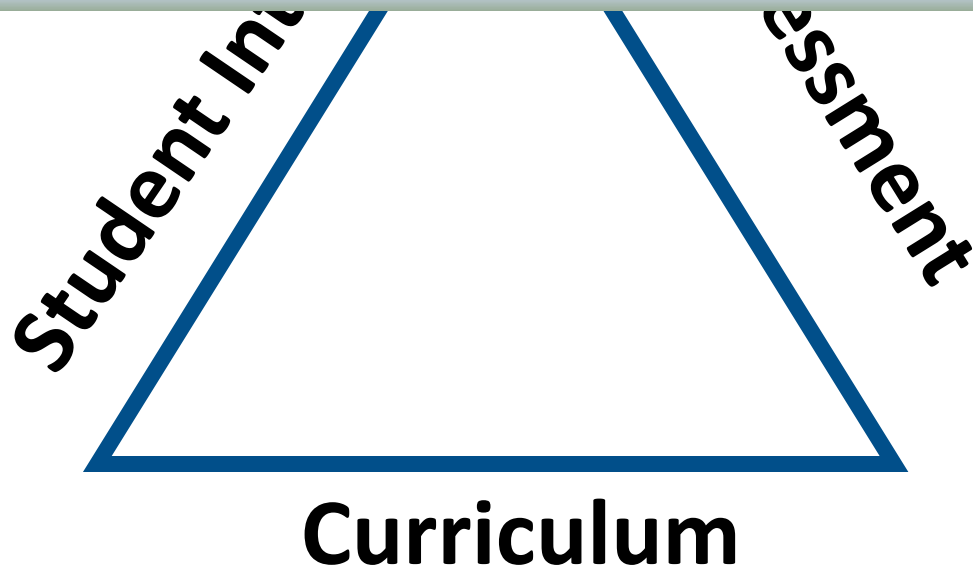


# Factors Influencing Choice of Teaching Context



# Factors Influencing Choice of Teaching Context

**Resource Access**



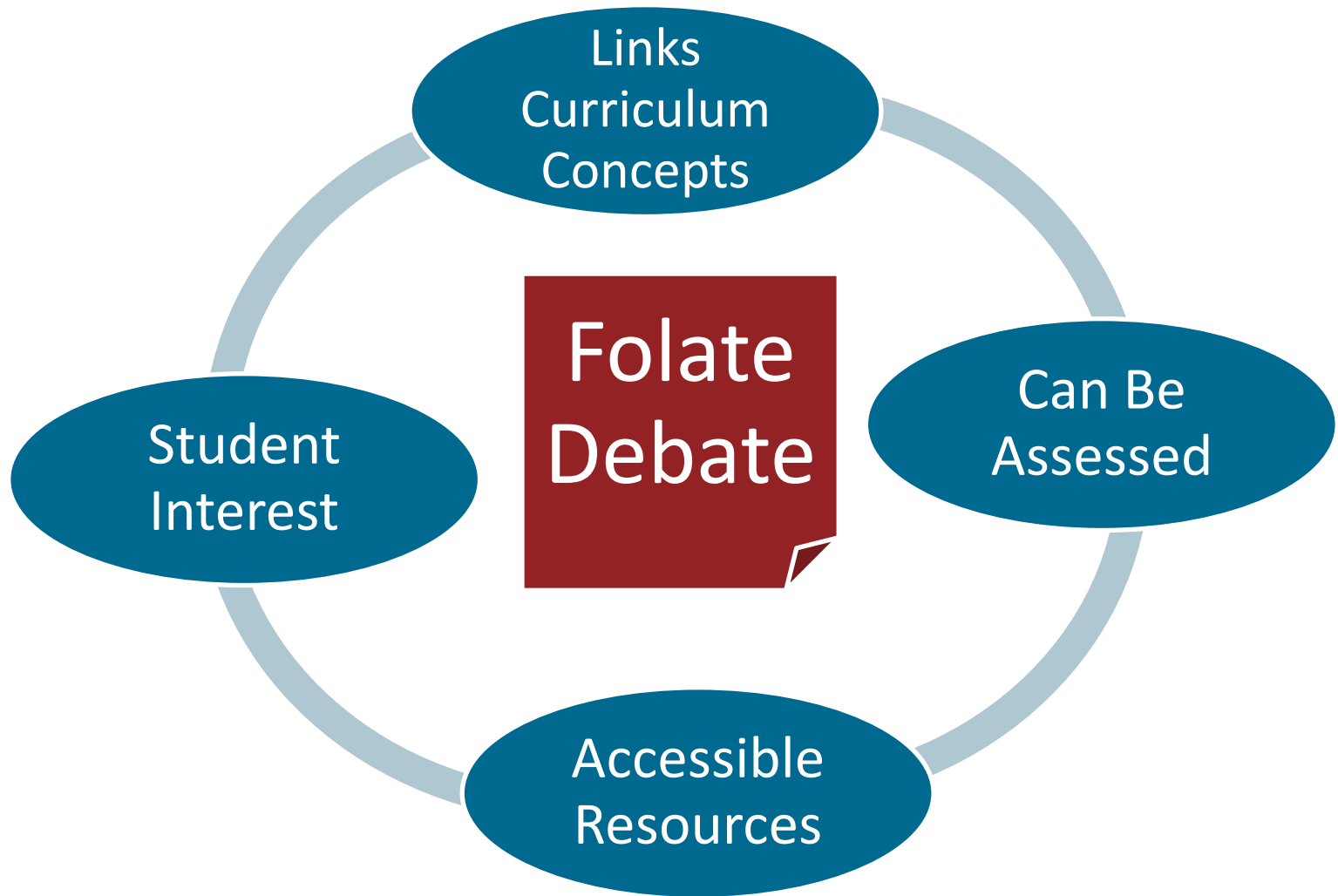
# Factors Influencing Choice of Teaching Context

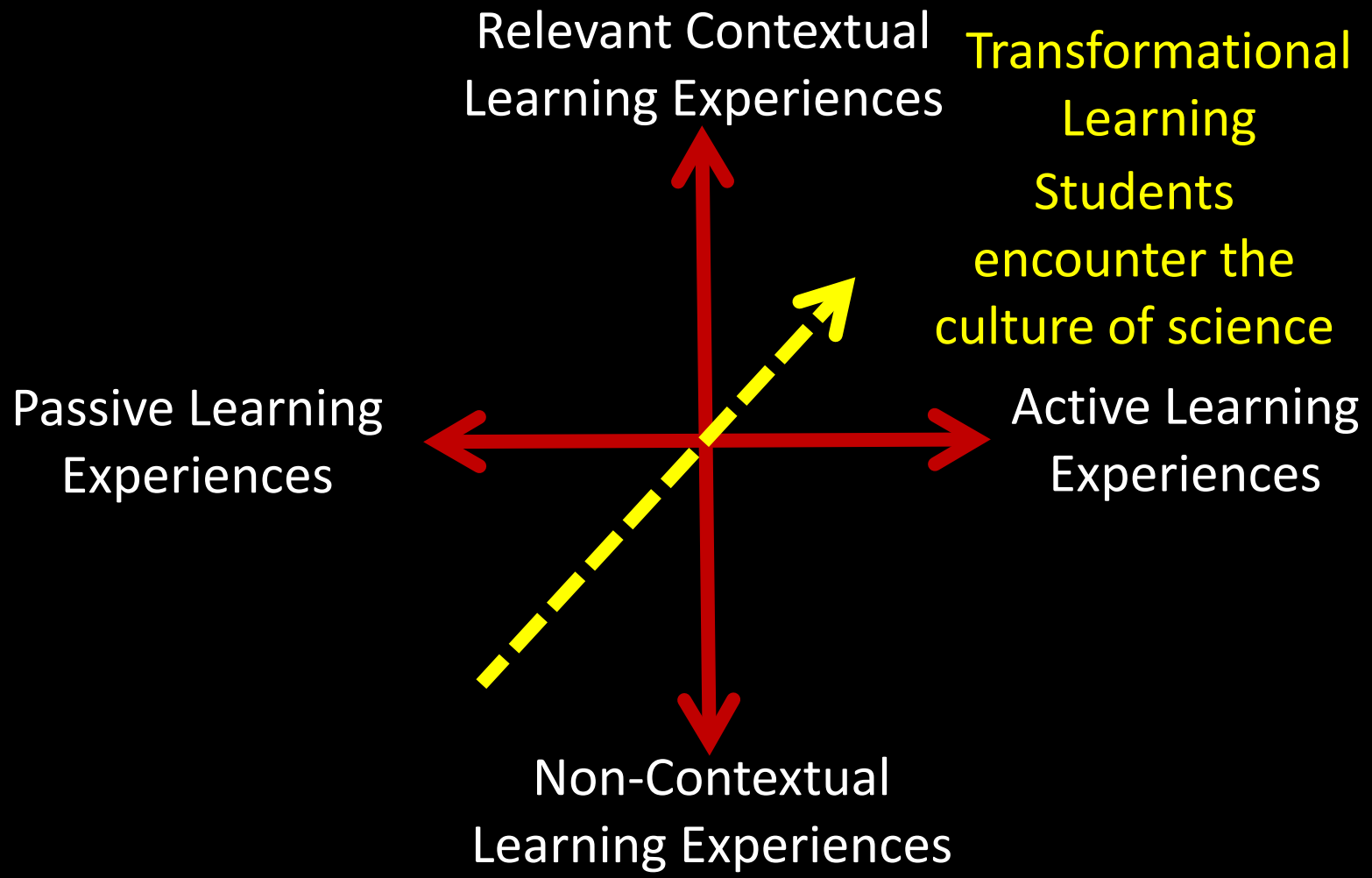
**Resource Access**

**Relevance to Society**

**Culture of Science**

**Curriculum**



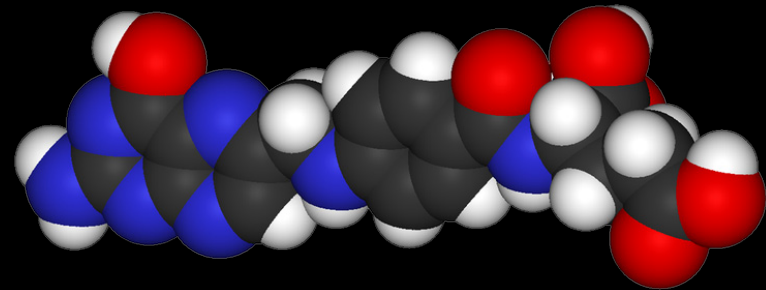


# The Folate Debate

- What is folate?
- Why do we need folate in the diet?
- Why do some people need more than others?
- Folic acid fortification – an easy or complex answer?



# Folate



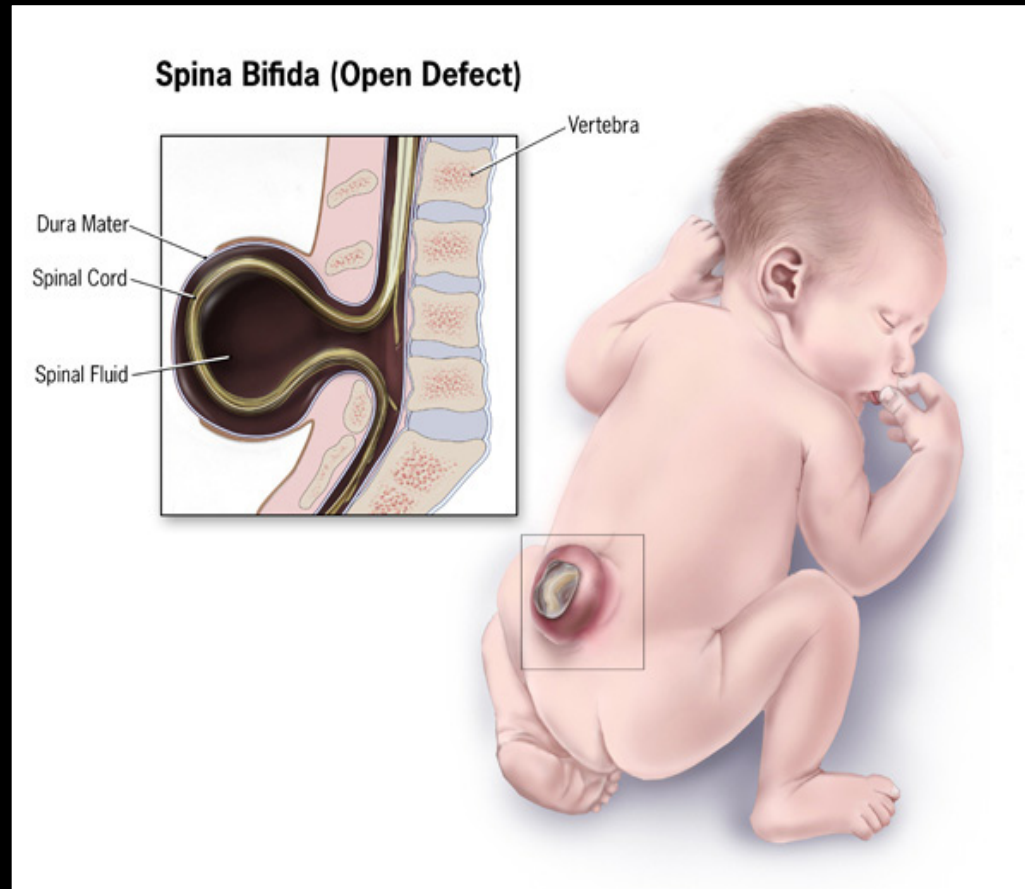
- B-group Vitamin
- Source – diet (cannot be synthesised within the human body)
- Essential for synthesis of nucleic acids
- Enzyme co-factor
- Involved in synthesis, function, and repair of DNA

# Where is folate found in the diet

- Green Vegetables
- Citrus Fruits
- Dietary Supplements
- Whole Grain Cereals & Breads
- Nuts and Pulses



# Folate and Neural Tube Defects

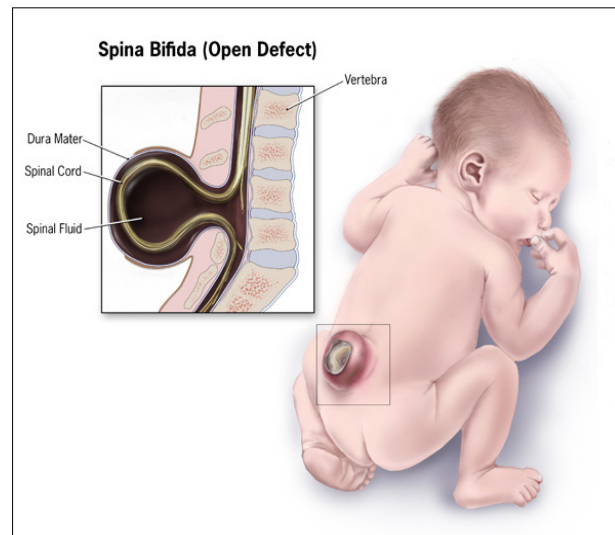


# Folate and Neural tube Defects

- ~50 NZ children per year born or terminated with NTD
- US ~ 4,000 neural tube defects per year(Live births, ignores terminations)
- Occur at 26-28 days post-conception
- 95% are spontaneous with no family history
- 1991 UK study showed 71% risk reduction in recurrences (4mg dose) (ref)
- In 1999 US Study 85% reduction in risk for primary prevention (0.4mg dose) (Nov 1999 NEJM)

# Neural Tube Defects are not the only issue

- Cardiovascular Disease
- Cancer
- Brain Health



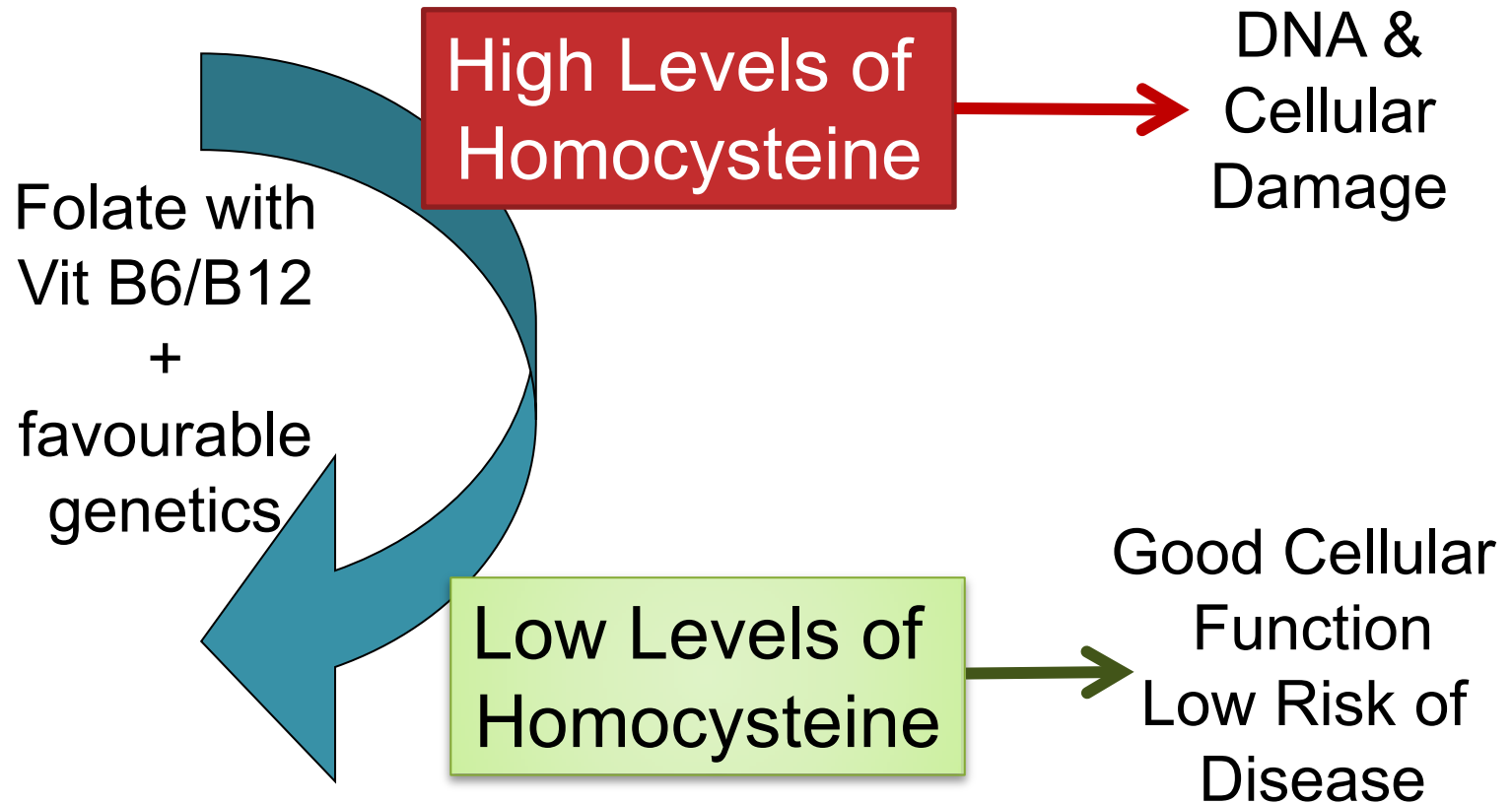
# Biomarkers as risk indicators

High Levels of  
Homocysteine

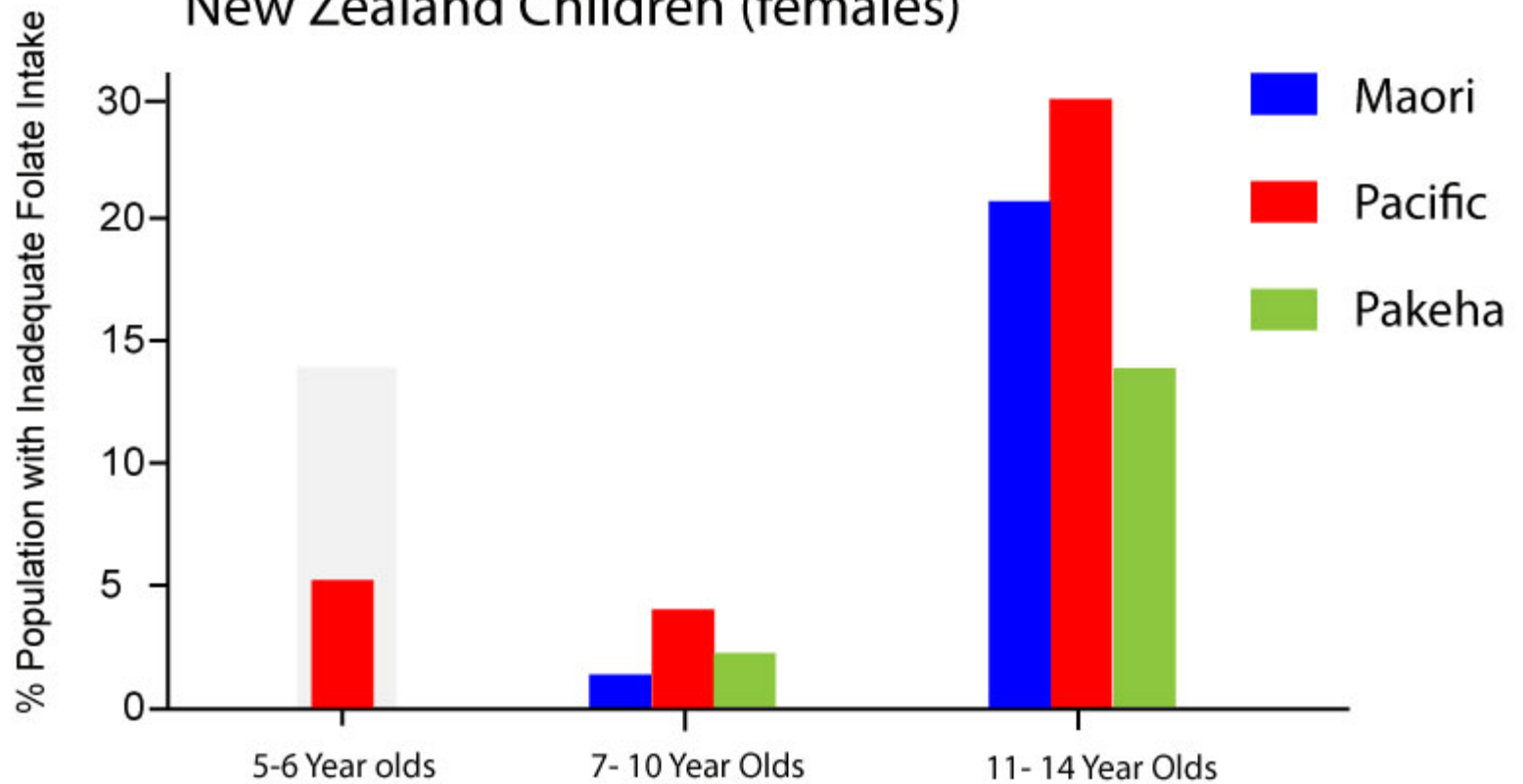


- Premature Atherosclerotic Heart Disease
- Cancer
- Brain Health

# Biomarkers as risk indicators



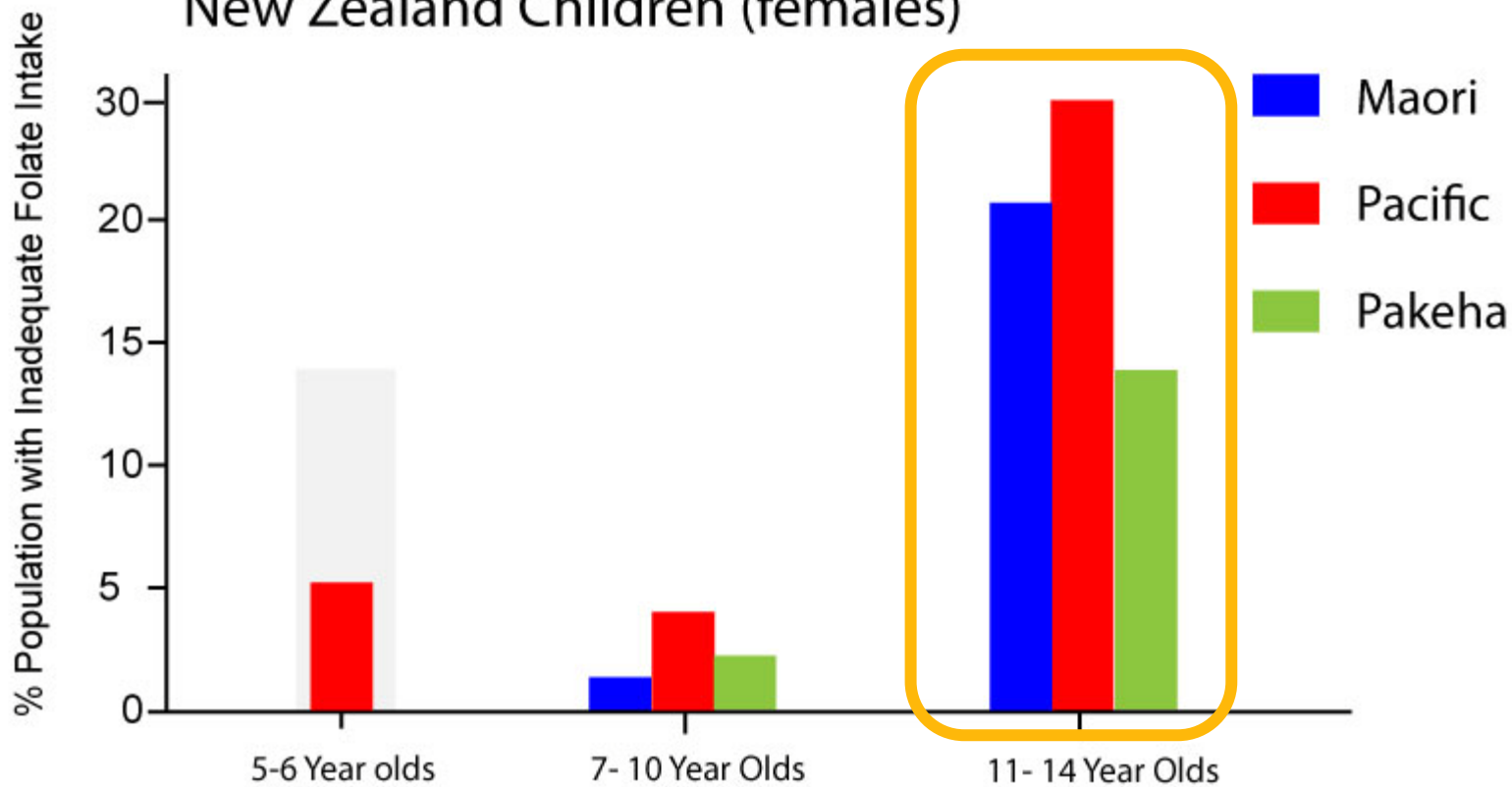
## Prevalence of inadequate folate intake in New Zealand Children (females)



2002 National Childrens Nutrition Survey (MoH)

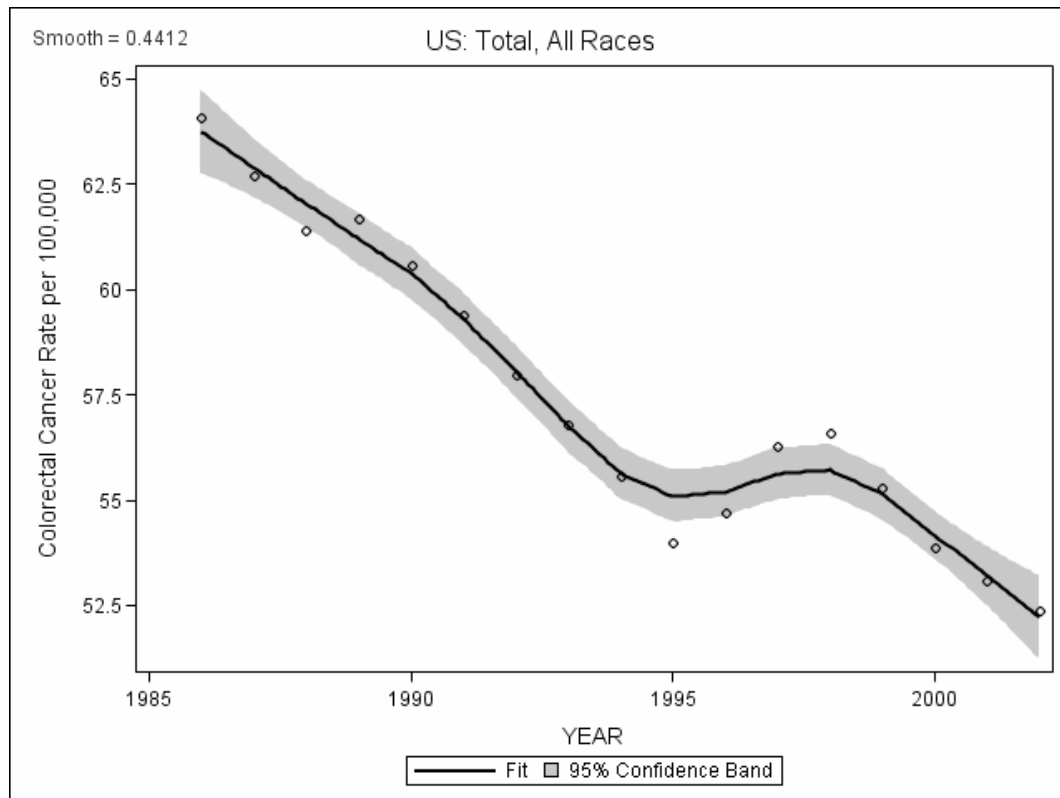


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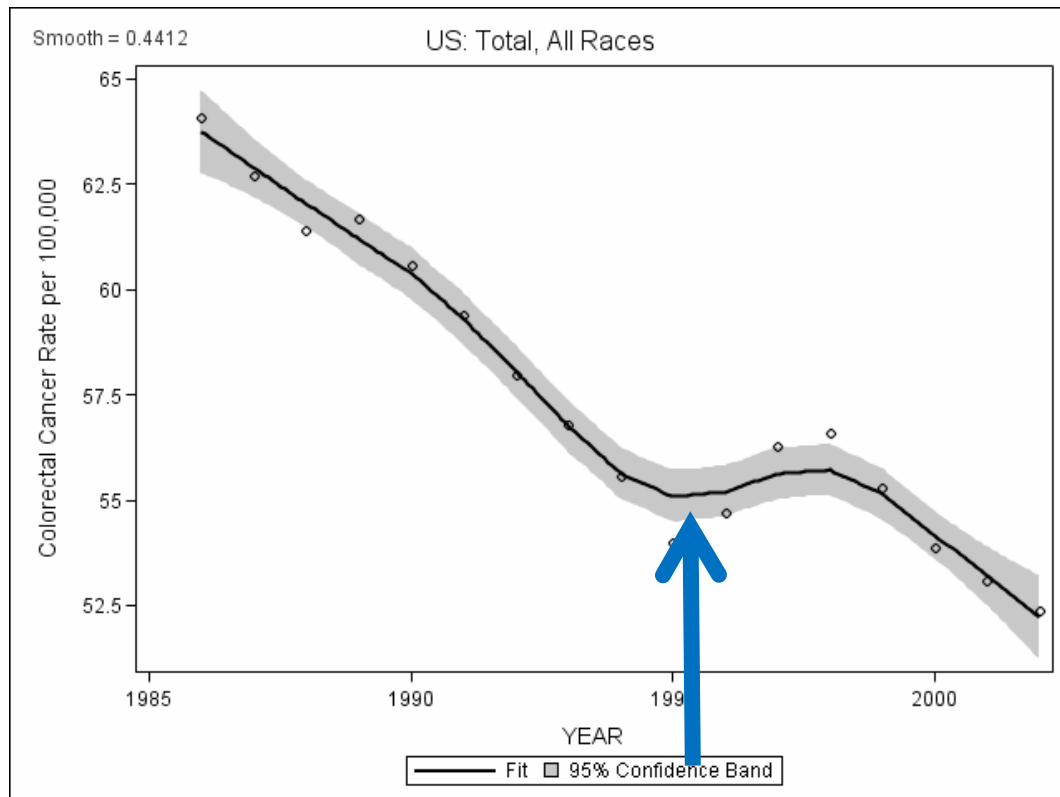
2002 National Childrens Nutrition Survey (MoH)

# Age-adjusted U.S.A. colorectal cancer incidence, 1996-2002, SEER database



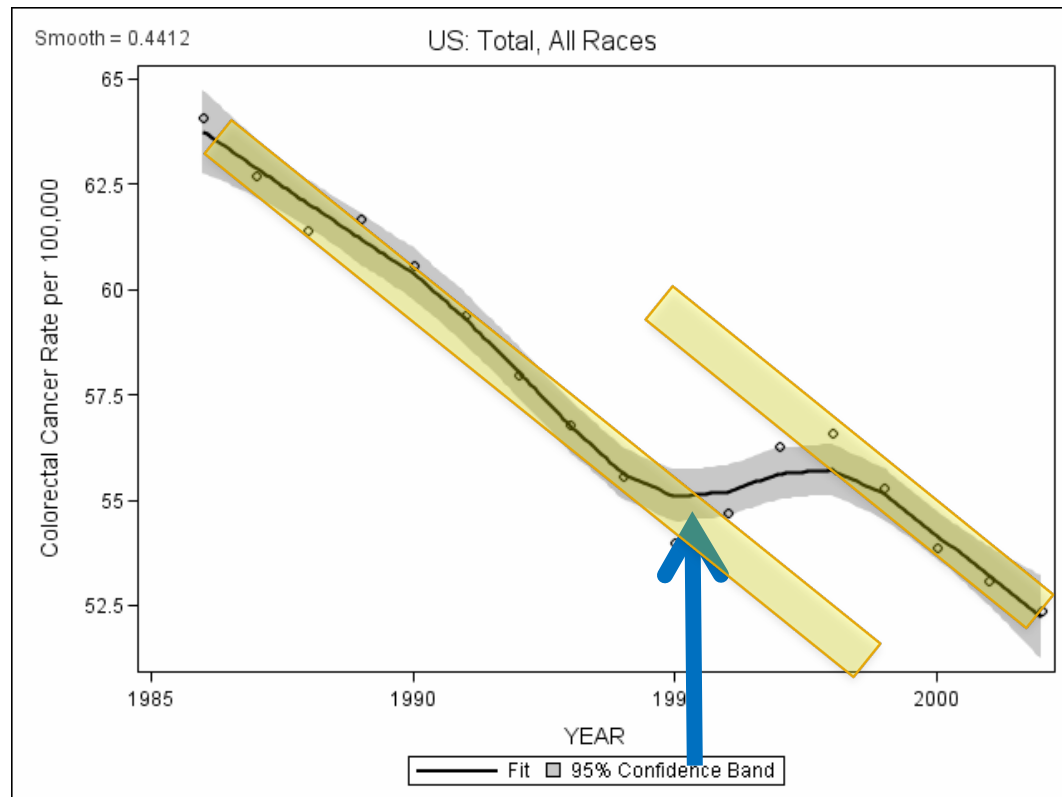
*Cancer Epidemiol Biomarkers Prevent 2007;16: 1325-9*

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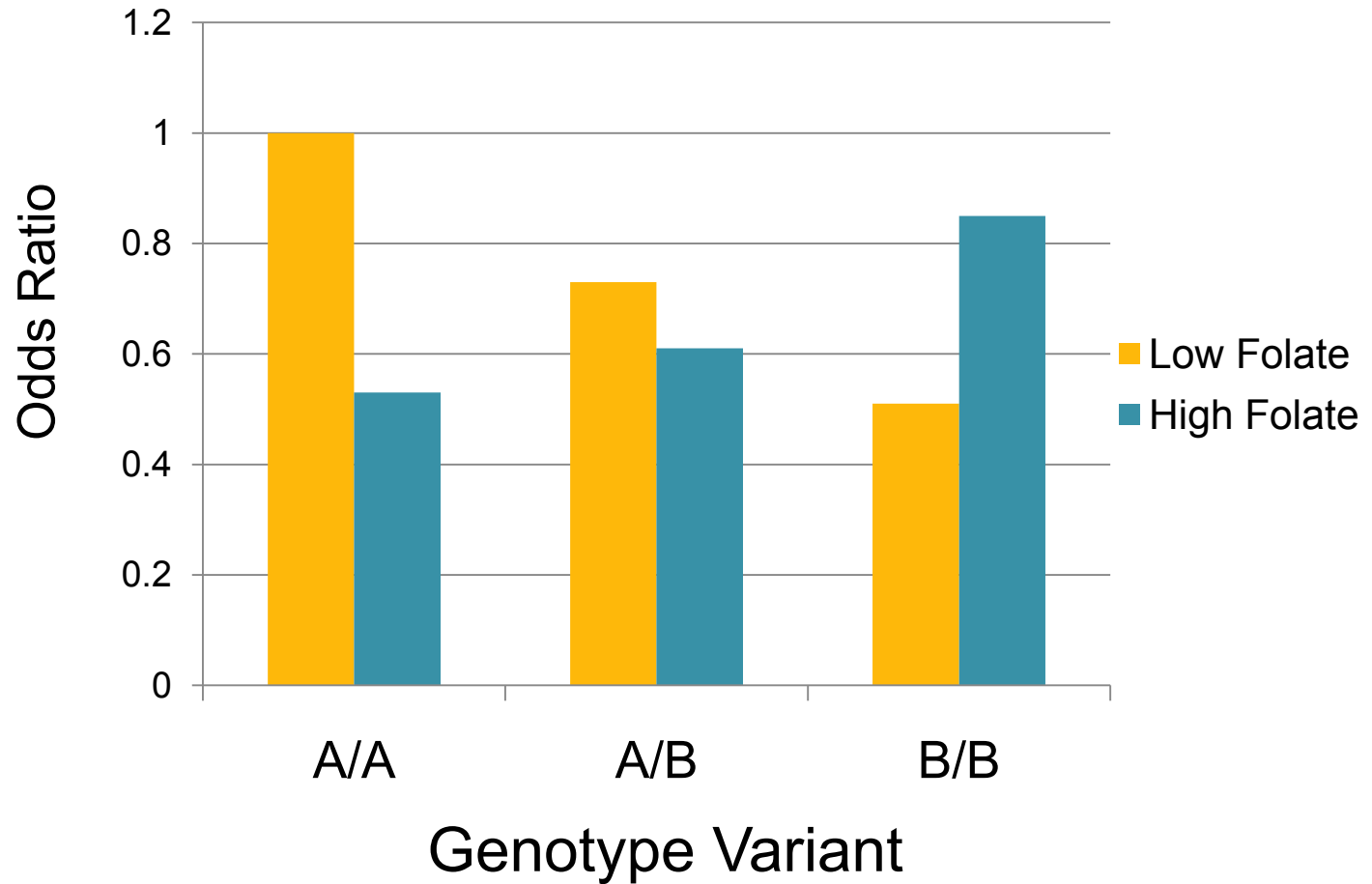
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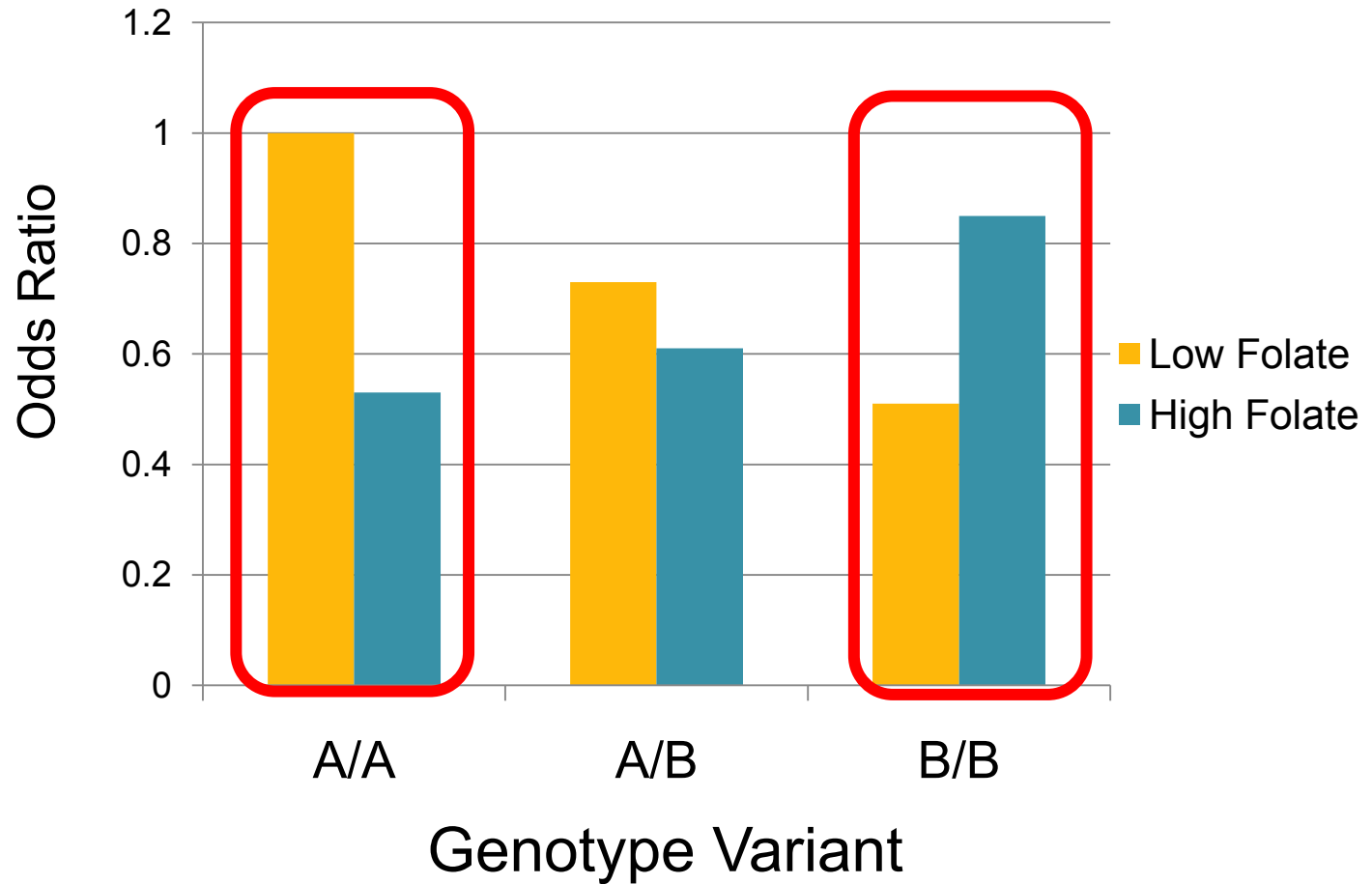


*Cancer Epidemiol Biomarkers Prevent 2007;16: 1325-9*

## TSER polymorphism and folate intake

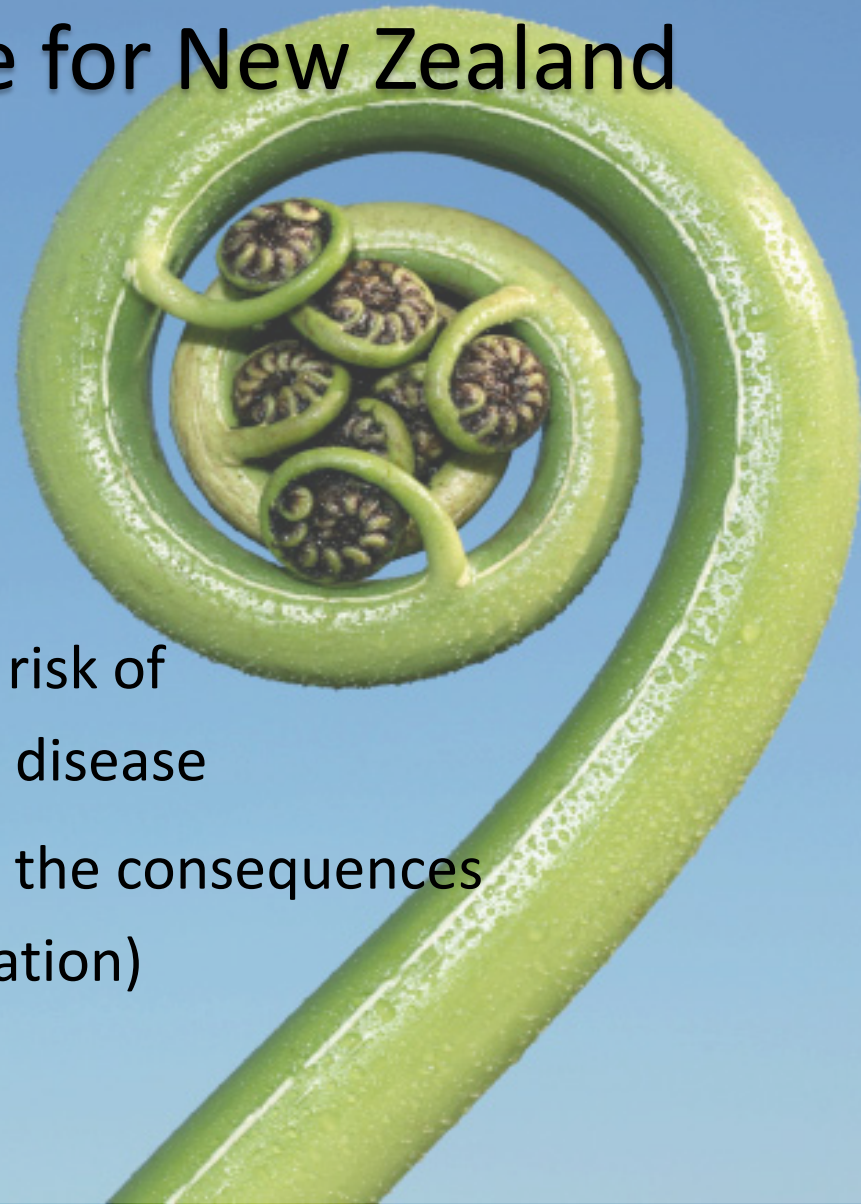


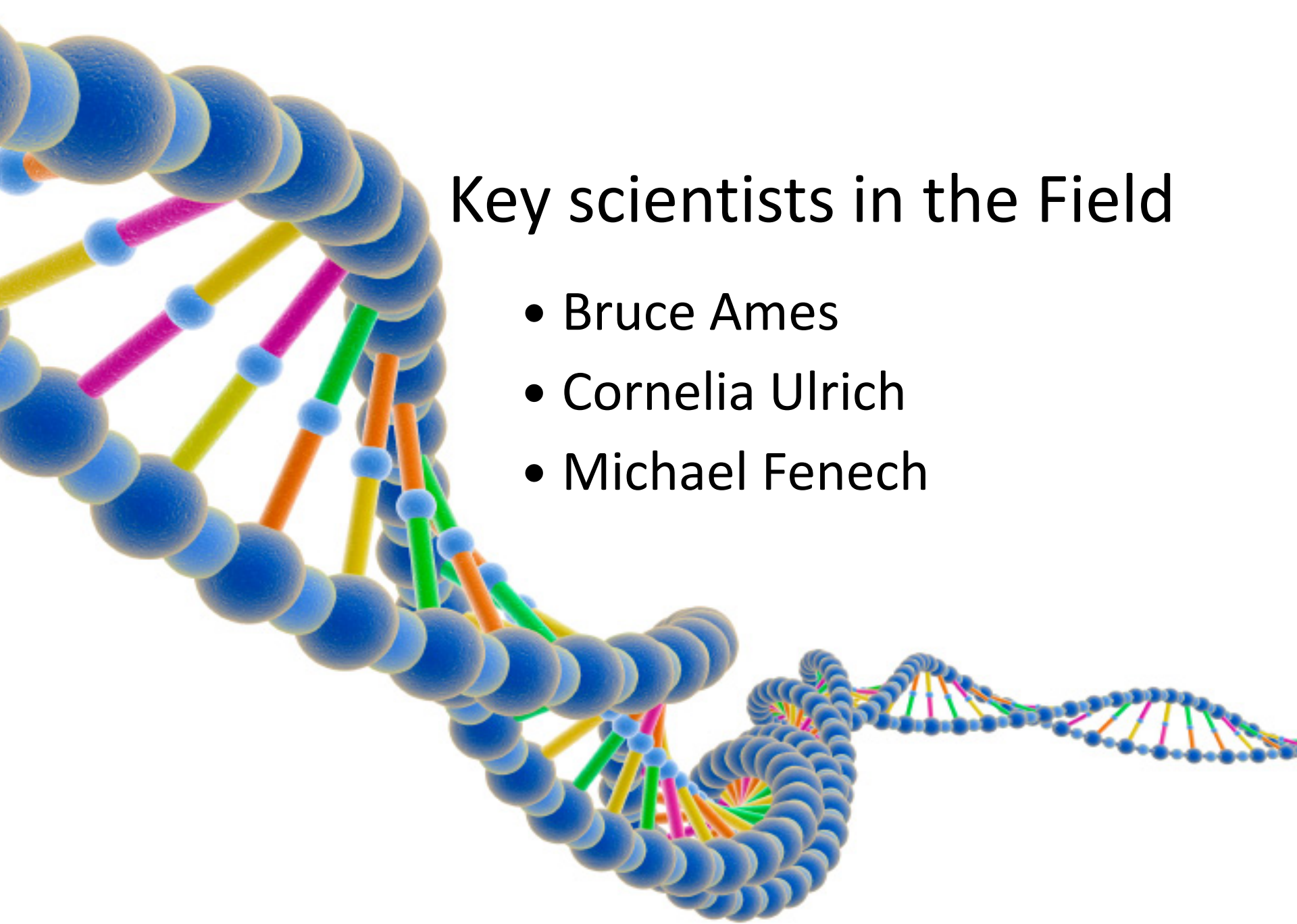
## TSER polymorphism and folate intake



# A controversial issue for New Zealand

- Bakers and Millers
- Traditional Dieticians
- Clinicians
- Free choice
- People and families at high risk of dementia or cardiovascular disease
- Families who have suffered the consequences of NTD (Children or Termination)





## Key scientists in the Field

- Bruce Ames
- Cornelia Ulrich
- Michael Fenech



# Curriculum, Assessment and Support

- Curriculum
  - Nature of Science
  - Living World
- Assessment
  - AS 90714
  - AS 90769
- Resource Support





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Writers / Presenters

**Jacquie Bay; Michal Denny; Lynn Ferguson**

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