

Nutrition and chromosome health in kids

Nathan O'Callaghan

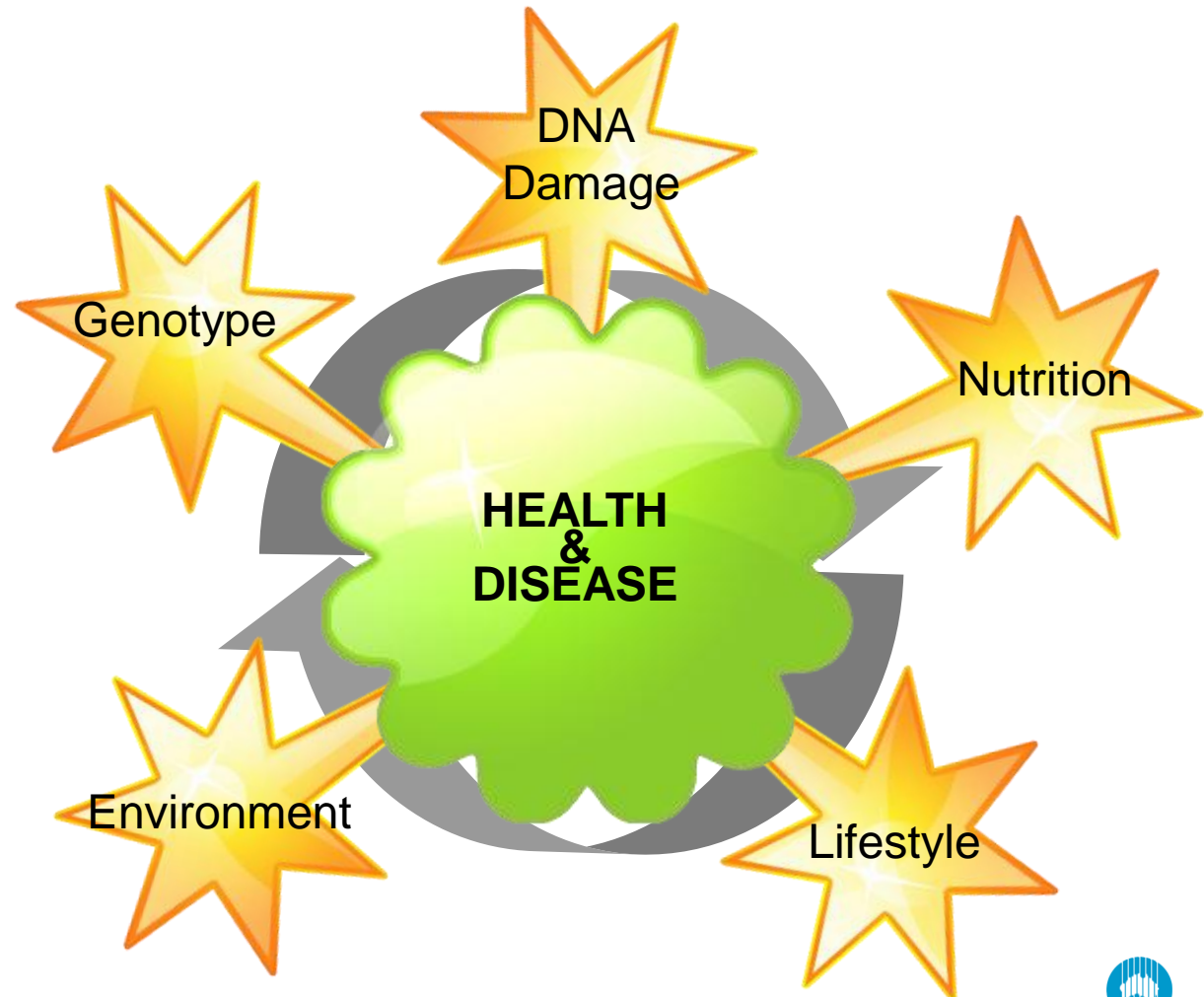
Nutritional Genomics & DNA Health Diagnostics

Food and Nutritional Sciences

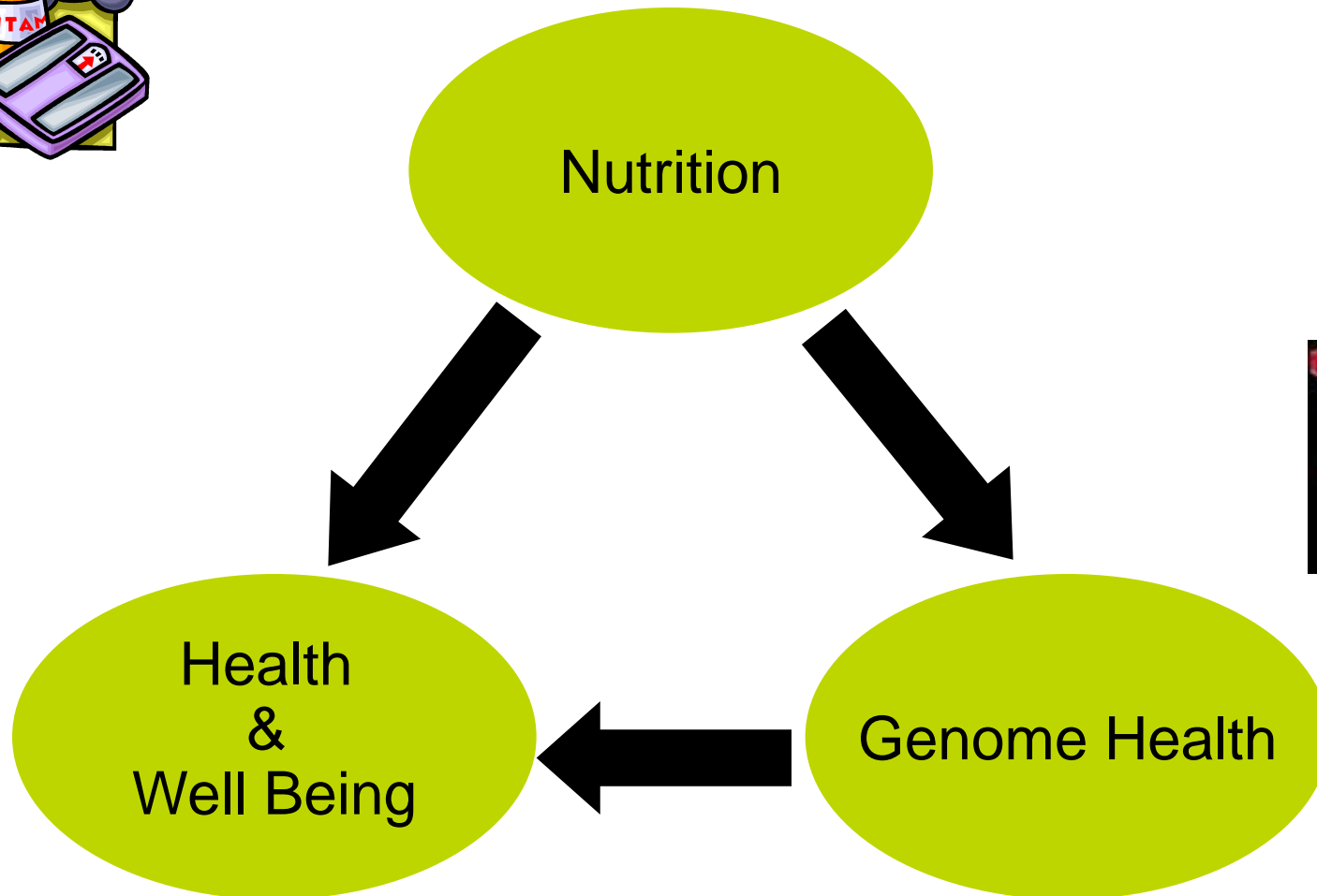


Overview

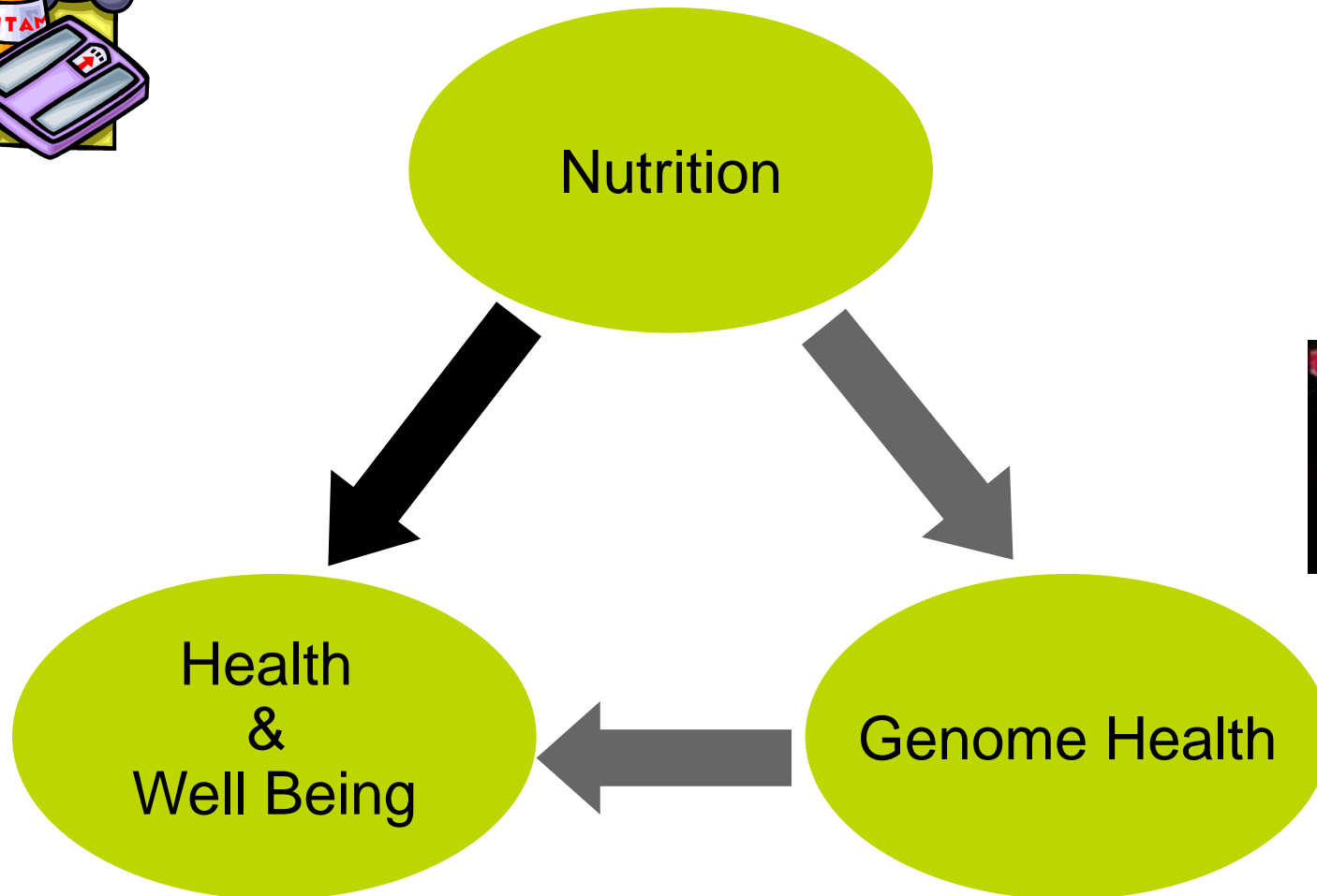
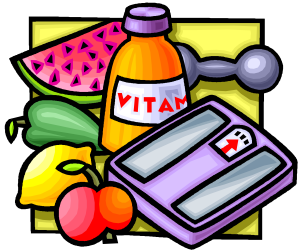
- Background
 - Nutrition and health
 - Chromosome health
 - Evidence for nutrition affecting DNA
- Genome health and nutrient status in children
- Knowledge gaps
- Future



Nutrition, health and DNA



Nutrition, health and DNA



Nutrition and Health

Food for health

Dietary Guidelines for Children and Adolescents

Encourage and support breastfeeding

Children and adolescents need sufficient nutritious foods to grow and develop normally

- Growth should be checked regularly for young children
- Physical activity is important for all children and adolescents

Enjoy a wide variety of nutritious foods

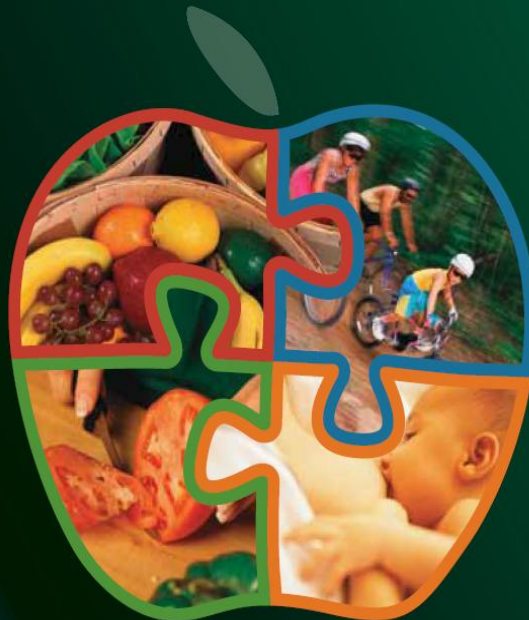
Children and adolescents should be encouraged to:

- Eat plenty of vegetables, legumes and fruits
- Eat plenty of cereals (including breads, rice, pasta and noodles), preferably wholegrain
- Include lean meat, fish, poultry and/or alternatives
- Include milks, yoghurts, cheeses and/or alternatives. Reduced-fat milks are not suitable for young children under 2 years, because of their high energy needs, but reduced-fat varieties should be encouraged for older children and adolescents
- Choose water as a drink

and care should be taken to:

- Limit saturated fat and moderate total fat intake. Low-fat diets are not suitable for infants
- Choose foods low in salt
- Consume only moderate amounts of sugars and foods containing added sugars

Care for your child's food: prepare and store it safely



Australian Government
Department of Health and Ageing
National Health and Medical Research Council

Materials including a booklet and brochure for the general public and nutrition educators are available by contacting the Population Health Publications Officer, Australian Government Department of Health and Ageing, on toll free 1800 020 103 extension 8654 or email phd.publications@health.gov.au



- * a step-by-step plan for giving kids a healthy start to life
- * train your child's tastebuds
- * over 100 recipes you and your children will love



the CSIRO wellbeing plan for kids

Dietary Guidelines for Australian Adults

Enjoy a wide variety of nutritious foods

- Eat plenty of vegetables
 - Eat plenty of cereals (bread and noodles), preferably wholegrain
 - Include lean meat, fish and/or alternatives
 - Include milks, yoghurts, cheeses and/or alternatives. Reduced-fat milks are not suitable for young children under 2 years, because of their high energy needs, but reduced-fat varieties should be encouraged for older children and adolescents
 - Drink plenty of water
- and take care to:
- Limit saturated fat and moderate total fat intake
 - Choose foods low in salt
 - Limit your alcohol intake
 - Consume only moderate amounts of sugars and foods containing added sugars

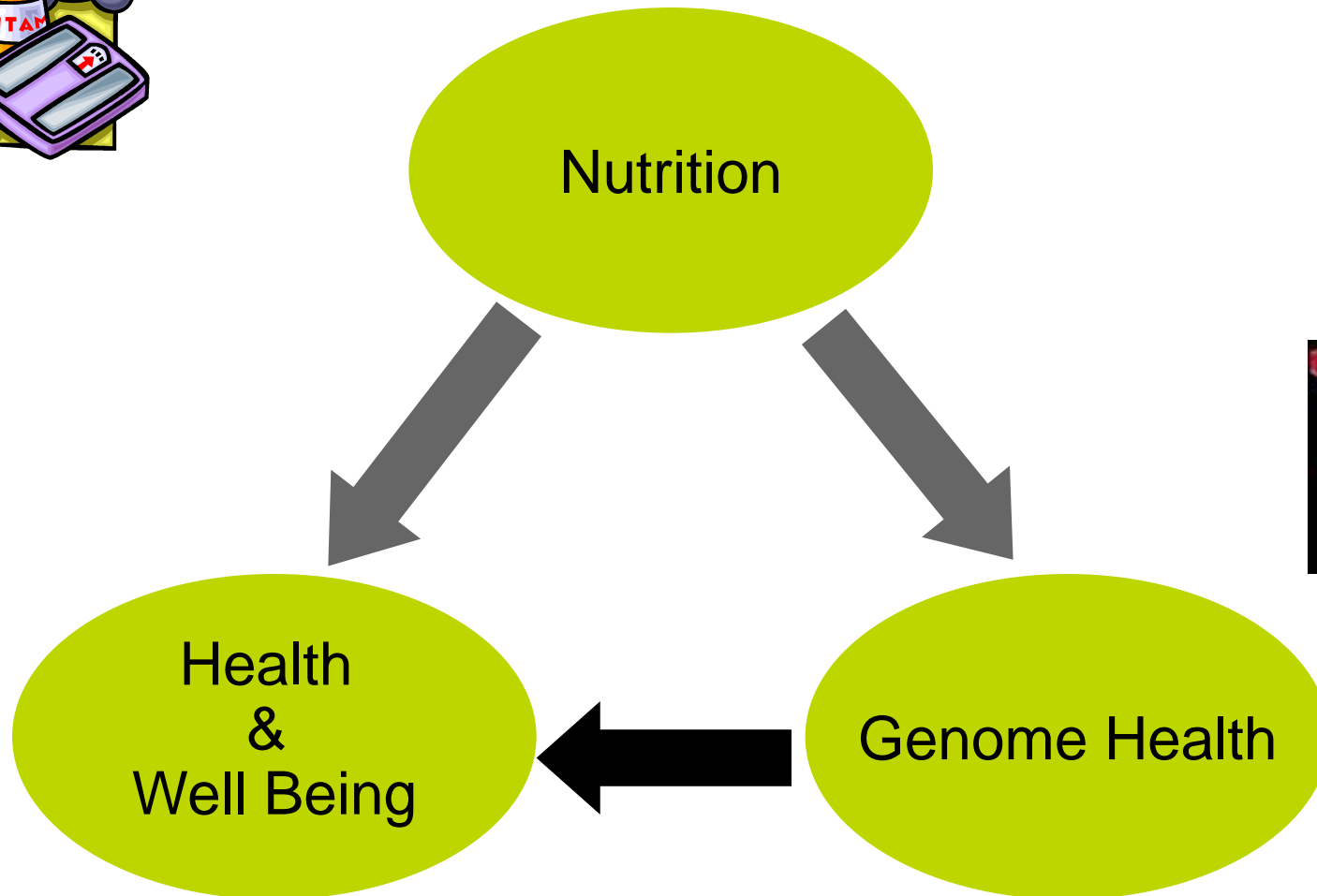
Prevent weight gain: be physically active and eat according to your energy needs

Care for your food: prepare and store it safely

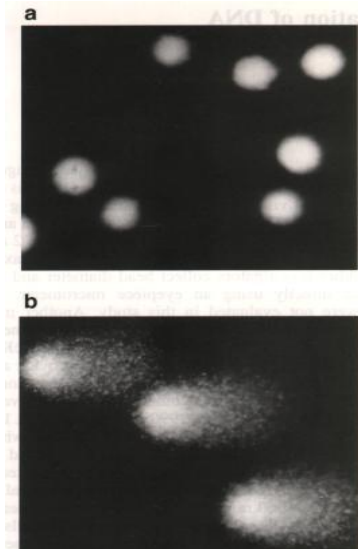
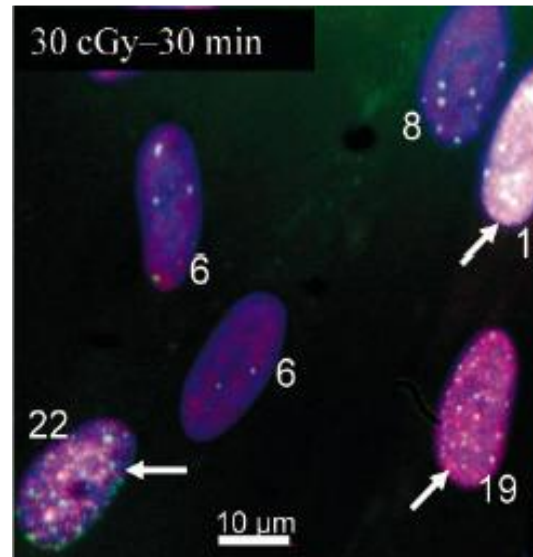
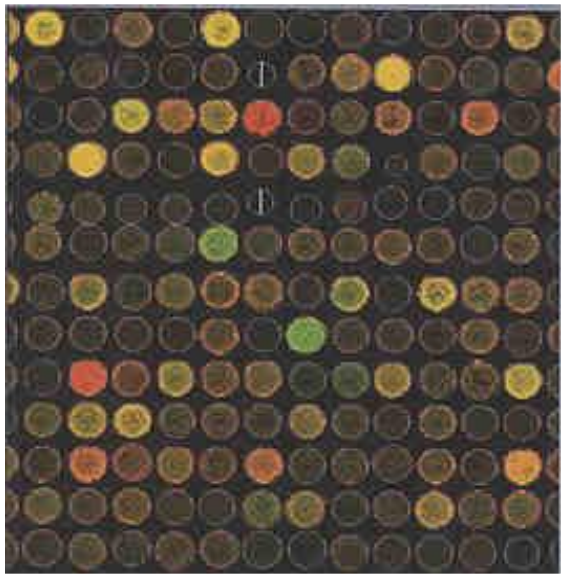
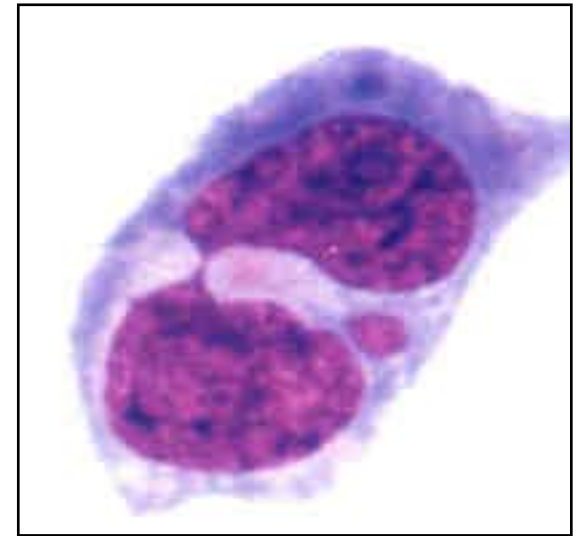
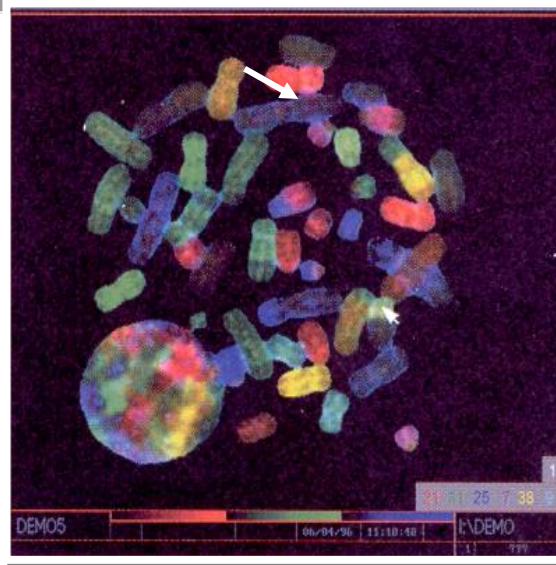
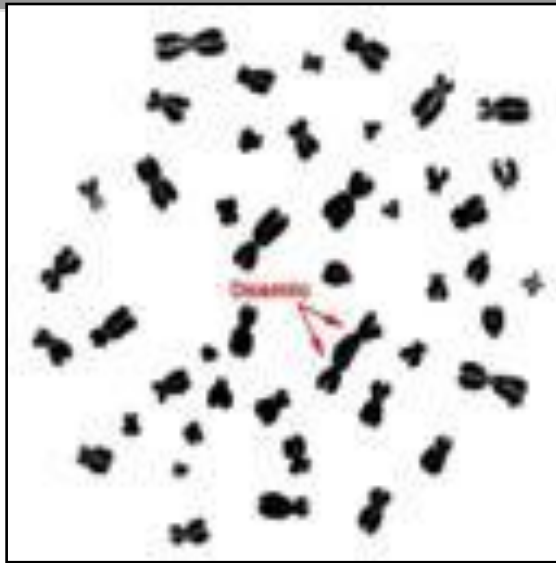
Encourage and support breastfeeding



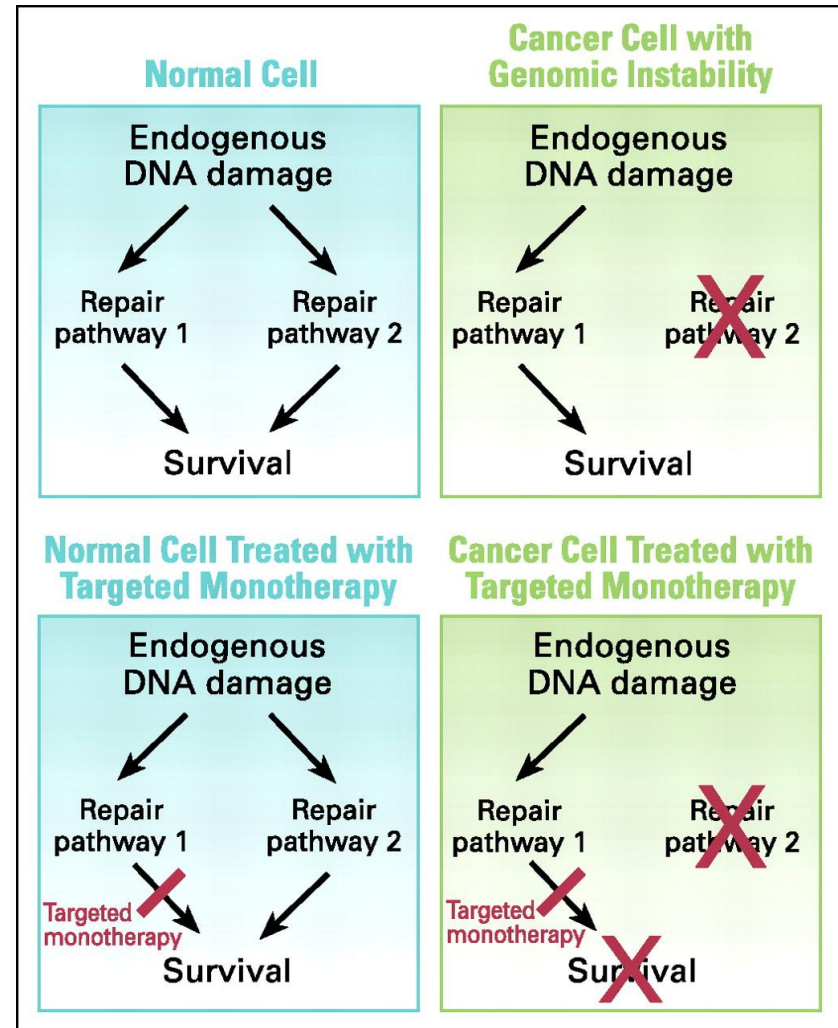
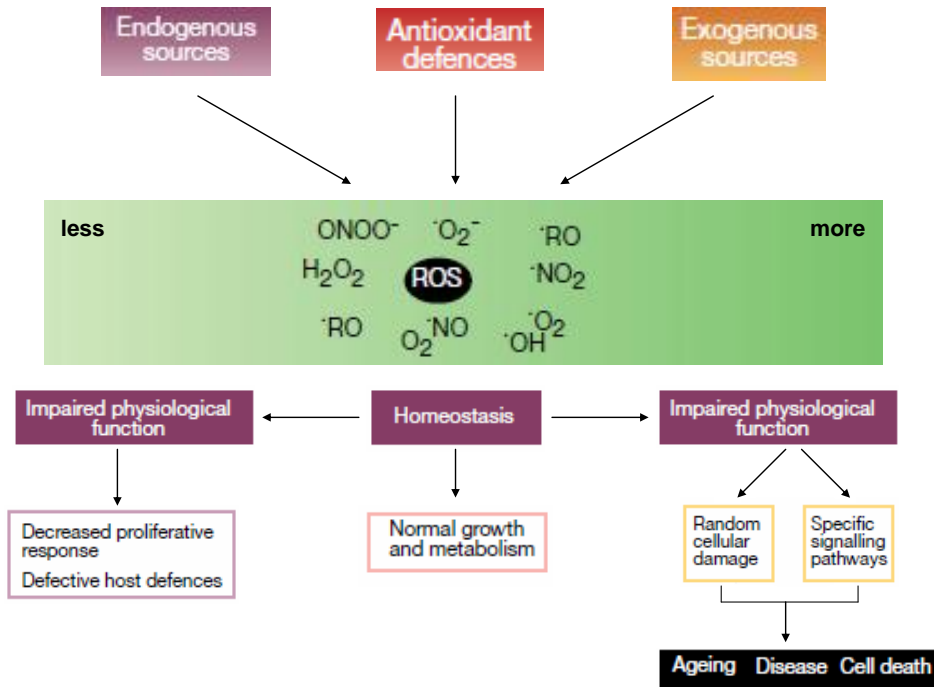
Nutrition, health and DNA



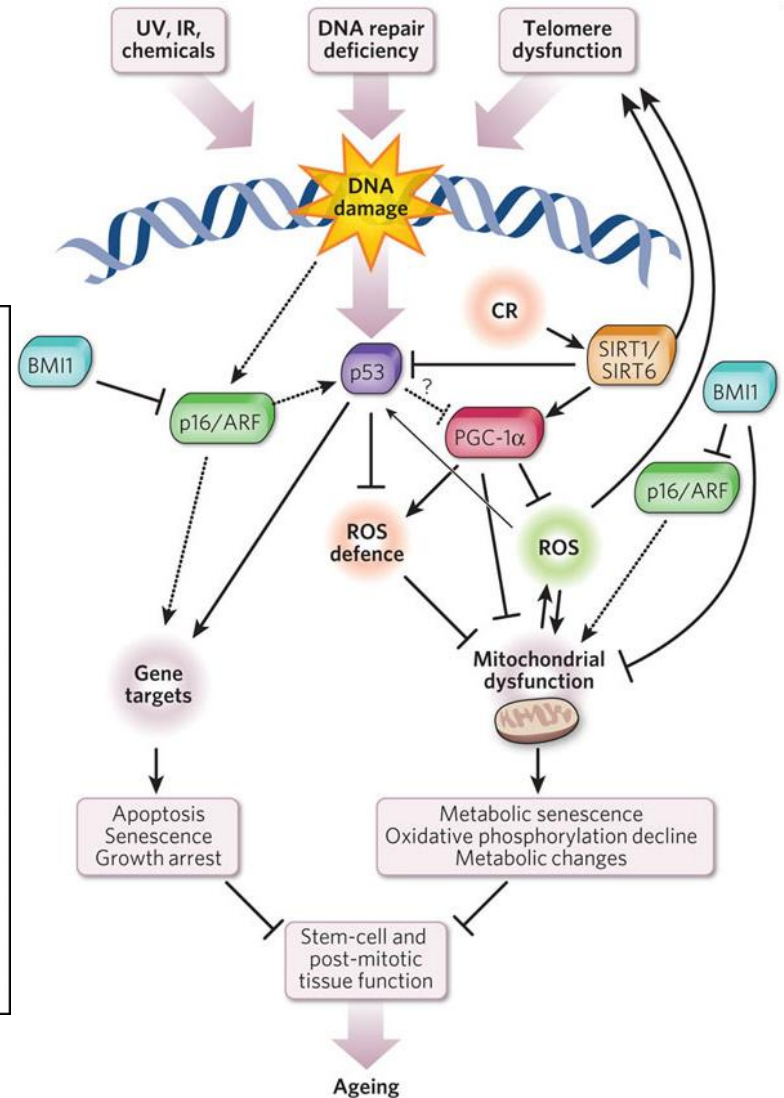
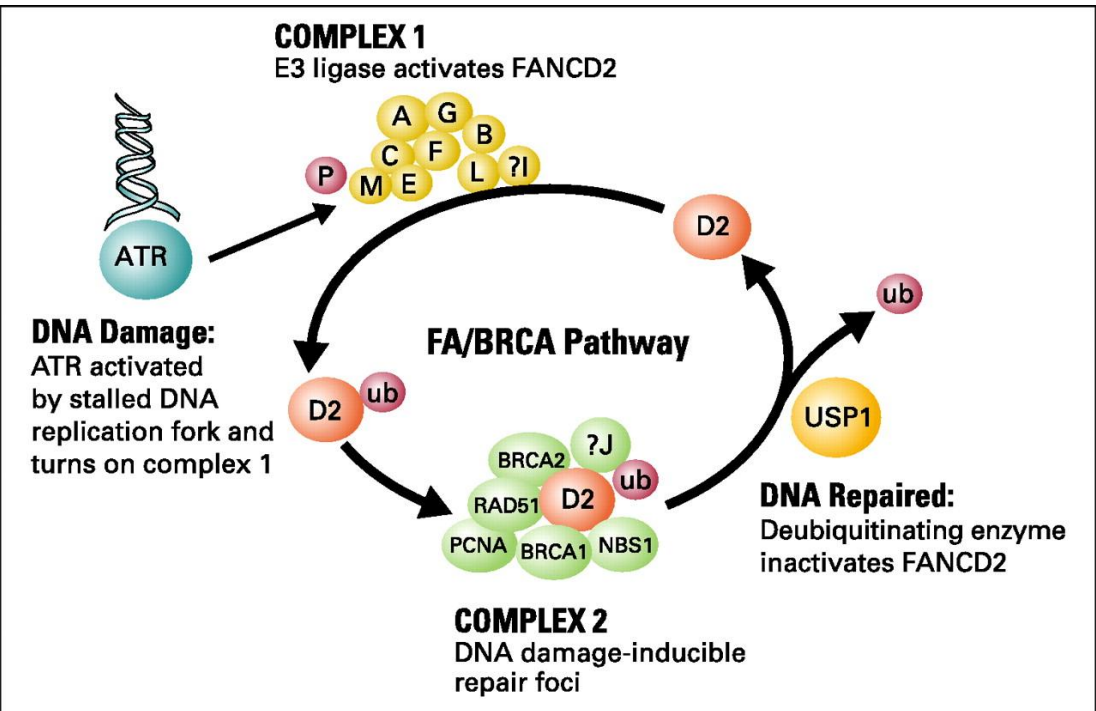
How to measure DNA damage



Sources of DNA damage

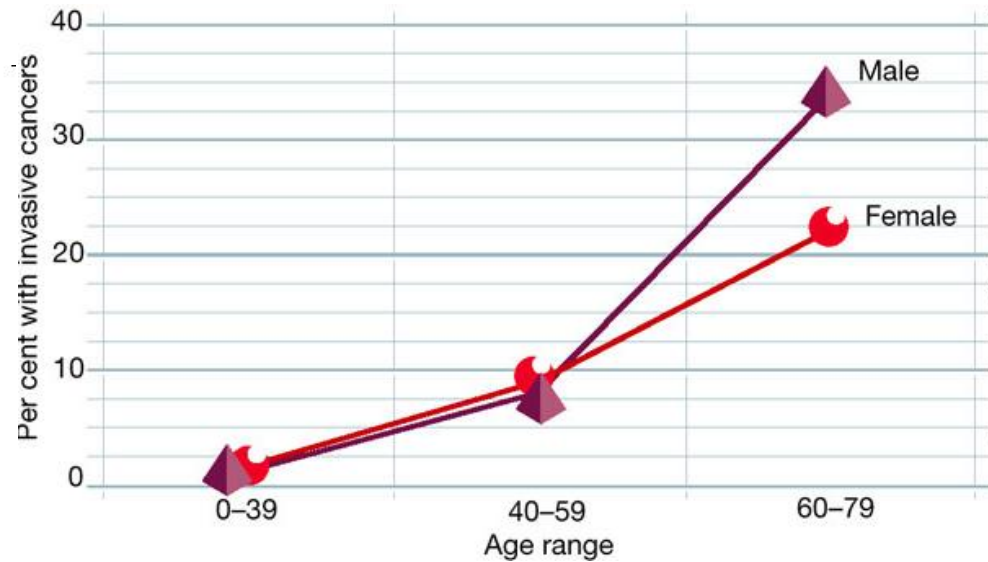
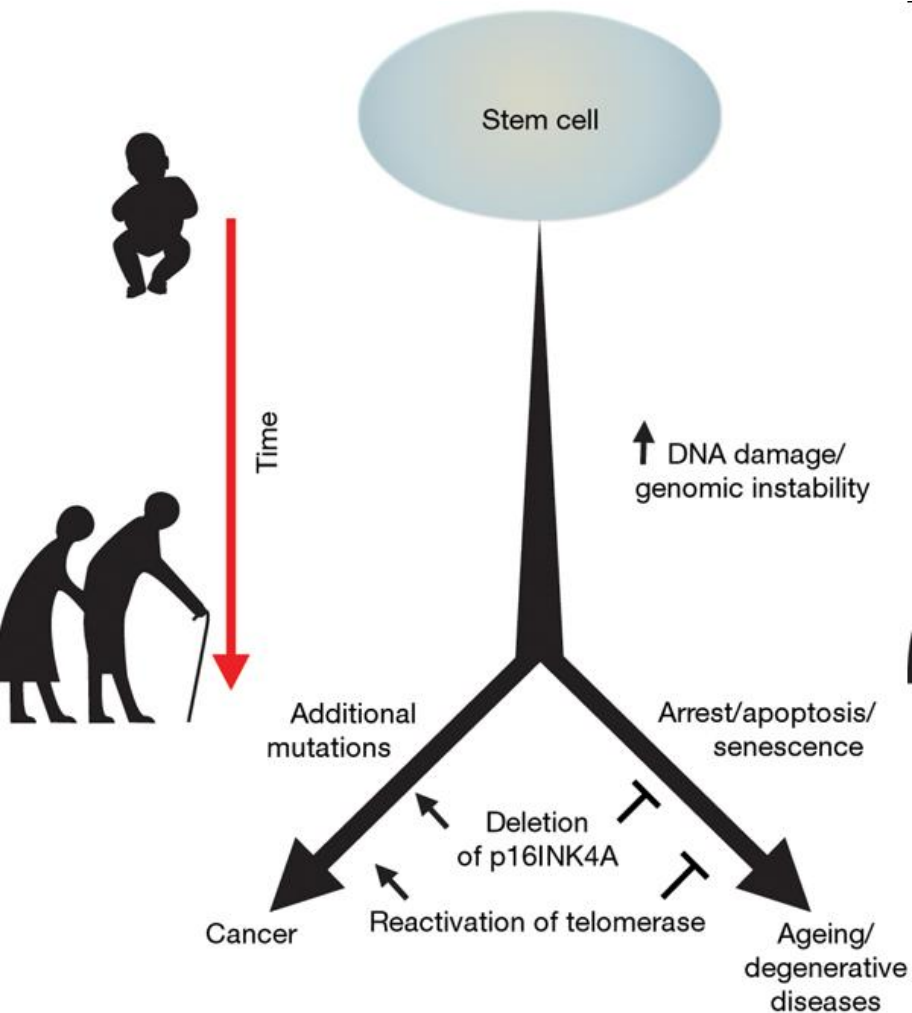


DNA damage *should* be transient

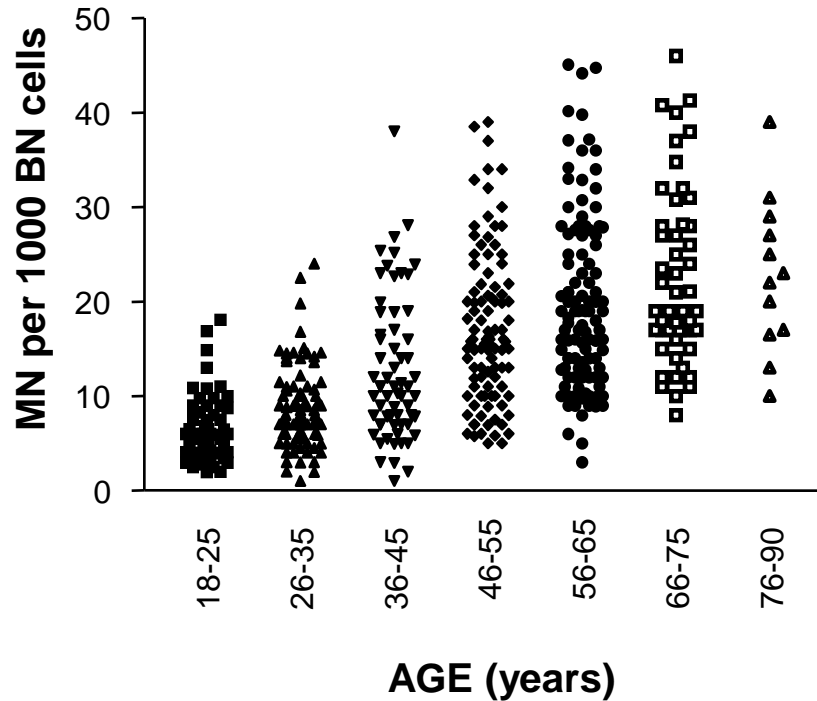
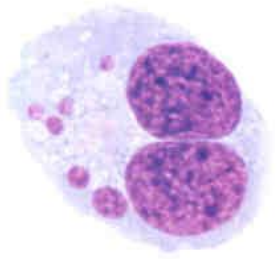


Kennedy R D , D'Andrea A D JCO 2006;24:3799-3808

DNA, ageing and disease



Genome damage increases with age

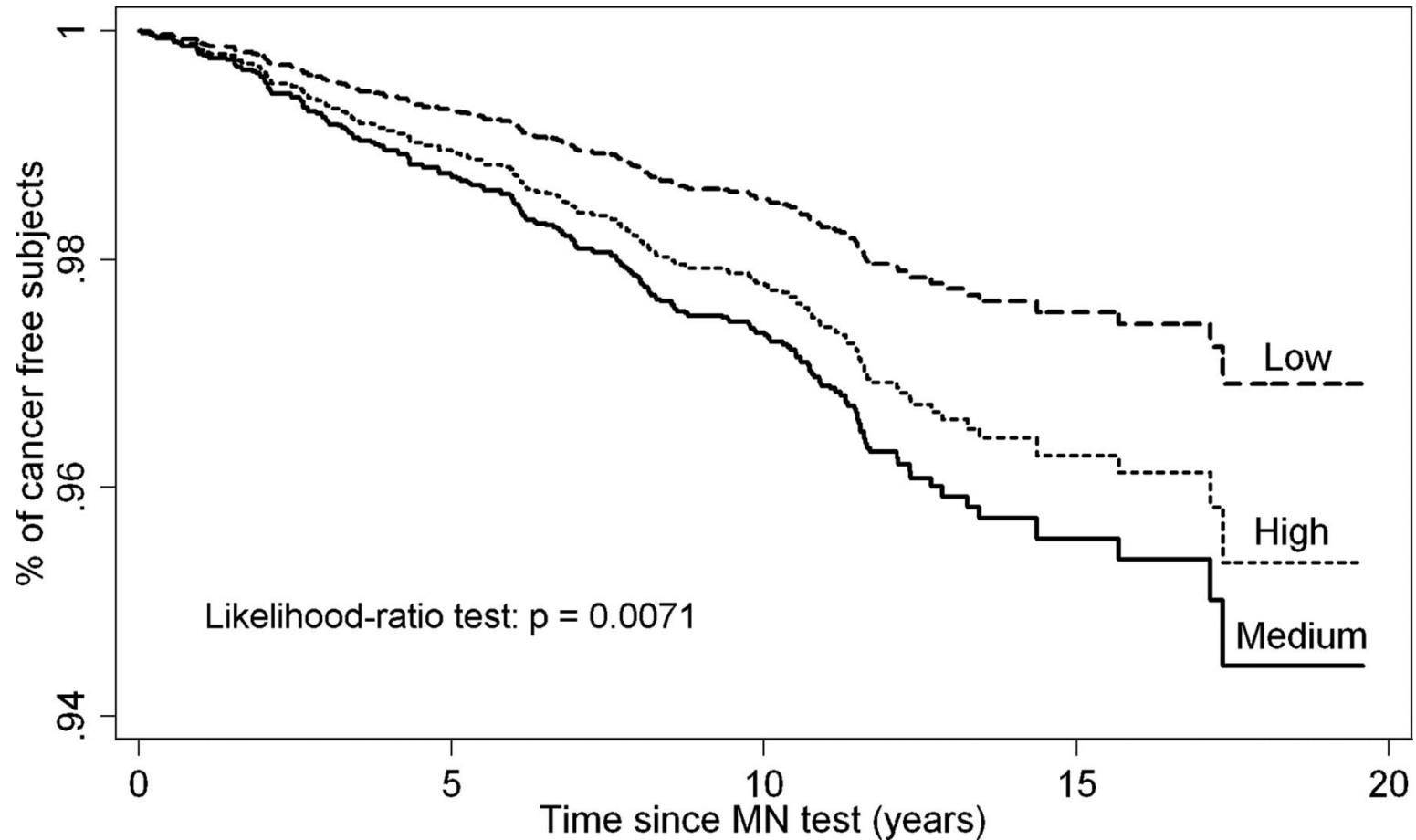


What are the nutrition, life-style and genetic variables that affect DNA damage?

Can we prevent the increase of DNA damage with age?

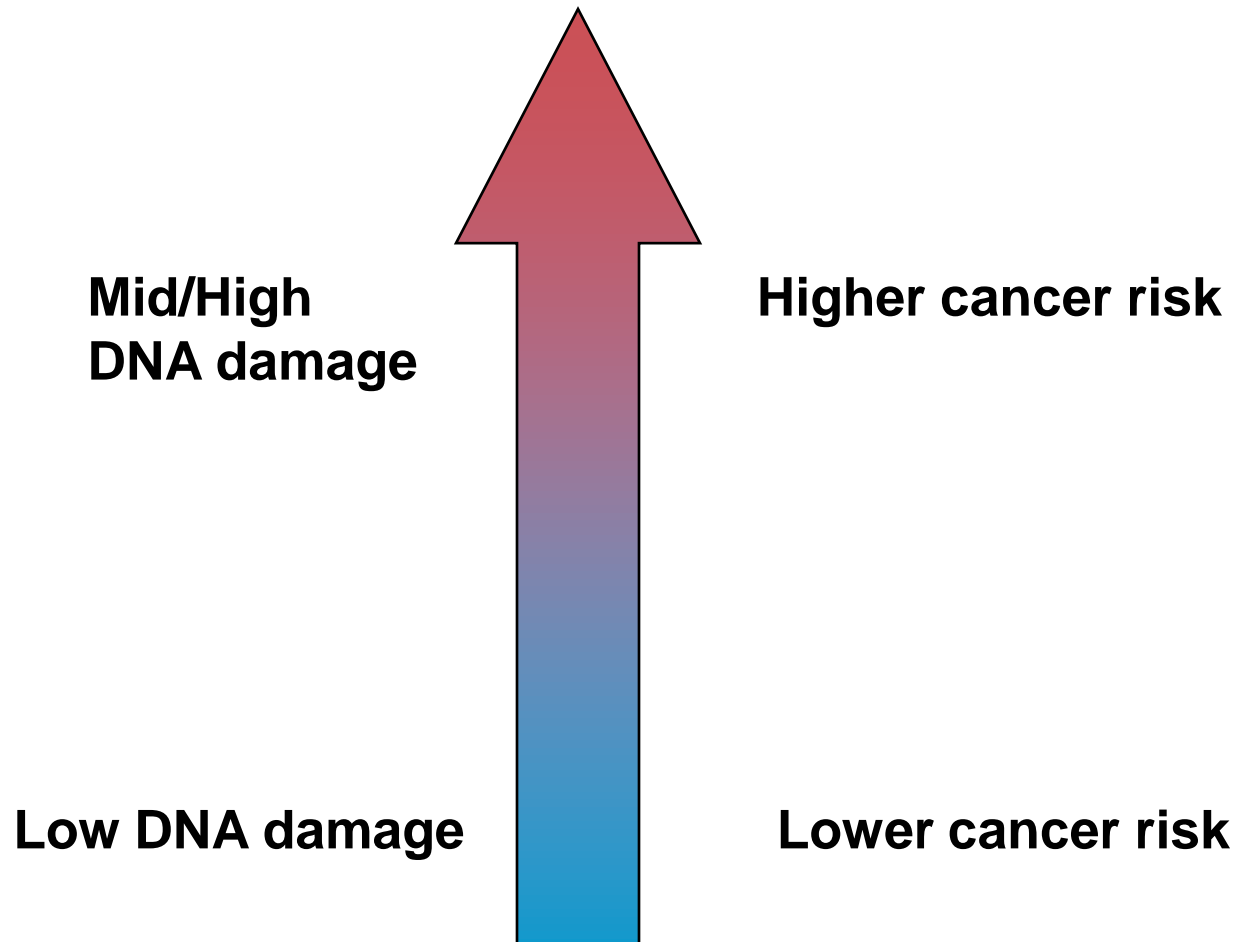
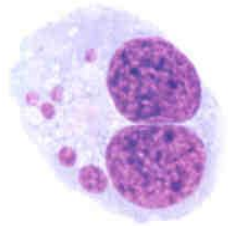
Fenech et al. 2000

DNA damage index predicts cancer risk



Bonassi, S. et al. *Carcinogenesis* 2007 28:625-631; doi:10.1093/carcin/bgl177

DNA damage index predicts cancer risk



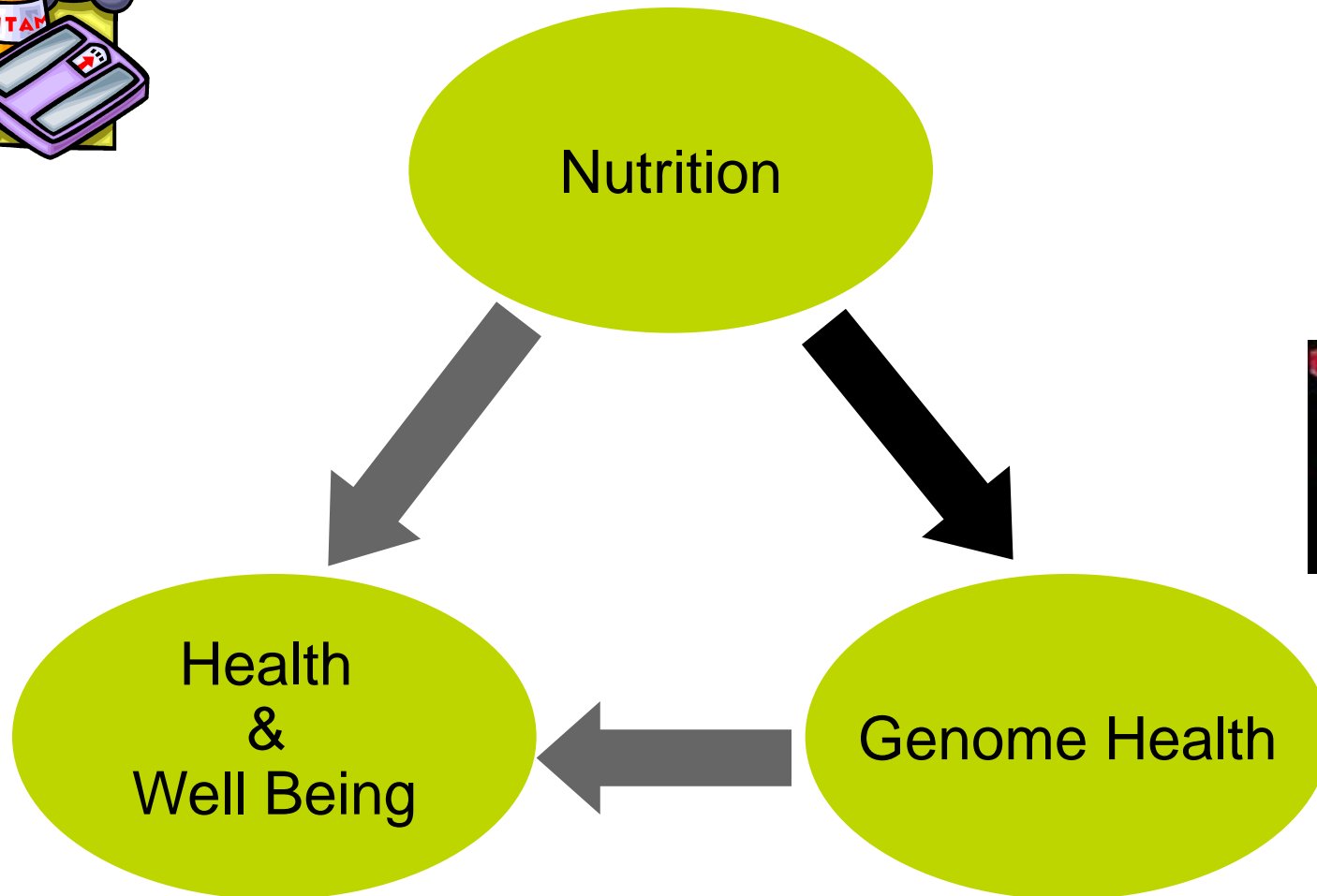
Genome health is modified by life-style factors

DNA damage accelerated by:

- Smoking
- Obesity and low physical activity
- Psychological stress
- Diet (inc. malnutrition)
- Environmental exposures
- Hours of sleep



Nutrition, health and DNA



Dietary impacts on DNA

Increase DNA damage are associated with:

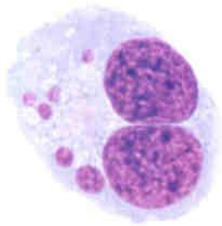
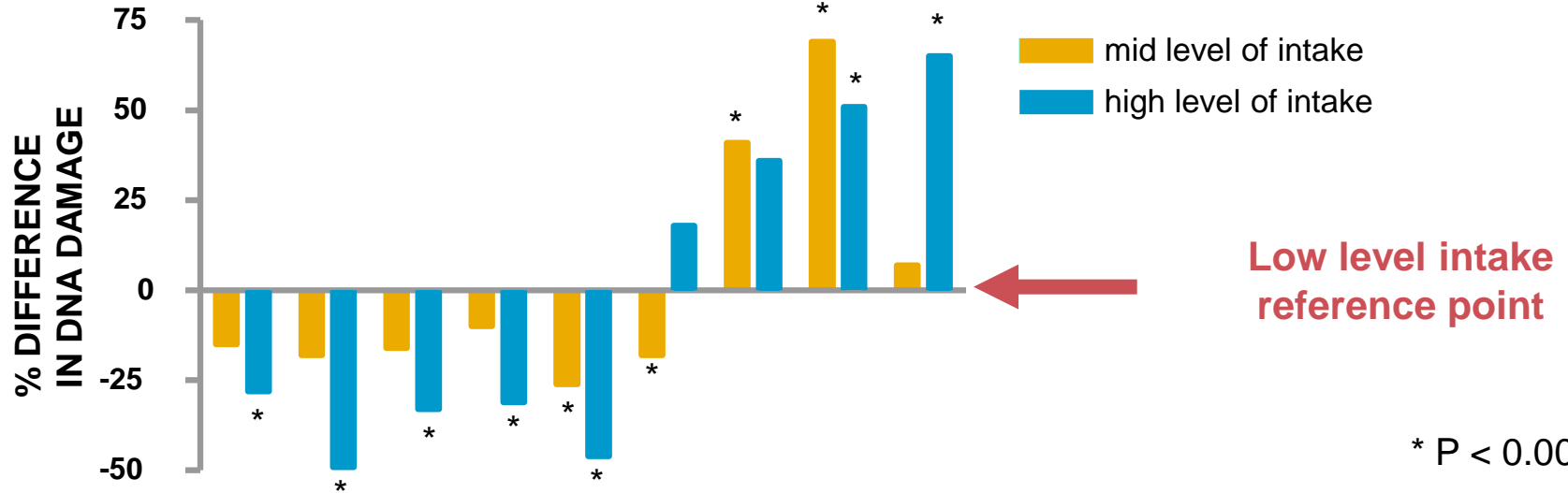
- Increased homocysteine
- low fruit & veg intake
- Increased alcohol intake
- Increased processed meat intake

Genome health is positively associated with:

- plasma folate
- Multi-vitamin use
- Vitamins E, D
- Fish intake
- Dietary fibre (cereals)
- Selenium



Micronutrient intake is a determinant of DNA Damage

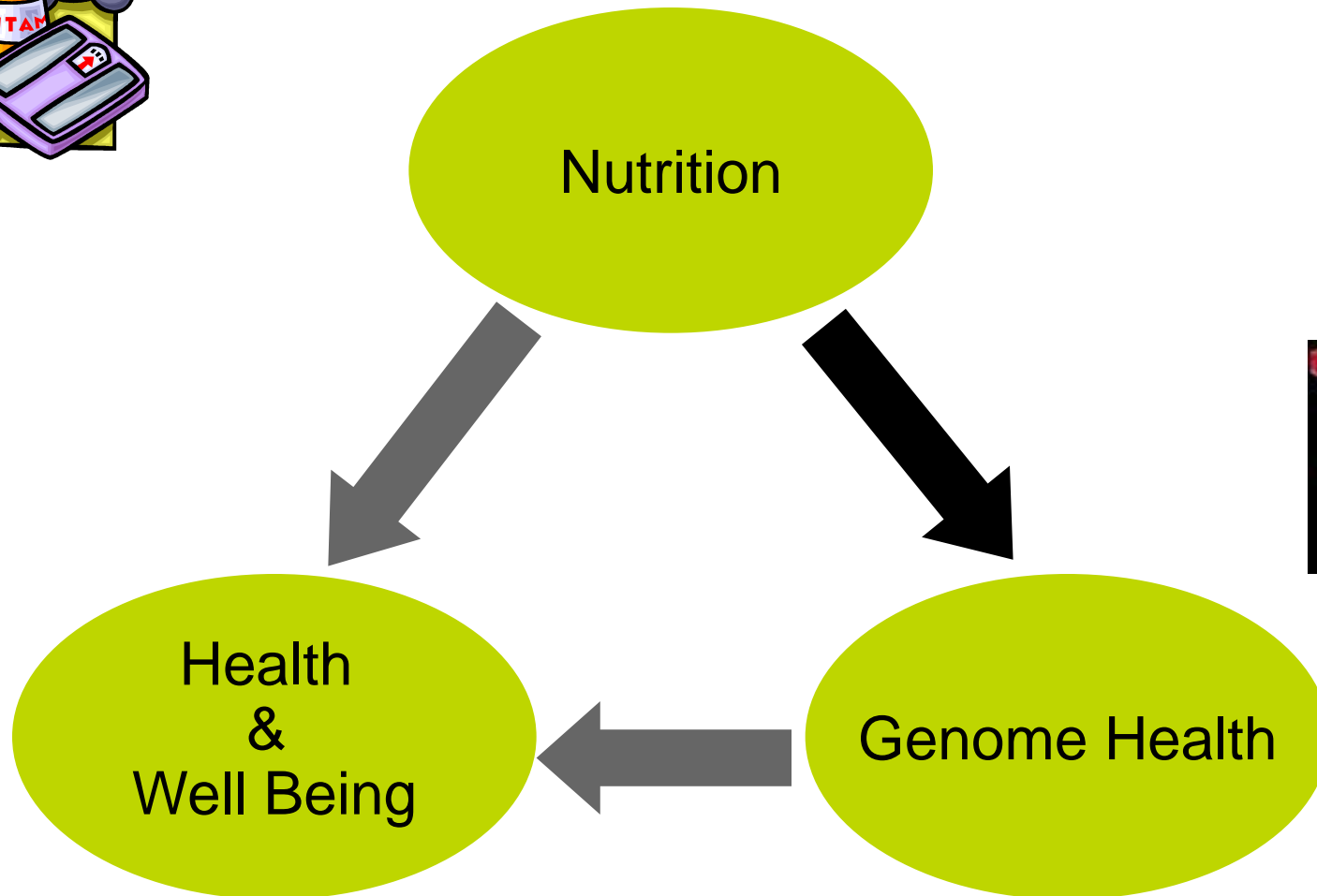
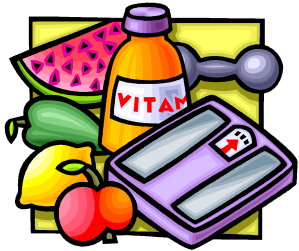


Vitamin E	Calcium	Folate	Retinol	Nicotinic acid	β -Carotene	Riboflavin	Pantothenic acid	Biotin
More is better					More is worse			

Nutrition and DNA damage

DNA oxidation prevention	Vit C, Cu, Zn, Vit E, polyphenols
DNA synthesis	folate, B12, Zn, Mg
DNA repair	niacin, Zn, folate
Gene expression	folate, Vit D, Vit A
Chromosome segregation	folate, Vit A, Mg
Telomere length	niacin? via PARP, folate
Necrosis/Apoptosis	niacin, Zn, Vit E, Vit D, Vit C Vit A, Vit K2.

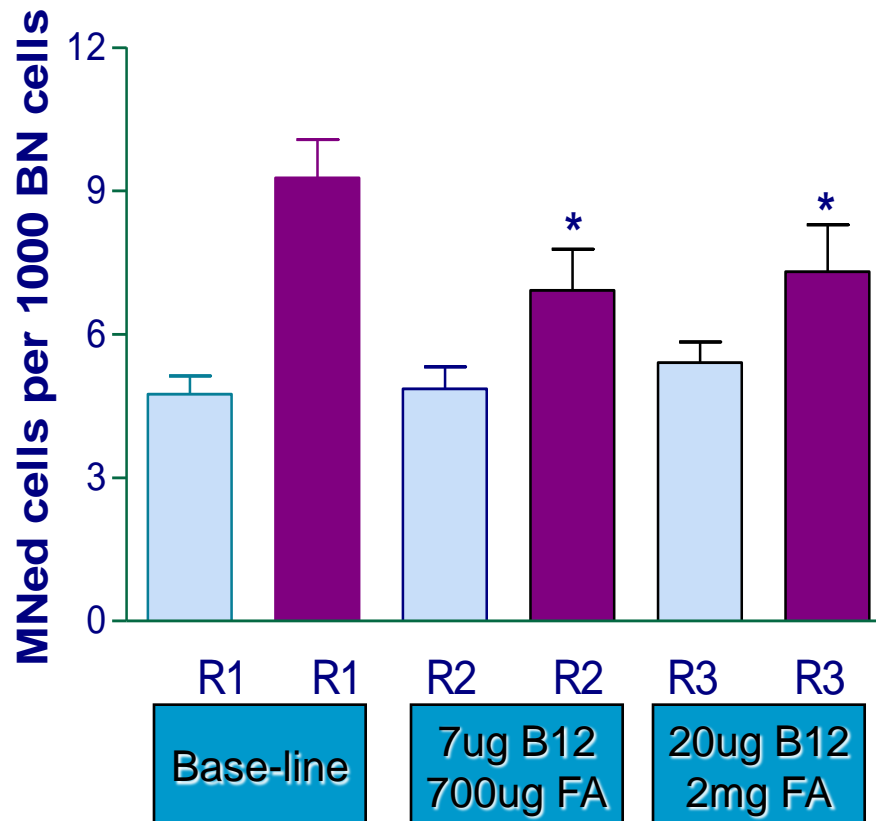
Nutrition, health and DNA



DNA Damage can be modified by diet

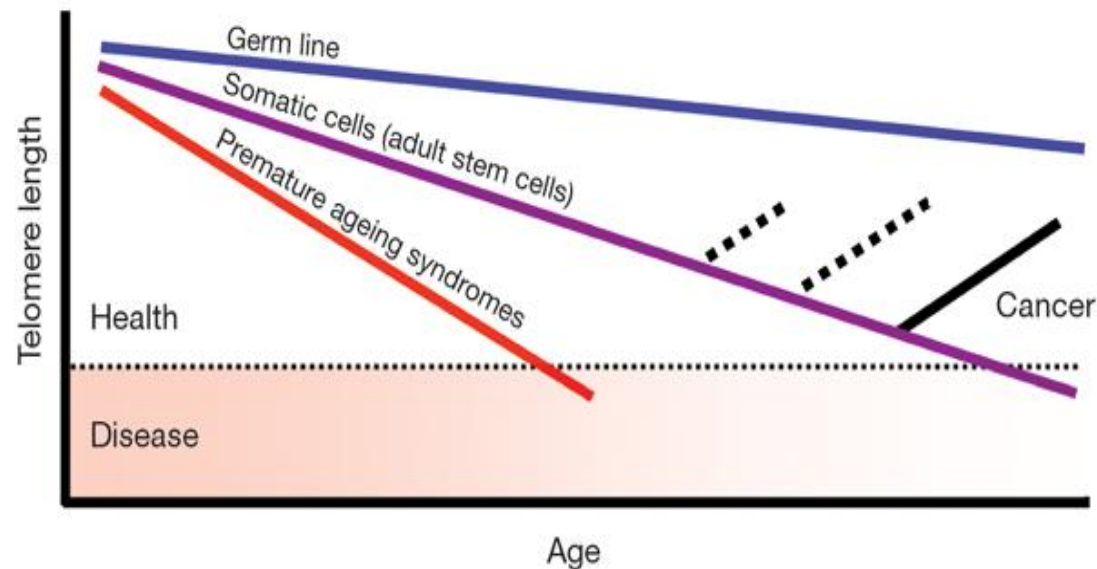
Low MNed cell freq. at R1. [N = 17] ANOVA P = 0.65

High MNed cell freq. at R1. [N = 16] ANOVA P < 0.0005



Genome damage in children

- Heritable premature ageing syndromes
 - Ataxia telangiectasia, Werner Syndrome, Bloom Syndrome, Dyskeratosis congenita, Fanconi anaemia.
- Early childhood cancers
 - Leukaemia and lymphomas



Nutritional factors associated with genome damage in children

AIMS:

1. Describe the nature of the interaction between nutritional factors in determining level of DNA damage in children.
2. Identify the key nutritional factors associated with DNA damage in children.
 - 3, 6 and 9 year olds
 - Dietary questionnaire
 - DNA damage and nutrient profile

Nutritional factors associated with genome damage in children

- DNA Damage markers

- CBMN-Cyt assay
- Telomere length

CSIRO – Food and Nutritional Sciences

- Vitamins

- Folate, Vitamin B12, Vitamin D
- SA Pathology

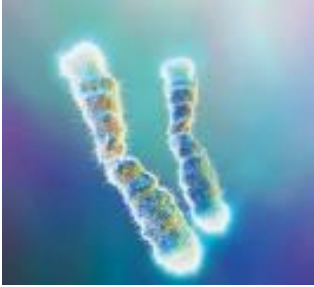
- Carotenoids

- Carotenes (α and β), α -tocopherol, lycopene, lutein, retinol
- CSIRO – Food and Nutritional Sciences

- Minerals

- zinc, magnesium, calcium, selenium
- Waite Analytical Services

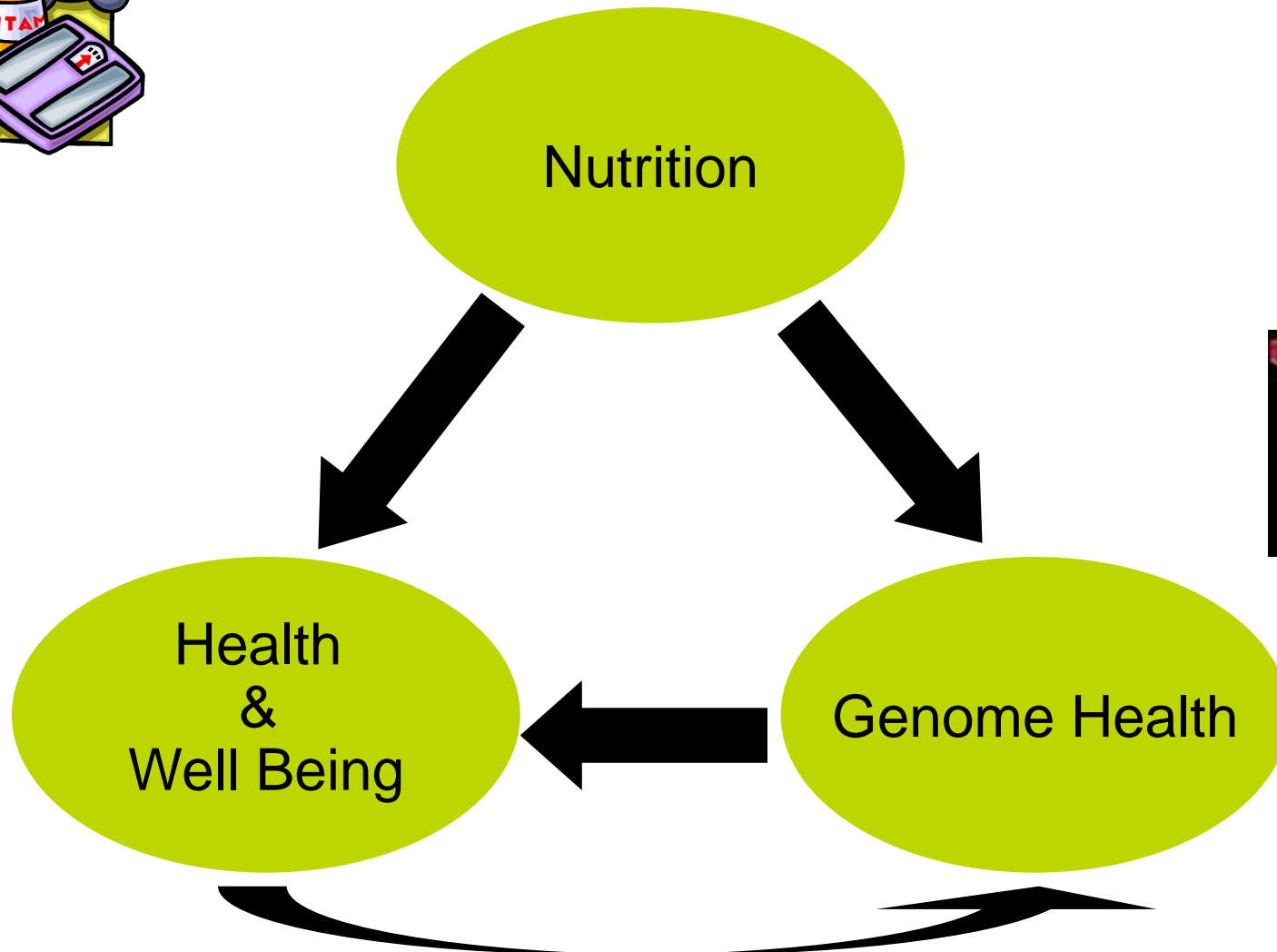
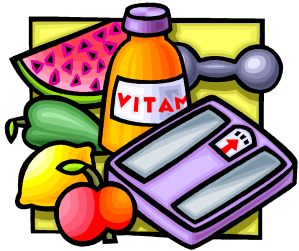
What next?

- 
- Determine the nutritional and genomic factors that significantly affect telomere maintenance and function in children.
 - Define nutrient levels for optimal genome functioning

- 
- Does improved nutrition in early life reduce disease?



Nutrition, health and DNA



Acknowledgements

CSIRO

Michael Fenech

Carolyn Salisbury, Theodora Almond,
Maryam Hor, Bianca Benassi-Evans,
Sasja Beetstra-Hill

TICHR

Liz Milne

Sandy Costanzo, Lisa Miller, Meg
McHugh

NHMRC Kids project CIs

Liz Milne, Michael Fenech, Bruce
Armstrong, Nick de Clerk, Marg Miller



Reference list

- Images are sited on slide they appear
- Others images:
 - Life be in it
 - Gearfuse.com
 - Futurama.com