

Epigenetics and Inheritance



AN EMERGING BASIC FIELD
OF SCIENCE AT THE
EPICENTER OF MODERN
MEDICINE

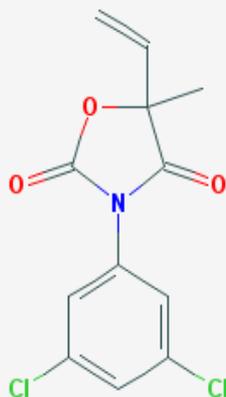
PART 4



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Epigenetic Inheritance and Toxins

Vinclozolin is a toxic fungicide sprayed on fruits and vegetables has been shown to act transiently at the time of embryonic sex determination and to promote in the F1 generation a spermatogenic cell defect and subfertility in the male. These males are predisposed to a variety of adult-onset diseases earlier than normal.



IUPAC:

(*RS*)-3-(3,5-dichlorophenyl)-5-methyl-5-vinyl-1,3-oxazolidine-2,4-dione

FORMULA:

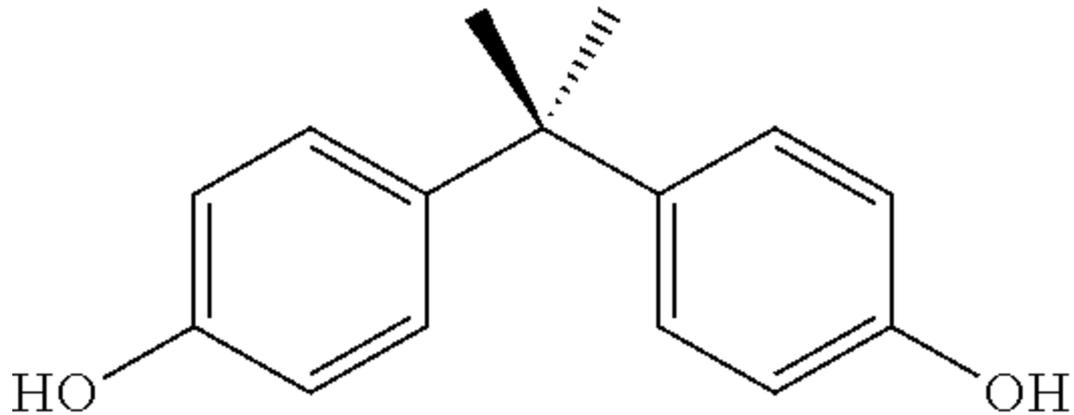
C₁₂H₉Cl₂NO₃

ACTIVITY:

fungicides ([dichlorophenyl dicarboximide fungicides](#); [oxazole fungicides](#))

Epigenetics and Toxins

Bisphenol A (BPA) has been called epigenetically toxic by the National Institutes of Health (NIH). To avoid BPA, avoid using reusable plastic water and baby bottles, polycarbonate plastic food containers, and plastic, especially those labeled #7 with PC underneath the number.



Bisphenol A

Epigenetics and Inheritance of Stress



- Stress happens to everyone and cortisol (a glucocorticoid) is released from the adrenal glands during stressful circumstances and is meant to be part of the fight-or-flight short term response. After the ‘danger’ is gone, cortisol levels lower and the body goes back to its normal state.
- However, in people who experience chronic high levels of stress, elevated levels of cortisol continue to circulate in the body over long periods of time. High levels of cortisol in the blood lead to anxiety, nervousness, depression, difficulty sleeping, and feeling loss of control.
- These are key factors in the development of alcoholism because alcohol consumption can temporarily reduce the anxiety.



Epigenetics and Nurturing

A rat pup raised by an anxious, low-nurturing mother will grow up to be an anxious adult. A rat pup raised by a relaxed, high-nurturing mother will grow up to be a relaxed adult. It is thought the same might be true in humans.



Epigenetic Inheritance and Abuse



Domestic violence is a type of abuse. It usually involves a spouse or partner, but it can also be a [child](#), [elderly relative](#), or other family member.

Domestic violence may include:

- a) Physical violence that can lead to injuries such as bruises or broken bones
- b) Sexual violence
- c) Threats of physical or sexual violence
- d) Emotional abuse that may lead to depression, anxiety, or social isolation

There is no typical victim. It happens among people of all ages. It affects those of all levels of income and education.

The first step in getting help is to tell someone you trust.

Centers for Disease Control and Prevention

Epigenetics and Cancer



Cancer patient
receiving
chemotherapy

inaccessible heterochromatin (in normal cell)

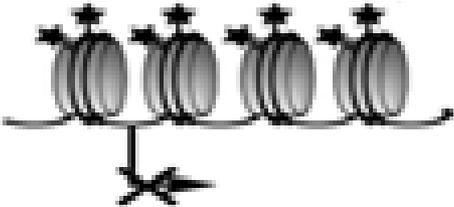
(A1) normal cell: methylated repetitive sequence



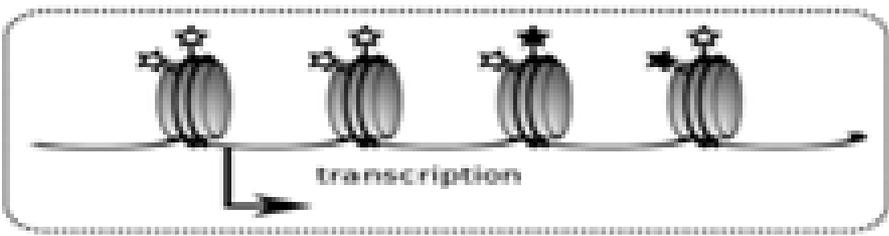
(A2) cancer cell: hypomethylation of DNA



(B1) normal cell: histone modifications (closed chromatin configuration)



(B2) cancer cell: loss of histone methylation



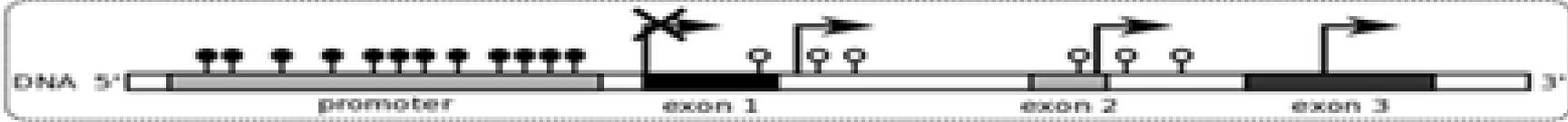
methylated CpG site ● unmethylated CpG site ○ acetyl group ○ methyl group ● transcription →

accessible euchromatin (in normal cell)

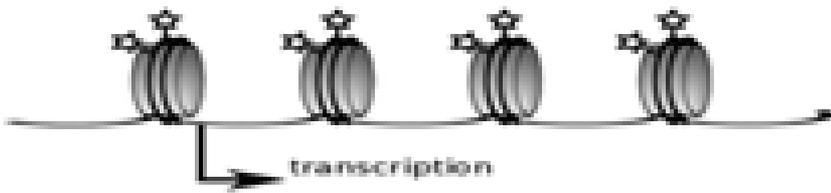
(C1) normal cell: unmethylated CpG island and methylated gene body



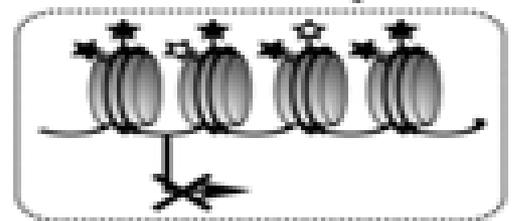
(C2) cancer cell: hypermethylation of promoter



(D1) normal cell: histone modifications (open chromatin configuration)



(D2) cancer cell: loss of histone acetylation



methylated CpG site (filled circle) unmethylated CpG site (open circle) acetyl group (circle with star) methyl group (circle with dot) transcription (arrow)

inaccessible heterochromatin (in normal cell)

(A1) normal cell: methylated repetitive sequence



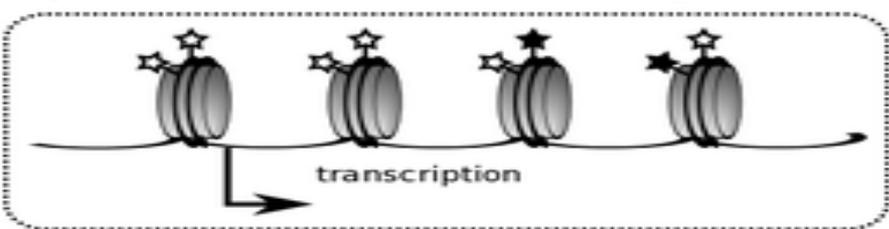
(A2) cancer cell: hypomethylation of DNA



(B1) normal cell: histone modifications (closed chromatin configuration)



(B2) cancer cell: loss of histone methylation

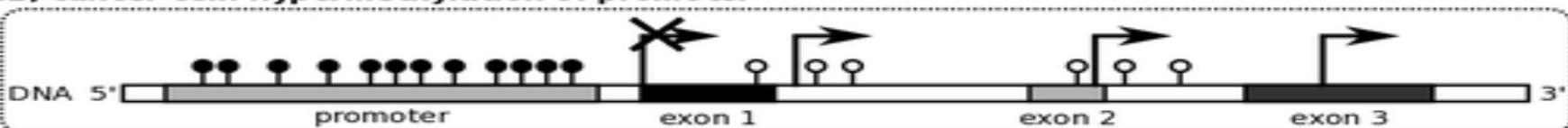


accessible euchromatin (in normal cell)

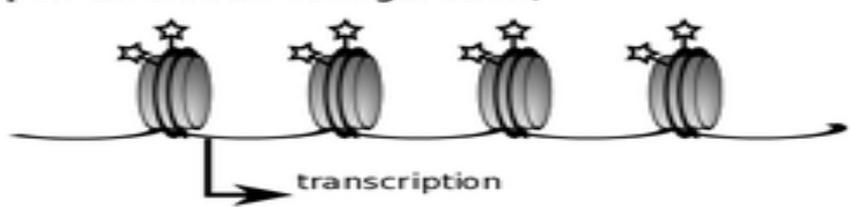
(C1) normal cell: unmethylated CpG island and methylated gene body



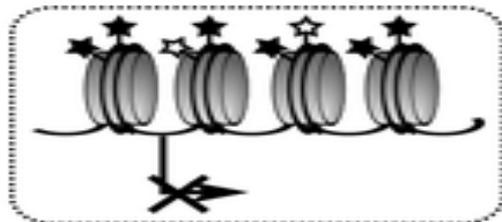
(C2) cancer cell: hypermethylation of promoter



(D1) normal cell: histone modifications (open chromatin configuration)



(D2) cancer cell: loss of histone acetylation



methylated CpG site ● unmethylated CpG site ○ acetyl group ☆ methyl group ★ transcription →

Epigenetics & Rheumatoid Arthritis

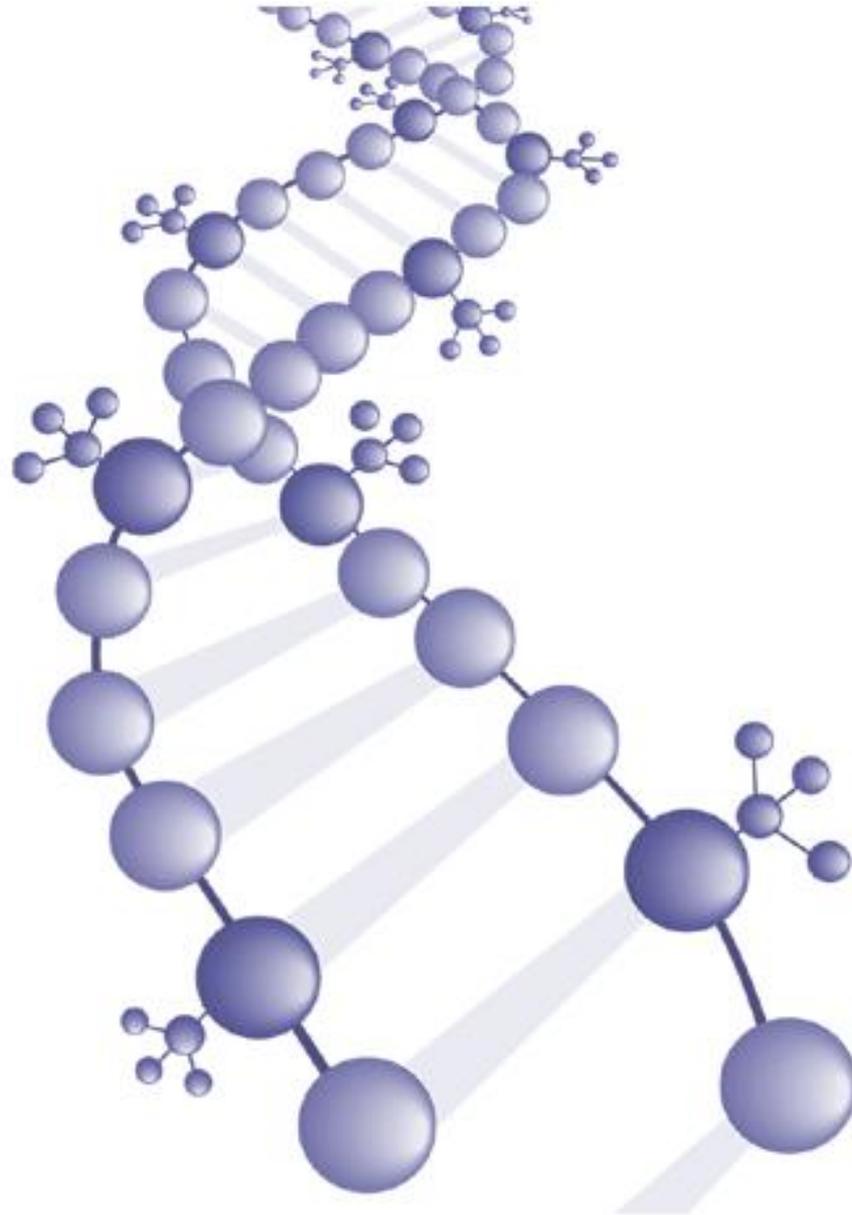
Rheumatoid arthritis (RA) is a painful swelling of the joints. It can occur in the shoulders, elbows, wrists, hands, knees, ankles, and feet and occurs symmetrically. This means that if RA occurs in one shoulder, it would also occur in the other.

RA has long been categorized as an autoimmune disease.



HEP

Human
Epigenome
Project



Roadmap Epigenomics Program

National Institutes of Health
Common Fund