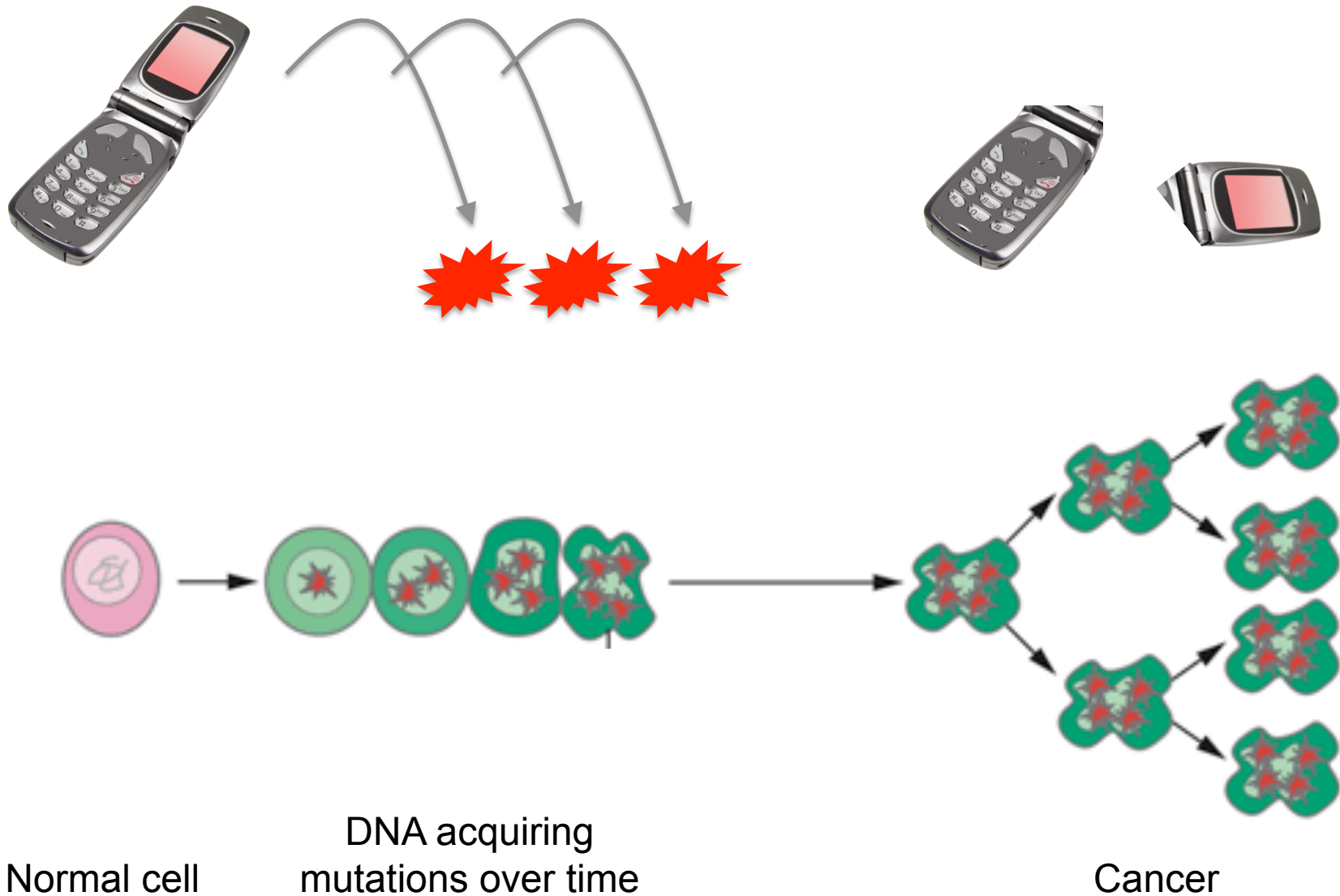


A cell phone breaks, after being dropped 5 times.

- Was the last drop the one responsible for breaking the phone?
- Is it possible that each drop caused some damage to the phone?
- Was the amount of damage to the phone after each drop random, or predictable?

Damage to the cell phone, as an analogy

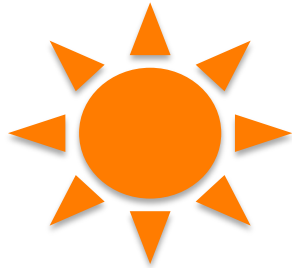


Mutations in DNA cause cancer.

What causes mutations in DNA?

As a class, make a list of things
you think cause mutations in DNA.

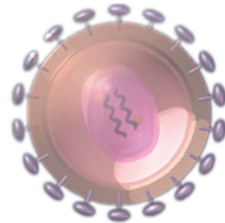
Examples of what can cause mutations



UV radiation



Other types of radiation
(x-rays, gamma rays)



Viruses
(HPV, Hepatitis B,
Hepatitis C)

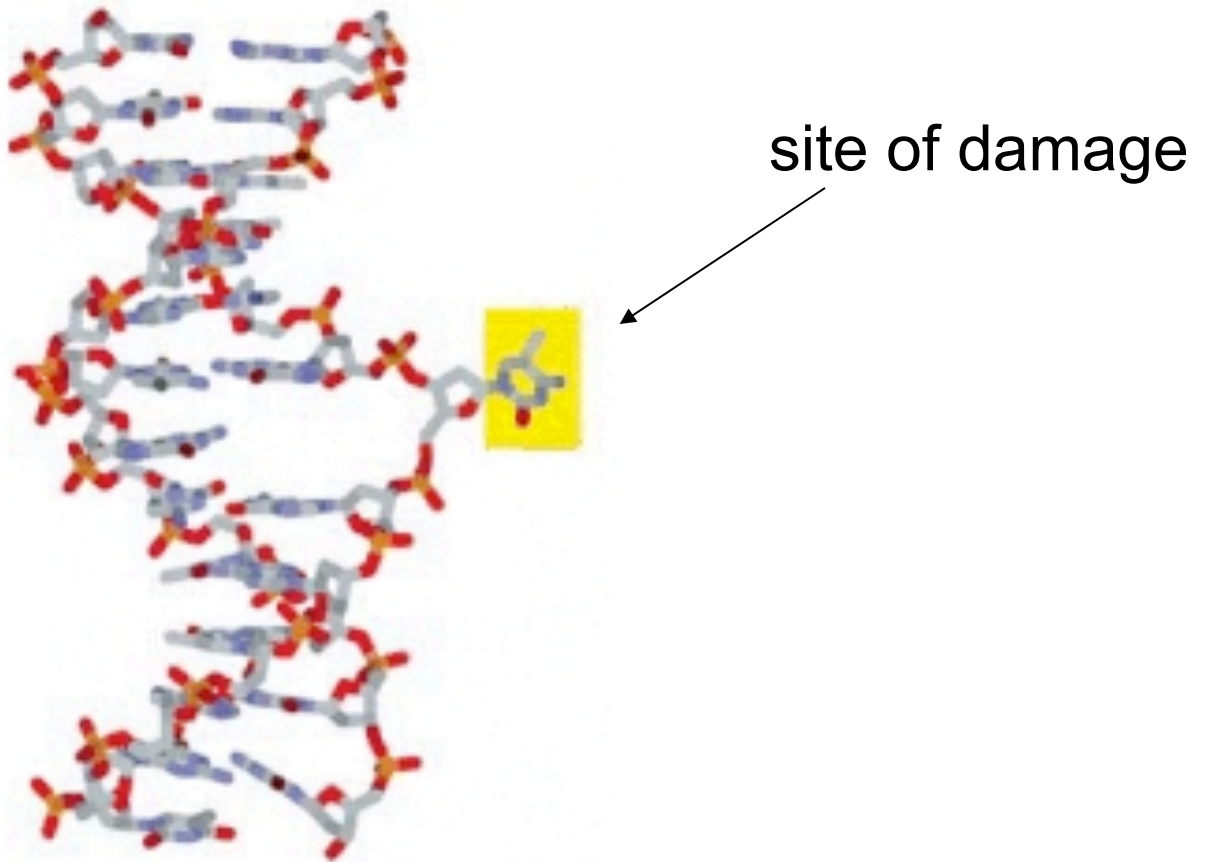


Tobacco smoke

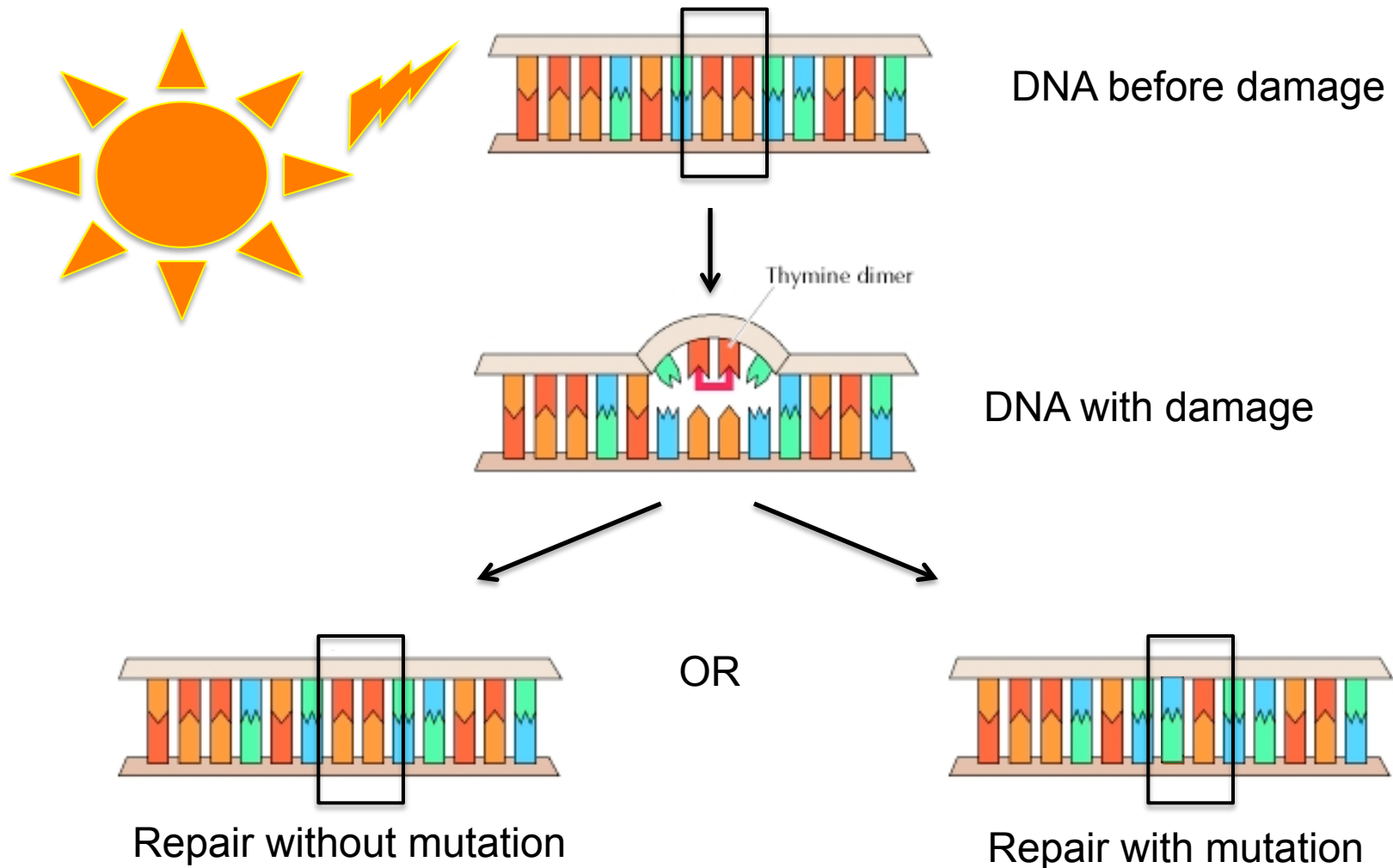


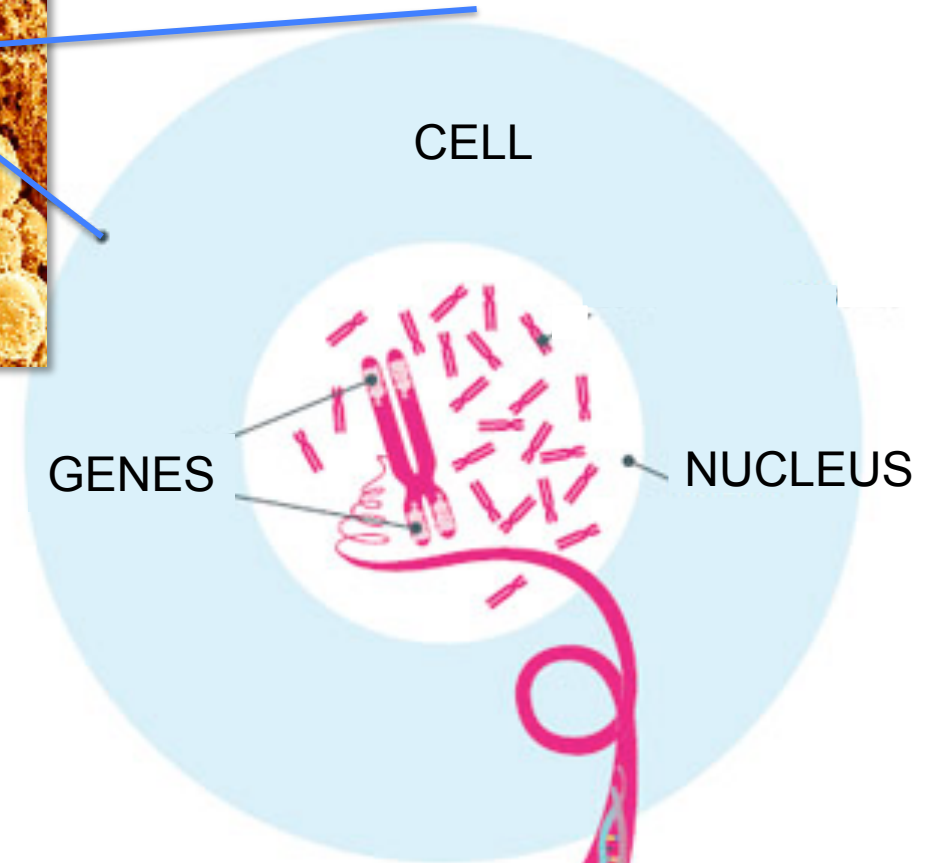
Radon

Example of DNA damage that could lead to a mutation



A mutation results when an error is made while repairing DNA damage



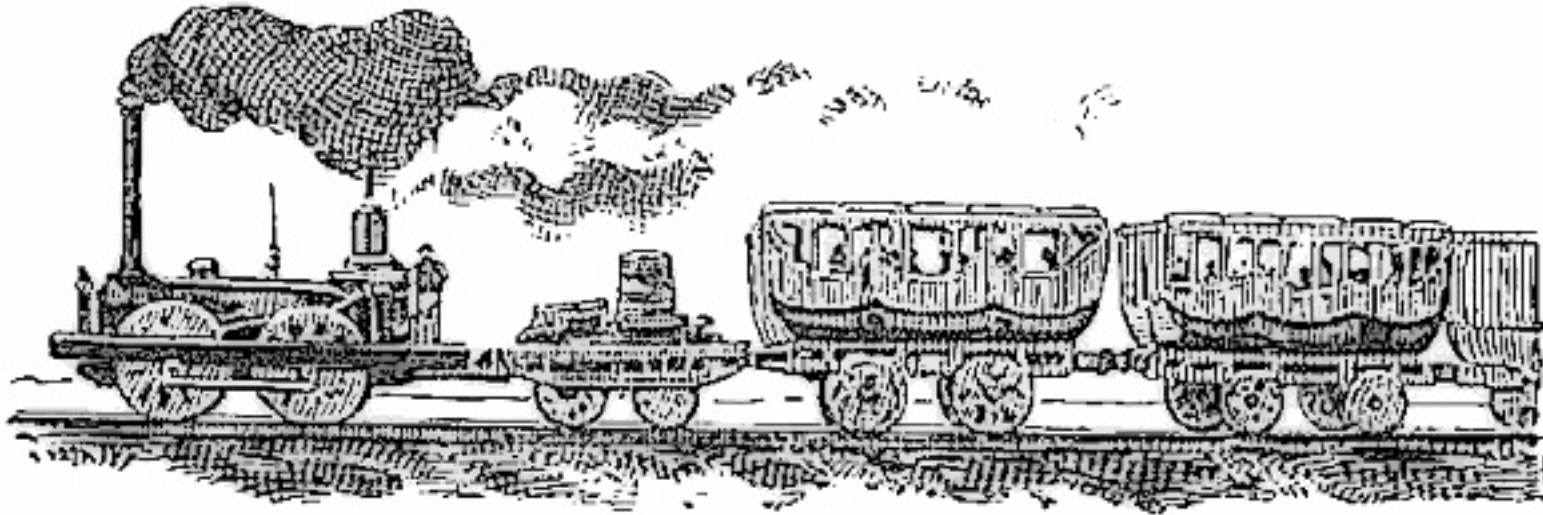


A steam engine train, as an analogy

coal



coal

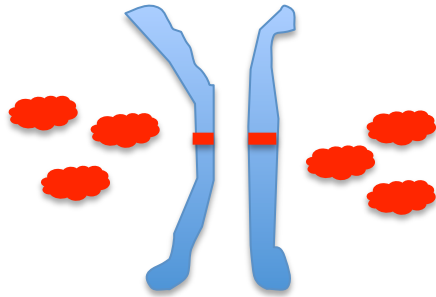


BRAKES

BRAKES

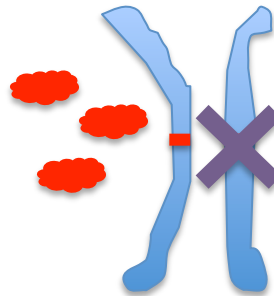
Loss-of-function mutations in tumor suppressor genes can lead to cancer

Non-mutated TS gene



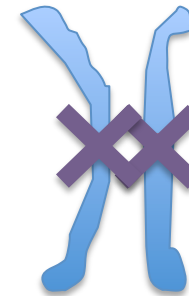
A tumor suppressor gene normally codes for a protein that inhibits cell growth and division.

Mutation of 1 TS gene (e.g. maternal)



Outcome:
No effect, because functional protein is still produced.

Mutation of both TS genes (maternal & paternal)



Outcome:
Potential tumor formation, because no functional protein is produced.

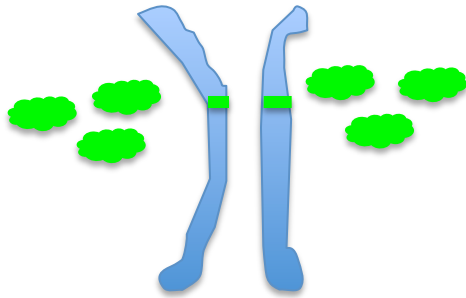


Proteins encoded by the tumor suppressor (TS) gene

— The tumor suppressor (TS) gene

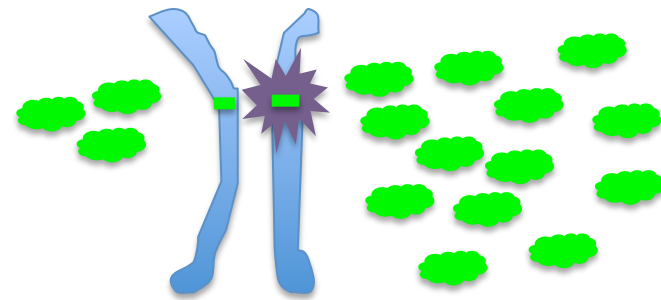
Gain-of-function mutations in oncogenes can lead to cancer

Non-mutated oncogene



An oncogene normally codes for a protein that promotes cell growth and division.

Gain-of-function mutation in oncogene



Outcome:
Potential tumor formation, because too much protein is produced.

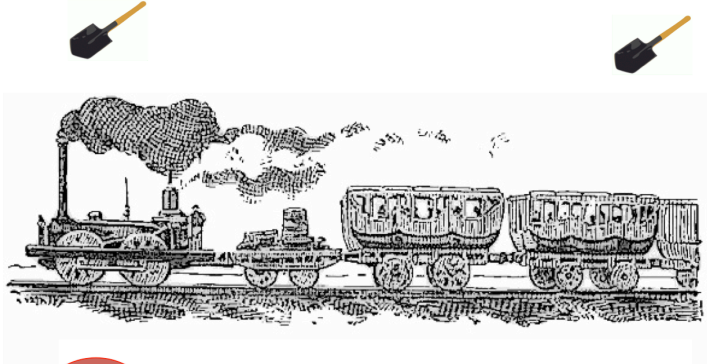


Proteins encoded by the oncogene

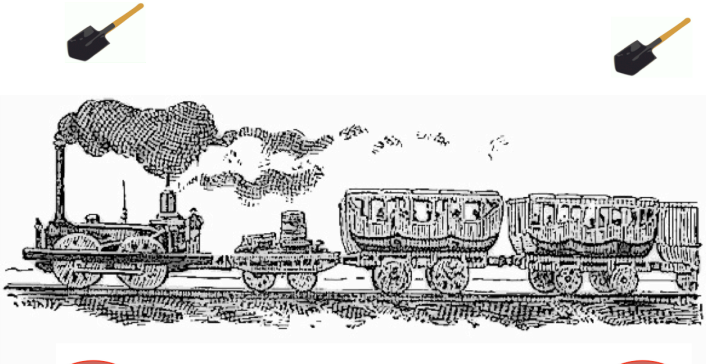


The Oncogene

For the train to go out of control, does 1 or 2 of the brakes need to be mutated?



Brakes



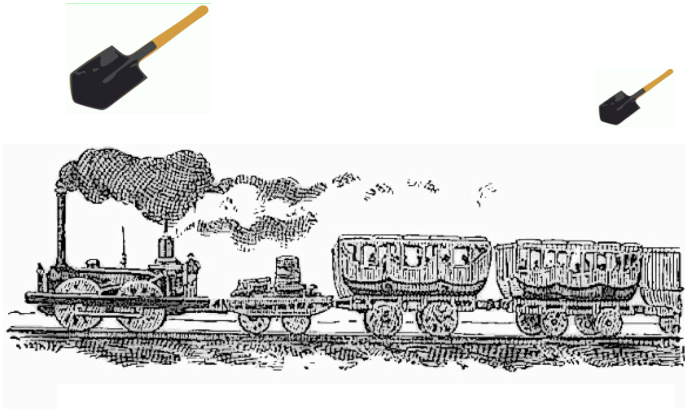
Compare:

h)

&

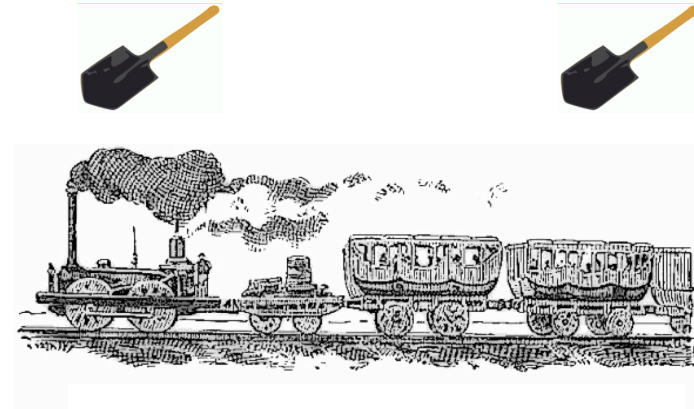
i)

For the train to go out of control, does 1 or 2 of the shovels need to be mutated?



Brakes

Brakes



Brakes

Brakes

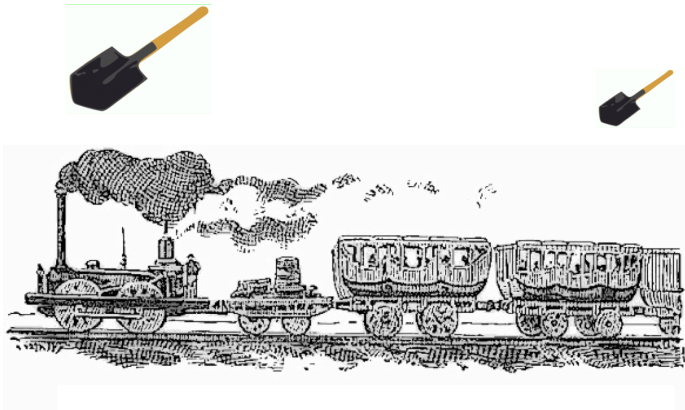
Compare:

c)

&

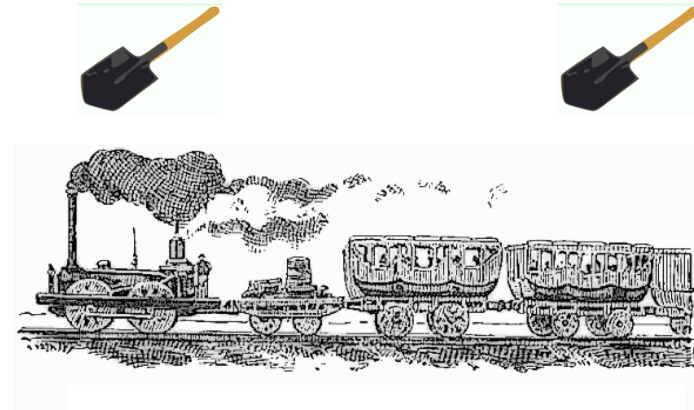
d)

Tumor formation can result when only *one* shovel is out of control



Brakes

Brakes



Brakes

Brakes

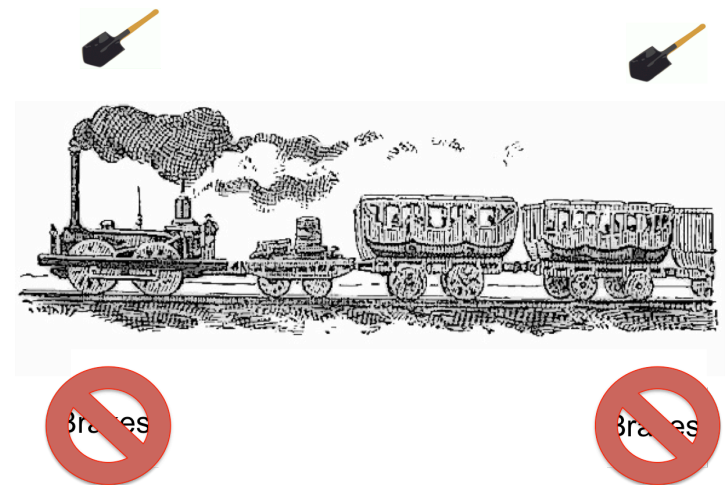
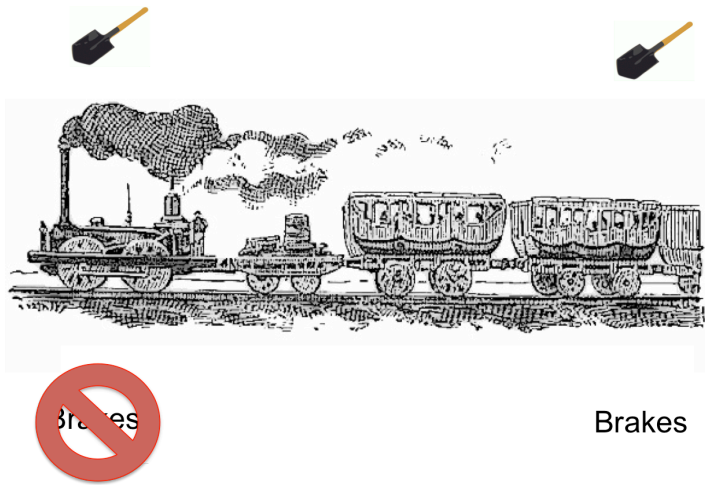
Compare:

c)

&

d)

Tumor formation can result only when *both* brakes lose function

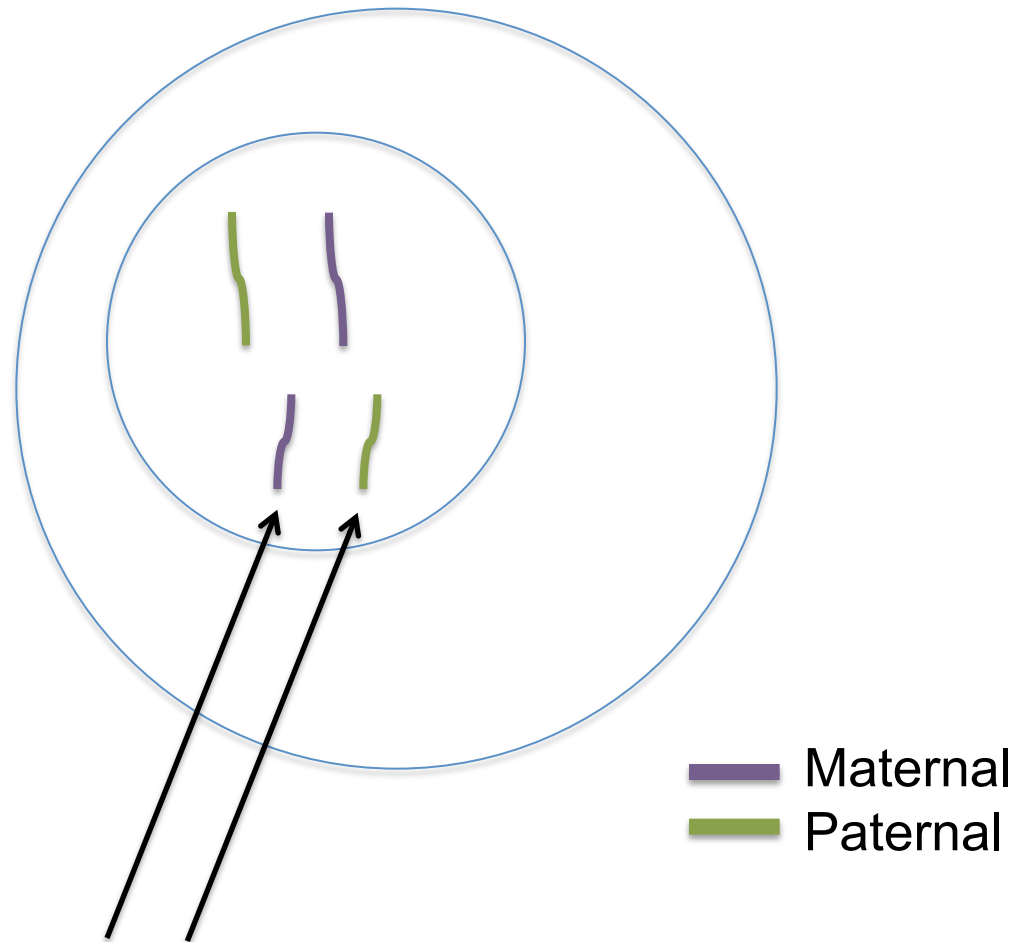


Compare:

h)

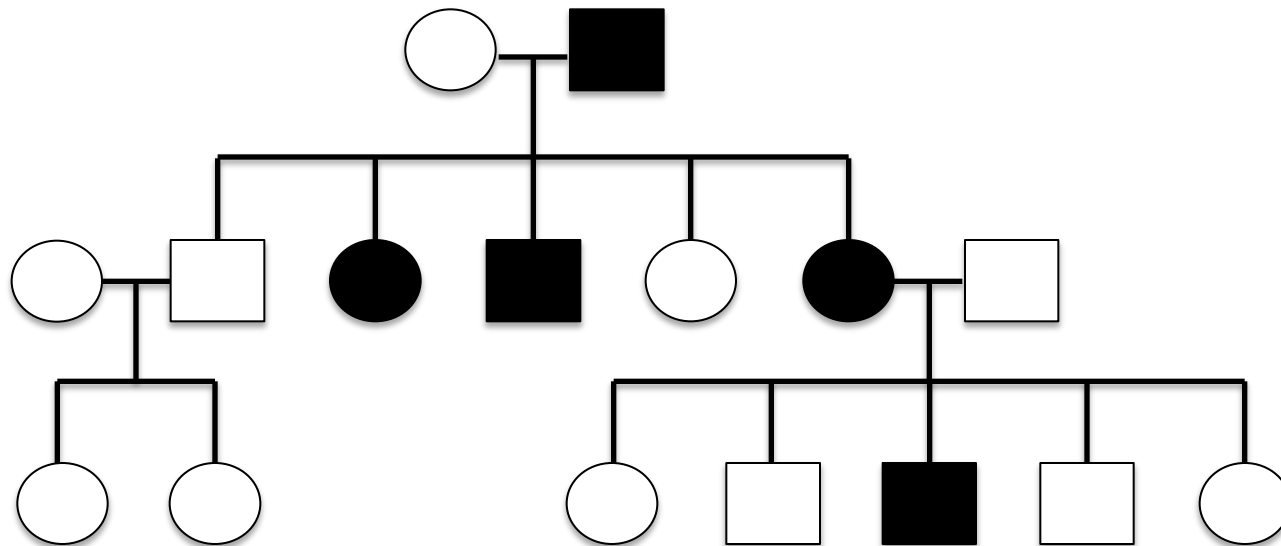
&

i)



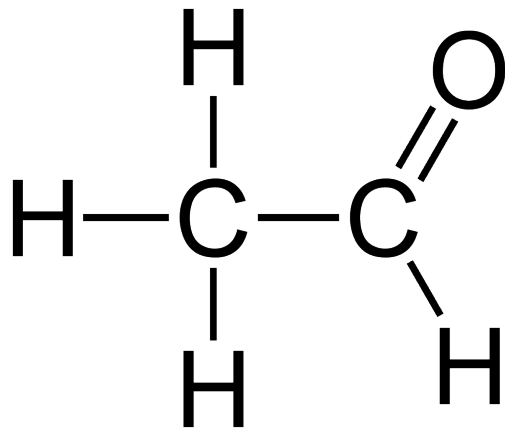
We have **2 *versions*** of every genes – one from the mother and one from the father.

A pedigree shows a disease being passed down through generations of a family



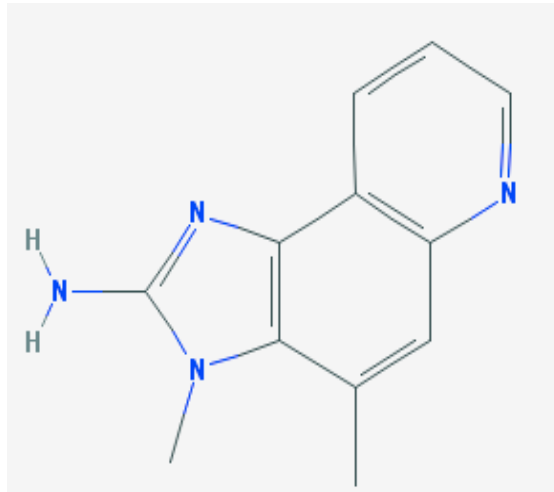
Common carcinogens that cause mutations

Acetaldehyde
affects lung cells



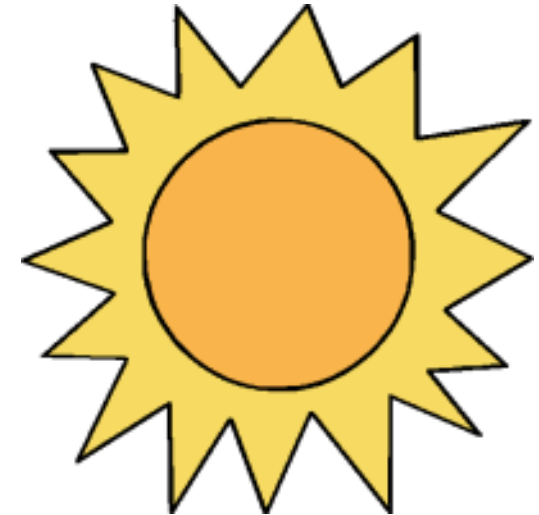
(found in cigarette smoke)

MeIQ affects intestine
cells



(formed when meats are cooked
at high temperatures)

UV Radiation
affects skin cells



(comes from the sun)