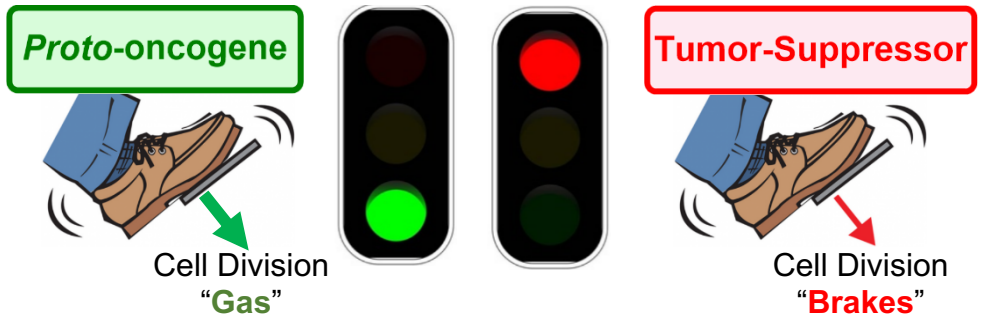
CONCEPT: SIGNALING DEFECTS & CANCER

- _____ in signaling pathways can cause them to fail, leading to *disease*.
- _____, a disease characterized by *uncontrollable/inappropriate* cell growth, is associated with signaling defects.

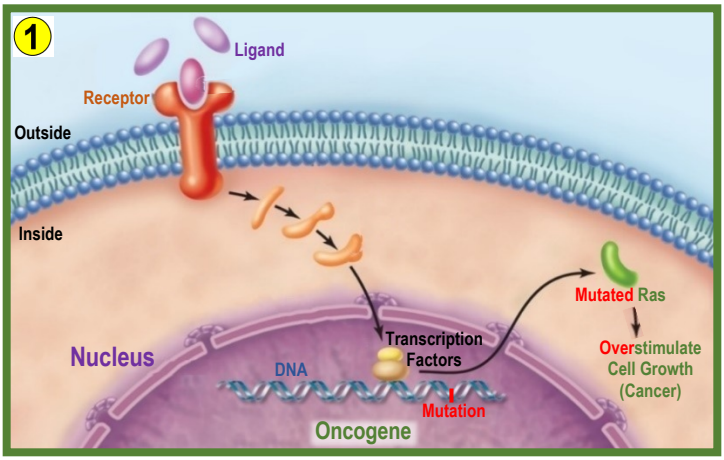
Types of Genes Regulating Cell Growth

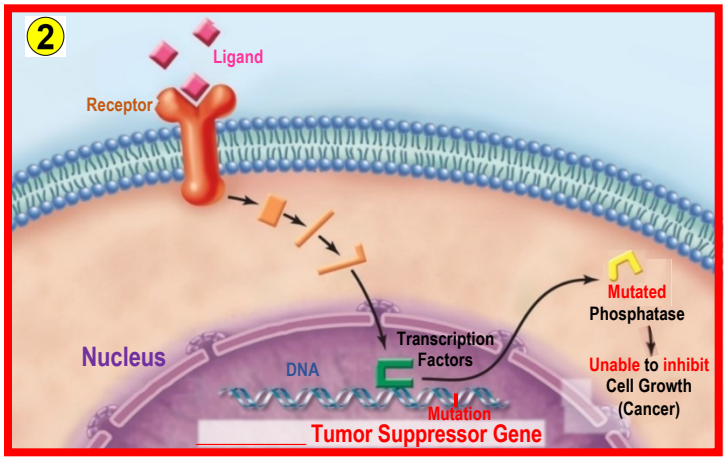
- In a healthy, normal cell, _____ types of genes regulate cell growth:
  1) _____-*oncogene*: provide signals that promote appropriate cell division (green light for cell division).
     - □ Ex. gene encoding _____ *G-protein*.
  2) *Tumor*-_____ *Gene*: provide signals to inhibit cell division (red light for cell division).
     - □ Ex. genes encoding _____ reversing kinase activity.



Oncogenes & Mutated-Tumor-Suppressor-Genes Promote Cancer

- Though proto-oncogenes are essential, they are susceptible to *mutations* that generate _____.
  - □ *Oncogene*: _____ gene that promotes unrestrained cell growth (*cancer*).
- The proto-oncogene encoding _____ is one of the most commonly *mutated* in human cancer tumors.
  1. Most common *mutation* in cancer tumors is loss of Ras's intrinsic _____ activity (keeping Ras active).
  2. *Mutations* in *tumor-suppressor genes* (ex. phosphatases) can also lead to _____ development.





CONCEPT: SIGNALING DEFECTS & CANCER

PRACTICE: Is there a difference between oncogenes and tumor suppressor genes?

a) Yes, oncogenes are genes that can cause cancer when they become mutated to become proto-oncogenes, whereas tumor suppressor genes play no role in cancer.
b) Yes, oncogenes prevent cancer from forming unless they are mutated to become proto-oncogenes, whereas tumor suppressor genes stimulate the formation of cancer even in the absence of mutation.
c) No, oncogenes and tumor suppressor genes both stimulate the development of cancer, even in the absence of their becoming mutated.
d) Yes, oncogenes are mutated versions of genes that promote abnormal cell division (such as mutated Ras), whereas tumor suppressor genes are genes that normally inhibit cell division.
e) No, since both types of genes contribute to the development of cancer, there is no difference between them.

PRACTICE: The protein product of the Ras oncogene is a mutated Ras protein. All of the following would be true EXCEPT**:**

a) The Ras protein is a G-protein and functions as an internal clock.
b) G-proteins have evolved to stay active for a certain length of time.
c) Ras protein is active in cell growth and division.
d) Ras can mutate so that it is less active as a GTPase.
e) A less active GTPase would mean less stimulation of the MAP kinase pathway.

PRACTICE: How does a proto-oncogene differ from an oncogene?

a) Proto-oncogenes code for proteins that regulate expression of structural genes; oncogenes code for nucleic acids involved in cell division.
b) Proto-oncogenes control normal cell division; oncogenes contribute to the development of cancer.
c) When oncogenes become damaged, they become proto-oncogenes.
d) Oncogenes activate tumor suppressor genes; proto-oncogenes repress tumor suppressor genes.
e) Proto-oncogenes cause cells to self-destruct when damaged; oncogenes cause damaged cells to repair themselves.