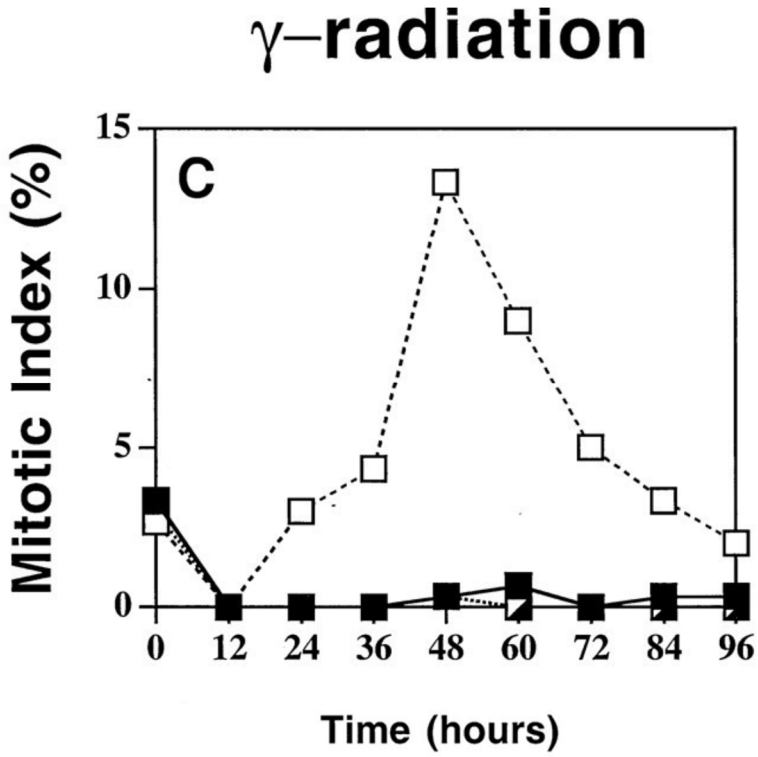
In-class worksheet. Adapted from: https://www.biointeractive.org/classroom-resources/role-p53-cell-cycle

Please answer the following questions about the graph. You are in encouraged to work in your groups.



Caption: *Alleles of the* p53 *gene were selectively disrupted in a line of human cells and then monitored after exposure to DNA-damaging gamma (γ) radiation to determine what proportion of the cells entered mitosis (cell division). The shaded squares represent cells with two normal alleles of the* p53 *gene. The half-shaded squares represent cells with one normal and one disrupted allele of the* p53 *gene (note that some of the half-shaded squares are covered by the shaded squares). The unshaded squares represent cells in which both alleles of the* p53 *gene were disrupted. The mitotic index is the proportion of cells undergoing mitosis at a given time.*

1. Draw your own legend for the graph in the space below.

Students should draw each of the squares from the graph and label them in order to connect the visual to the data:

■ Cell with two normal alleles of the p53 gene

□ Both alleles of p53 gene disrupted

◪ Cell with one normal and one disrupted allele of the p53 gene

2. What is the dependent variable in the graph? Independent variable?

Dependent = mitotic index
Independent = time and how many normal or disrupted alleles of p53 gene the cell has.

3. Explain the mitotic index. Why is this important to normal cell function? To cancer cells?

The mitotic index is the proportion of cells undergoing mitosis at a given time. Cells need to undergo mitosis in order to divide/reproduce. You might want to be able to halt mitosis if a cell undergoes damage. If you are cancerous you might want to be able to undergo mitosis as any time to replicate yourself.

4. What trends do you see in the data above?

Cells with a normal copy of p53 halt their reproduction after exposure to damage inducing gamma radiation. Cells without a normal copy do not.

5. Which cell line(s) have a properly functioning p53 protein?

The one with one or two properly functioning alleles of p53.

6. How many normal alleles of the p53 gene do cells need to function properly? Use evidence from the figure to support your claim.

Just one, because in the case of one or two properly functioning alleles of p53 mitosis is halted after exposure to gamma radiation, as would be expected in a healthy cell.

7. Based on the figure, what role does the p53 protein play in cell division? Why might a cell need to stop dividing?

It puts the brakes on cell division, presumably when there is potential damage to a cell that might result in improper copies of genes being replicated. This gives the cell time to repair any DNA damage before replication commences.

8. What hypothesis might the authors have had when they designed this study?

Any number of hypotheses might be proposed and would be acceptable, one example is: p53 halts the cell cycle temporarily after potential DNA damage.

9. How would you design a follow-up experiment to determine whether other proteins in addition to p53 play a regulatory role in cell division after DNA damage?

Any number of answers is appropriate here. They should expand on the current study by bringing in other genes. Students might propose a similar study where another gene typically associated with cancer might be disrupted and normal in a cell. Depending on what that gene does the treatment might vary.