Study Guide — MI Unit 3: How to Conquer Cancer (End-of-Unit Test)

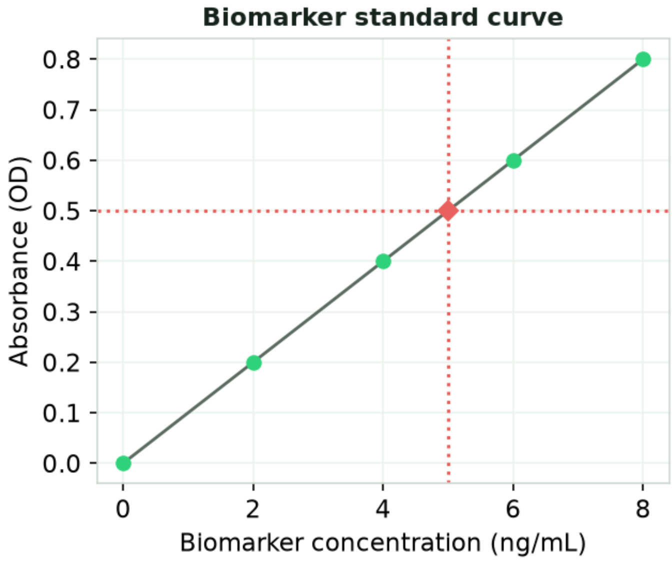
Medical Interventions (Genetics of Disease) · Unit 3 — How to Conquer Cancer · Modeled on the PLTW Guided Review format

Vocabulary to know cold

Term	Definition
TP53 / p53	Tumor suppressor 'guardian of the genome'; arrests the cycle for repair or triggers apoptosis.
Multiple-hit model	Cancer usually needs several mutations (oncogene activation + tumor suppressor loss) to develop.
Nonsense mutation	A base change creating a premature stop codon, producing a truncated, nonfunctional protein.
Angiogenesis	New blood-vessel formation; required for a solid tumor to grow beyond a few millimeters.
Biomarker / standard curve	A measurable disease molecule; a standard curve converts assay signal (OD) into concentration.
Correlation vs. causation	An association between variables does not by itself prove that one causes the other.
Imaging modalities	MRI, CT, X-ray, ultrasound, and PET (radiolabeled glucose tracer) used to locate/characterize tumors.
Chemotherapy	Drugs that kill or stop rapidly dividing cells, including many cancer cells.
Radiation therapy	Ionizing radiation that damages DNA in a targeted area, killing dividing cancer cells.
Targeted therapy	Treatment aimed at a specific molecule/mutation in cancer cells, sparing more normal cells.
Immunotherapy	Treatment that helps the patient's own immune system recognize and attack cancer cells.
Sensitivity	True positive rate = TP / (TP + FN); ability to correctly flag people who HAVE the disease.
Specificity	True negative rate = TN / (TN + FP); ability to correctly clear people who do NOT have the disease.
Control group	Comparison group (placebo/standard care) in a trial used to attribute effects to the treatment.

Worked examples (follow the reasoning)

Example 1. A biomarker ELISA gives a patient absorbance (OD) of 0.50. Using the standard curve, estimate the patient's biomarker concentration and explain each step.



- Confirm the standards form a straight line: each 2 ng/mL adds 0.2 OD, so OD = 0.1 × concentration.
- Find the patient OD (0.50) on the y-axis.
- Read horizontally to the line, then down to the x-axis.
- 0.50 ÷ 0.1 = 5, so the concentration is about 5 ng/mL.

Answer: About 5 ng/mL (the linear curve gives OD = 0.1 × concentration, so 0.50 OD → 5 ng/mL).

Example 2. A screening test was checked against true diagnoses: of 100 cancer patients it flagged 90 (missing 10); of 100 healthy people it cleared 80 (falsely flagging 20). Calculate sensitivity and specificity and state what each means.

- Sensitivity = TP / (TP + FN) = 90 / (90 + 10) = 90/100 = 90%.
- This means the test catches 90% of people who truly have cancer.
- Specificity = TN / (TN + FP) = 80 / (80 + 20) = 80/100 = 80%.
- This means the test correctly clears 80% of truly healthy people (20% get a false alarm).

Answer: Sensitivity = 90% (catches most true cases); Specificity = 80% (correctly clears most healthy people, but 20% false positives).

Practice questions (with reasoning)

1. A mutation produces a premature stop codon and a truncated tumor suppressor. This is a:

A. Silent mutation
B. Missense mutation
C. Nonsense mutation
D. Duplication

Answer: C. A premature stop codon that truncates the protein is a nonsense mutation.

2. Higher oncogene expression correlates with higher tumor incidence in a scatter plot. The safest conclusion is:

A. Expression definitely causes every cancer
B. There is an association, but correlation does not prove causation
C. The gene is irrelevant
D. Incidence falls as expression rises

Answer: B. Correlation indicates an association worth studying, not proof of causation.

3. Which treatment helps the patient's own immune system attack the cancer?

A. Radiation therapy
B. Immunotherapy
C. Standard chemotherapy
D. Angiogenesis

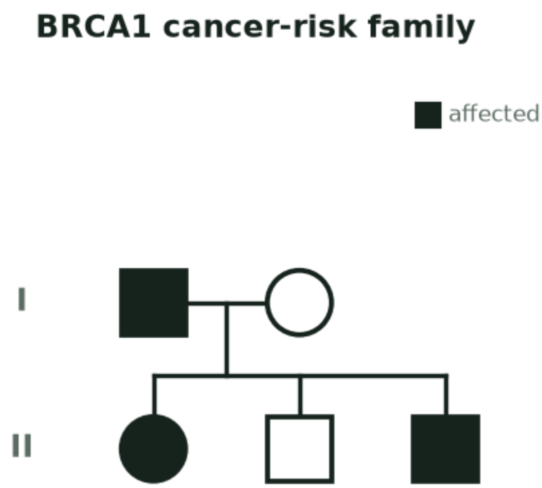
Answer: B. Immunotherapy enlists or directs the immune system against cancer cells.

4. A test correctly clears 95% of healthy people but catches only 60% of true cases. It has:

A. High sensitivity, low specificity
B. High specificity, lower sensitivity
C. Low specificity and low sensitivity
D. Perfect accuracy

Answer: B. Clearing most healthy people = high specificity; missing many true cases = lower sensitivity.

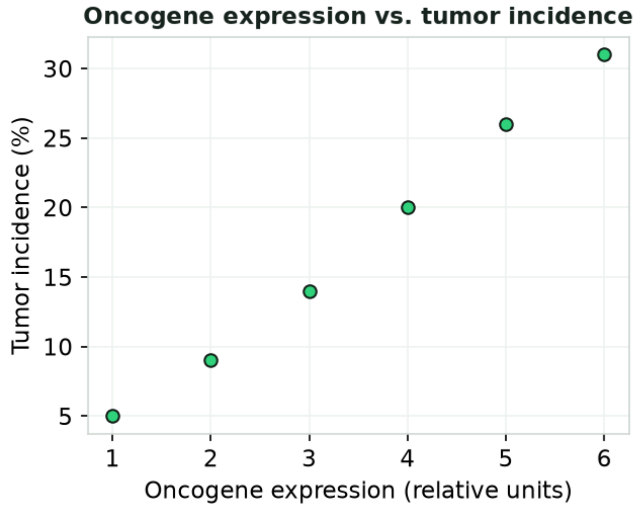
5. This family carries an inherited BRCA1 mutation that raises breast/ovarian cancer risk. An affected parent passes it to roughly half of the children, both sexes are affected, and every affected child has an affected parent. What inheritance pattern does the pedigree show?



A. Autosomal recessive
B. Autosomal dominant
C. X-linked recessive
D. Mitochondrial

Answer: B. Affected children always have an affected parent, both sexes are affected, and about half the offspring of an affected parent are affected — the hallmark of an autosomal dominant trait like an inherited BRCA1 mutation.

6. The scatter plot shows tumor incidence rising as oncogene expression increases across patient samples. What does this pattern best support?



A. A negative correlation between expression and incidence

B. A positive correlation, but causation is not proven by this plot alone

C. Proof that the oncogene directly causes every tumor

D. No relationship between the two variables

Answer: B. As expression rises, incidence rises — a positive correlation — but a scatter plot alone shows association, not proof of causation.