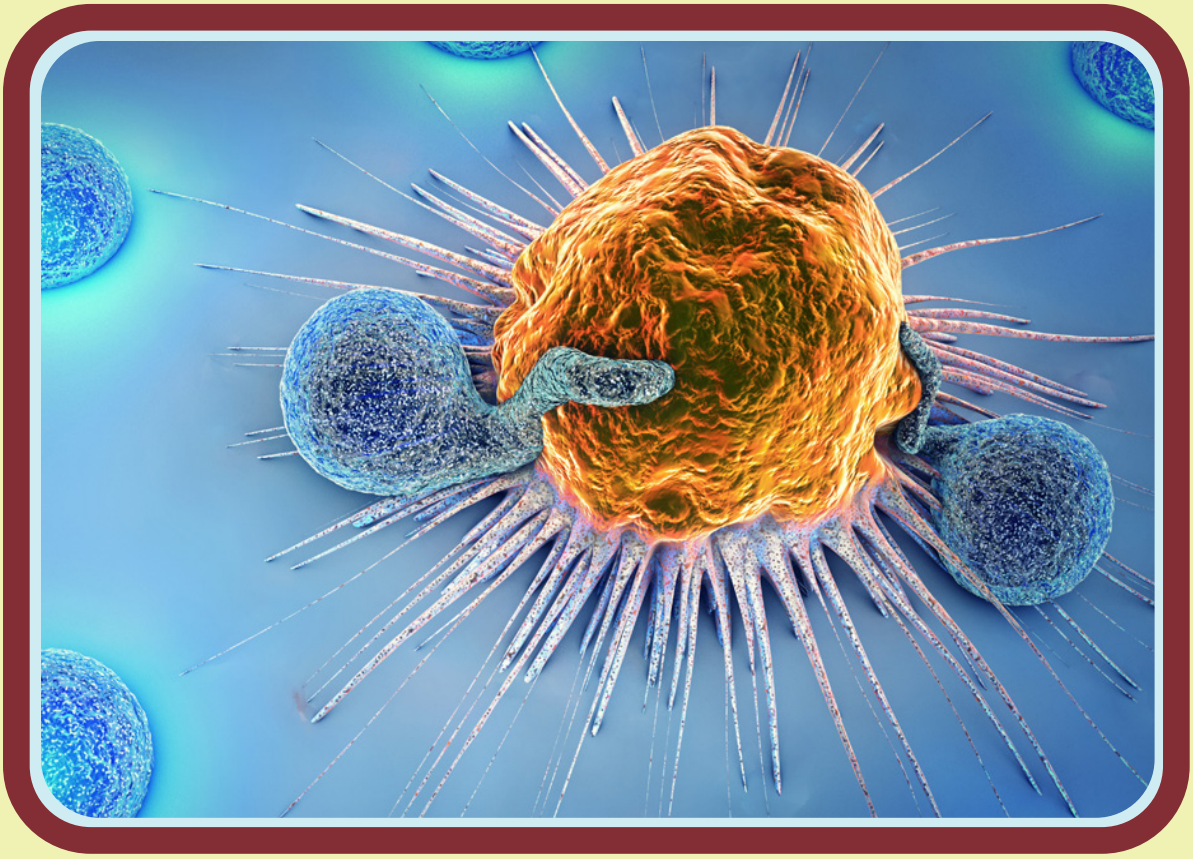
STEM Sims™

Tumor Marker



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Do you need an idea for a scientific study? Try out one of our ideas or make one of your own.

Making decisions is a hard process for some. Making medical decisions can be even harder. Take the following brief quiz to see how much you already know about how to make informed decisions. See the bottom of page 4 to check your answers.

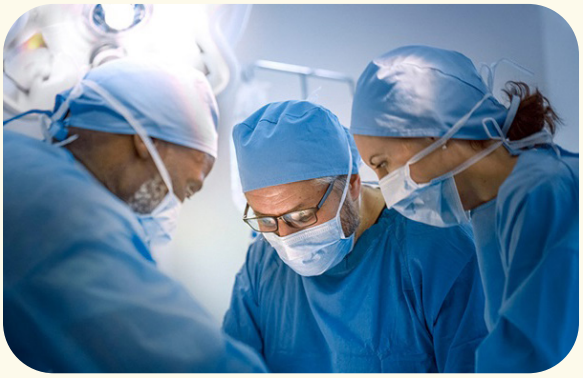
1. As of 2018 according to the Center for Disease Control (CDC), about what percentage of deaths in the United States were attributed to medical mistakes?
   a. 0.1%
   b. 1.0%
   c. 10%
   d. 35%

2. As of 2018 according to the CDC, medical mistakes were the _____ highest cause of deaths in the United States.
   a. 1st
   b. 2nd
   c. 3rd
   d. 6th

3. As of 2018 according to the CDC, about how many deaths in the United States each year were attributed to medical mistakes?
   a. 10,000
   b. 50,000
   c. 150,000
   d. 250,000

4. Which term is defined as “injury or illness caused by medical personnel?”
   a. injurious harm
   b. unplanned harm
   c. medicine harm
   d. iatrogenic harm

5. All the following are the most common medical mistakes causing harm to patients *except*:
   a. misdiagnosis.
   b. ordering unnecessary medical tests.
   c. medication errors.
   d. infections.



Which Test is Best?

Misdiagnosing illnesses is a common mistake made by the medical community. Many times, these mistakes are attributed to human error. Other times a faulty test is the culprit. In this activity, you'll evaluate two medical tests using an ROC curve and determine which is the better at identifying patients with a disease.

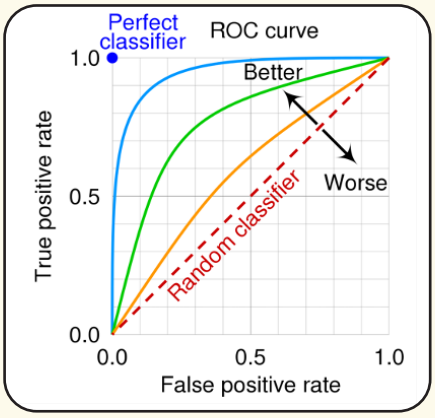
Directions

1. View the test results for Test A and Test B.
2. Use the following equation to calculate the accuracy of each test:

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

   Where TP = the true positive cases (tested + and have the disease), TN = true negative cases (tested – and do not have the disease), FP = false positive cases (tested + and do not have the disease), and FN = false negative cases (tested – but have the disease).
3. Observe the ROC graph below. A truly random test or process, such as flipping a coin and getting a head or a tail would have a graph that started at the origin and had a slope that moved through the point (0.5, 0.5).
4. Answer the questions below.

TP = 63	FN = 37		TP = 77	FN = 23
FP = 28	TN = 72		FP = 77	TN = 23
Accuracy =			Accuracy=	



Questions

1. Which is the better test at diagnosing disease, Test A or Test B?
2. Why is this test better?

3. Which line on the graph most likely represents Test A?
4. Which line on the graph most likely represents Test B?

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What is an ROC Curve?

Although the first radar was created in late 19th century, it was not until the late 1930's before radar operators could tell the difference between a flock of birds and other objects in the sky. During World War II, radar was deployed to help make identifications of enemy airplanes approaching military bases. The radar operators needed a way to discern airplanes (true cases) from flocks of birds (false cases). The receiver operating characteristic curve (ROC curve) was developed to make these distinctions.

Fast forward decades and medical researchers today still use the ROC curve to evaluate the efficacy of various medical tests in detecting cancers. In recent years, a variety of new cancer detection methods have joined X-rays, MRI, ultrasound, CT, and endoscopy as the go-to method of finding cancerous cells. One of these newer techniques involves using nanotechnologies to find early-stage cancers. These new tests provide high sensitivity and specificity, which is exactly what the ROC curve is used to determine. Diagnostic sensitivity is a measure of those that do have the disease and do test positive. Diagnostic specificity is a measure of those who do *not* have the disease and test negative.

The goal of all these medical tests is to increase the number of true positive and true negative test results and reduce the number of false positive and false negative test results. Cancer claims about 9 million lives each year. Effective tests that can quickly find cancer may save a significant number of people from this dreaded disease. The ROC curve is a major tool to help evaluate these new tests. And this all goes back to those engineers who wanted to help radar operators discern airplanes from flocks of birds. You just never know where one scientific discovery will lead.

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Answers: Page 2 Answers: 1) c, 2) c, 3) d, 4) d, 5) b. **Page 3 Answers:** Which Test is Best? 1) Test A. 2) Test A is more accurate than Test B. 3) Green line. 4) The dashed red line.