Name: _____ Hour: _____ Date: _____

Can You Taco Tongue and Evil Eyebrow? Day 2

Are the events "Yes Taco Tongue" and "Yes Evil Eyebrow" independent?

1. Find class data from the previous lesson and fill in the following two-way table.

	Yes Evil Eyebrow	No Evil Eyebrow	Total
Yes Taco Tongue	15	5	20
No Taco Tongue	3	7	10
Total	18	12	30

Suppose we randomly choose a student from class.

Review

2. Find P(Yes Taco Tongue OR Yes Evil Eyebrow)

$$\frac{20}{30} + \frac{18}{30} - \frac{15}{30} = \frac{23}{30}$$

conditional probability

3. Given that the person selected is a Yes Evil Eyebrow, what is the probability that they are a Yes Taco Tongue? Write as a fraction, a decimal, and a percent.

$$\frac{15}{18} = 0.83 = 83\%$$ P(Yes Taco Tongue | Yes Evil Eyebrow)

4. Given that the person selected is a No Evil Eyebrow, what is the probability that they are a Yes Taco Tongue? Write as a fraction, a decimal, and a percent.

$$\frac{5}{12} = 0.42 = 42\%$$ P(Yes Taco Tongue | No Evil Eyebrow)

Definition: Two events are **independent** if knowing whether or not one event has occurred does not change the probability that the other event will occur.

5. Are the events "Yes Taco Tongue" and "Yes Evil Eyebrow" independent? Explain.

No! Knowing whether or not a student is Yes or No Evil Eyebrow changes the probability they are Yes Taco Tongue from 83% to 42%.

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Consider the data for all Seniors at EKHS.

	Yes Evil Eyebrow	No Evil Eyebrow	Total
Yes Taco Tongue	180	300	480
No Taco Tongue	20	100	120
Total	200	400	600

6. Find each of the following using the data in the table. Write as a fraction, a decimal, and a percent.

   a. P(Yes Taco Tongue) = $\frac{480}{600}$ = 0.8 = 80%.

   b. P(Yes Taco Tongue | Yes Evil Eyebrow) = $\frac{180}{200}$ = 0.9 = 90%.

   c. P(Yes Taco Tongue | No Evil Eyebrow) = $\frac{300}{400}$ = 0.75 = 75%.

   d. Are "Yes Taco Tongue" and "Yes Evil Eyebrow" independent? No! → dependent events

7. Fill in the table as if the events were INDEPENDENT.

   80% of 200   80% of 400   80% of 600

	Yes Evil Eyebrow	No Evil Eyebrow	Total
Yes Taco Tongue	160	320	480
No Taco Tongue	40	80	120
Total	200	400	600

8. Find each of the following using the INDEPENDENT table. Write as a fraction, a decimal, and a percent.

   a. P(Yes Taco Tongue) = $\frac{480}{600}$ = 0.8 = 80%.

   b. P(Yes Taco Tongue | Yes Evil Eyebrow) = $\frac{160}{200}$ = 0.8 = 80%.

   c. P(Yes Taco Tongue | No Evil Eyebrow) = $\frac{320}{400}$ = 0.8 = 80%.

9. What do you notice about your answers in #6 and #8?
When events are not independent, all 3 probabilities are different.
When events are independent, all 3 probabilities are equal.

10. Generalize: Complete the following statement using a formula.

   Let A → Yes Taco Tongue and B → Yes Evil Eyebrow

   If events A and B are INDEPENDENT then...

   $$P(A) = P(A|B) = P(A|B^c)$$

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Conditional Probability and Independence

Important Ideas:	LT#2: Independent Events
LT#1: Conditional Probability $P(A\|B) \rightarrow$ "probability of A, given B"	Knowing whether or not one event has occurred does not change the probability that the other event will occur. $$P(A) = P(A\|B) = P(A\|B^c)$$

Check Your Understanding:

Yellowstone National Park surveyed a random sample of 1526 winter visitors to the park. They asked each person whether he or she owned, rented, or had never used a snowmobile. Respondents were also asked whether they belonged to an environmental organization (like the Sierra Club). The two way table summarizes the survey responses.

		Environmental club		
		No	Yes	Total
Snowmobile experience	Never used	445	212	657
	Renter	497	77	574
	Owner	279	16	295
	Total	1221	305	1526

Suppose we randomly select one of the survey respondents. Define events E: environmental club member, S: snowmobile owner, and N: never used.

1. Find P(N | E). Interpret this value in context. $P(N|E) = \dfrac{212}{305} = 0.695$

The probability someone has never used a snowmobile, given they are in the environmental club is 0.695.

2. Given that the chosen person is not a snowmobile owner, what's the probability that she or he is an environmental club member? Write your answer as a probability statement using correct symbols for the events.

$$P(E|S^c) = \frac{212+77}{657+574} = \frac{289}{1231} = 0.235$$

3. Are the events "Snowmobile owner" and "Environmental club member" independent? Explain.

$P(\text{snowmobile}) = {}^{295}/_{1526} = 0.193$

$P(\text{snowmobile} | \text{environmental}) = {}^{16}/_{305} = 0.052$

$P(\text{snowmobile} | \text{no environmental}) = {}^{279}/_{1221} = 0.229$

No
$P(S) \neq P(S|E) \neq P(S|E^c)$

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