

# AP Biology Chi-Squared Practice Problems

## (Set I)

The integration of analytical skills in the AP Biology course has provided a new challenge for AP Biology teachers. In an attempt to facilitate student mastery of unfamiliar skills I have chosen to front-load analytical skills into beginning of my course. My students will be assessed with a minimum of 5 grid-in problems on each unit exam.

I have experienced extreme difficulties finding chi-squared problems that are not all content specific, but still appropriate for the course. In order to implement the course long strategy I needed a bank of problems that students could complete at any time in the course. I've decided to pass these problems I've developed on to the AP Biology teachers who are experiencing the same struggle!

**Chi-Squared Formula:**  $\chi^2 = \sum \frac{(O-E)^2}{E}$

**Where:**

- O** = Observed Result
- E** = Expected Result
- Σ** = Sum of

### Critical Values:

Degrees of Freedom	Level of Probability (P)									
	.98	.95	.80	.50	.20	.10	.05	.02	.01	.001
1	.001	.004	.064	.455	1.64	2.71	3.84	5.41	6.64	10.83
2	.040	.103	.466	1.386	3.22	4.61	5.99	7.82	9.21	13.82
3	.185	.352	1.005	2.366	4.64	6.25	7.82	9.84	11.35	16.27
4	.429	.711	1.649	3.357	5.99	7.78	9.49	11.67	13.28	18.47
5	.752	1.145	2.343	4.351	7.29	9.24	11.07	13.39	15.09	20.52

1. When studying animal behavior, the distribution of organisms within a choice chamber can be studied to identify animal preferences. 20 Isopods are placed in a 2-choice choice chamber. A cotton ball dampened with distilled water is placed in Chamber A; A dry cotton ball is placed in Chamber B. After 15 minutes 2 Isopods are located in Chamber B, and 18 isopods are found in Chamber A. Perform the chi-squared test to determine if the distribution of isopods is significant or due to random chance. (3 points)

<p>a. Complete the grid in space with the chi-squared value.</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">-</td><td style="text-align: center;">.</td><td style="text-align: center;">/</td><td style="text-align: center;">/</td><td style="text-align: center;">/</td><td></td></tr> <tr><td></td><td style="text-align: center;">.</td><td style="text-align: center;">.</td><td style="text-align: center;">.</td><td style="text-align: center;">.</td><td style="text-align: center;">.</td></tr> <tr><td></td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td></td></tr> <tr><td style="text-align: center;">1</td><td style="text-align: center;">1</td><td style="text-align: center;">1</td><td style="text-align: center;">1</td><td style="text-align: center;">1</td><td></td></tr> <tr><td style="text-align: center;">2</td><td style="text-align: center;">2</td><td style="text-align: center;">2</td><td style="text-align: center;">2</td><td style="text-align: center;">2</td><td></td></tr> <tr><td style="text-align: center;">3</td><td style="text-align: center;">3</td><td style="text-align: center;">3</td><td style="text-align: center;">3</td><td style="text-align: center;">3</td><td></td></tr> <tr><td style="text-align: center;">4</td><td style="text-align: center;">4</td><td style="text-align: center;">4</td><td style="text-align: center;">4</td><td style="text-align: center;">4</td><td></td></tr> <tr><td style="text-align: center;">5</td><td style="text-align: center;">5</td><td style="text-align: center;">5</td><td style="text-align: center;">5</td><td style="text-align: center;">5</td><td></td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">6</td><td style="text-align: center;">6</td><td style="text-align: center;">6</td><td style="text-align: center;">6</td><td></td></tr> <tr><td style="text-align: center;">7</td><td style="text-align: center;">7</td><td style="text-align: center;">7</td><td style="text-align: center;">7</td><td style="text-align: center;">7</td><td></td></tr> <tr><td style="text-align: center;">8</td><td style="text-align: center;">8</td><td style="text-align: center;">8</td><td style="text-align: center;">8</td><td style="text-align: center;">8</td><td></td></tr> <tr><td style="text-align: center;">9</td><td style="text-align: center;">9</td><td style="text-align: center;">9</td><td style="text-align: center;">9</td><td style="text-align: center;">9</td><td></td></tr> </table>							-	.	/	/	/			.	.	.	.	.		0	0	0	0		1	1	1	1	1		2	2	2	2	2		3	3	3	3	3		4	4	4	4	4		5	5	5	5	5		6	6	6	6	6		7	7	7	7	7		8	8	8	8	8		9	9	9	9	9		<p>b. 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2. When a six-sided die is rolled, the roller has six possible outcomes. Emily claims that she nearly always rolls 5. Emily believes that 5 is her lucky number, and something super-natural is leading to this pattern or outcomes. Emily rolls a die 300 times and records the outcomes. Perform a chi-squared test to determine if Emily is truly rolling a significant number of fives, or if Emily's rolls are simply due to chance. (3 points)

Die Face	1	2	3	4	5	6
# of times rolled	15	70	33	31	89	62

a. Complete the grid in space with the chi-squared value.

		/	/	/	
-	.	.	.	.	.
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

b. Complete the grid in space with the critical value.

		/	/	/	
-	.	.	.	.	.
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

c. Do you reject the null hypothesis?  
Yes or No

3. When studying animal behavior, the distribution of organisms within a choice chamber can be studied to identify animal preferences. 99 fruit flies are placed in a 2-choice choice chamber with a large middle passage where flies may remain. Chamber A contains a 5 g sample of over ripe grapes; the middle passage is empty. Chamber B contains a 5 g sample of not yet ripe grapes. After 40 minutes 20 flies are in the middle, 43 flies are in chamber A, and 36 flies are in chamber B. Perform the chi-squared test to determine if the distribution of fruit flies is significant or due to random chance. (3 points)

a. Complete the grid in space with the chi-squared value.

		/	/	/	
-	.	.	.	.	.
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

b. Complete the grid in space with the critical value.

		/	/	/	
-	.	.	.	.	.
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

**c. Do you reject the null hypothesis?  
Yes or No**

4. Mark accuses Brandon of using a weighted coin when they are flipping coins for a piece of pizza. Mark states that Brandon always chooses heads, and the coin seems to decide in Brandon's favor. To prove his innocence, Brandon flips the coin 30 times to demonstrate his innocence. After 30 flips the coin lands on heads 18 times, and the coin lands on heads tails 12. Perform the chi-squared test to determine if Brandon is truly cheating his friend.

**a. Complete the grid in space with the chi-squared value.**

		○	○	○	
○	○	○	○	○	○
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

**b. Complete the grid in space with the critical value.**

		○	○	○	
○	○	○	○	○	○
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

**c. Do you reject the null hypothesis?  
Yes or No**

5. In a marketing study, 120 Students are given a taste-test of 4 different colas. The results are recorded below Is there a cola students prefer by taste?

	Cola A	Cola B	Cola C	Cola D
# of students choosing cola	20	45	17	38

a. Complete the grid in space with the chi-squared value.

		⊗	⊗	⊗	
⊖	⊙	⊙	⊙	⊙	⊙
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

b. Complete the grid in space with the critical squared value.

		⊗	⊗	⊗	
⊖	⊙	⊙	⊙	⊙	⊙
		0	0	0	0
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5
	6	6	6	6	6
	7	7	7	7	7
	8	8	8	8	8
	9	9	9	9	9

c. Do you reject the null hypothesis?  
Yes or No