MT HOSA Genetics

Event Category: Health Professions

Dress Code: Attire appropriate to the occupational area or business casual	**Round One:** 50 Q test (60 minutes)	**Digital Upload:** Yes, mystery skills video during Jan 18- Feb 12 window
Solo Event: 1 competitor	**Round Two:** Skill(s) assessment	

Event Summary

Genetics provides HOSA Members the opportunity to gain the knowledge and skills required for a laboratory setting and to explore genetics-related careers. This competitive event consists of two rounds. Round One is a written, multiple-choice test, and the top-scoring competitors will advance to Round Two for the skills assessment. This event aims to inspire members to learn more about the careers available. Carolina Biological Supply Company has developed a special landing page for HOSA competitors and advisors.

General Event Information

Competitors Must Provide

- Safety glasses or goggles
- Disposable gown (PPE)
- Disposable non-latex gloves
- Full-face shield (or equivalent PPE)
- Disposable masks with ties or loops

HOSA Conference Staff will provide equipment and supplies listed in Appendix I.

Official References

The references below are used in the development of the test questions and skill rating sheets

- Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy
- Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Printed Version

Official References

The following references are used in skill development:

Skill	References
Skill I: DNA Extraction	Strawberry DNA Extraction Video and Handout
Skill II: Perform Gene Transfer with Asexually Reproducing Organism (E.Coli)	**Bacterial Conjugation:** • Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (page 19) • Sterile Technique • Streaking for Isolation • **Suggested preparation:** Lab Skills: Aseptic Technique **Bacterial Transduction:** • Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (page 17-18) • Sterile Technique • **Suggested preparation:** Lab Skills: Serial Dilution

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

	Skill III: Perform Test Genetic Cross with Sexually Reproducing Model Organism	**Drosophila:** • Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (pages 89-111) • Drosophila Care Guide and Videos • Introductory Genetics With Drosophila **Wisconsin Fast Plants:** • Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (pages 84-88) • Wisconsin Fast Plants Care Guide and Videos • Wisconsin Fast Plants Video Playlist • Wisconsin Fast Plants
	Skill IV: Genetic Cross Results Interpretation	Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (pages 25-48)
	Skill V: Validate Mode of Inheritance Using Chi-Square Test	Carolina® Genetics: A Guidebook for the HOSA Genetics Written Test Digital Copy (pages 67-75)

ROUND ONE- Test

Test Instructions	The written test will consist of 50 multiple-choice items in a maximum of 60 minutes. See test instructions here.
Written Test Plan	The written test for Genetics is: • Reproduction, Mitosis and Meiosis- 20% • Classical Genetics- 20% • Chromosomal Inheritance- 10% • Experimental Design and Model Organisms- 15% • Molecular Genetics- 15 % • Population Genetics- 10% • Modern Applications and Careers in Genetics- 10%
Sample Test Questions	1. During which phase of the cell cycle is DNA replicated? (Teaching the Cell Cycle and Mitosis - Carolina Knowledge Center) A. G1 **B. S** C. G2 D. M 2. A cross between white eyed female drosophila and red eyed male drosophila produced the F1 generation below

F1	Red Eyes	White Eyes
Female	6	0
Male	0	6

From the F1 generation, crossing a red-eyed female with a white eyed male produced

F2	Red Eyes	White Eyes
Female	5	5
Male	5	5

	Using the charts above which of the following inheritance patterns matches the data of this cross for white eye color? (Genetics with Drosophila F1 Crosses: Sex-Linkage | Carolina Biological Supply) A. Simple dominance B. Codominance C. Incomplete dominance **D. X-linked trait**  3. What type of mutation has occurred to the DNA strand shown above? (Modeling-DNA-to-Protein_NSTA-DENVER-2024.pdf) A. Frameshift – addition B. Frameshift – deletion C. Translocation **D. Substitution**
Mystery Skill Video	This event has a mystery skill video that must be uploaded. The mystery skill will be released along with instructions to upload on January 18th. Videos must be uploaded by **February 12th** at midnight MST as the final deadline, and there will be **NO EXCEPTIONS.** We STRONGLY suggest not waiting until the last minute to upload online to avoid user challenges with the system. Videos must be uploaded to the hosa website for judges to access them. Detailed instructions for uploading materials can be found at https://hosa.org/competitive-event-digital-uploads/ For SLC, the digital materials uploaded by **February 12** will be PRE-SCREENED to qualify for Round 2. Competitors who do not upload materials are NOT eligible for the Round Two presentation portion of the competition and **will NOT be given a competition appointment time at SLC**.

ROUND TWO- Skills Assessment

1. The top competitors from Round One will advance to Round Two. The number of advancing competitors will be determined by the scores obtained in Round One, the mystery skill video upload, and the space and time available for Round Two. Competitors shall report to the event site 10 minutes before their appointment time.

2. Round Two is a selected skill(s) performance. The Round Two skills approved for this event are:

Skill I: DNA Extraction	**20 minutes**
Skill II-A: Perform Gene Transfer with Asexually Reproducing Organism (E.Coli) Bacterial Conjugation	**20 minutes**
Skill II-B: Perform Gene Transfer with Asexually Reproducing Organism (E.Coli) Bacterial Transduction	**20 minutes**
Skill III-A: Perform Test Genetic Cross with Sexually Reproducing Model Organism	**25 minutes**
Skill III-B: Perform Test Genetic Cross with Sexually Reproducing Model Organism- Wisconsin Fast Plants	**25 minutes**
Skill IV: Genetic Cross Results Interpretation	**15 minutes**
Skill V: Validate Mode of Inheritance Using Chi-Square Test	**15 minutes**

3. For all skills, body fluids will be simulated products.

4. The selected skill(s) will be presented to competitors as a written scenario at the beginning of the round. The scenario will be the same for each competitor. A sample scenario can be found here. Some scenarios may involve the combination of multiple skills. If the event rating sheets are combined, it is not necessary to repeat a task a second time. An example would be competitors would not need to identify the patient twice.

5. Timing will begin when the scenario is presented to the competitors and will be stopped at the end of the time allowed. The scenario is a secret topic. Competitors MAY NOT discuss or reveal the secret topic until after the event has concluded or will face penalties per the GRRs.

6. Competitors must complete all skill steps listed in the guidelines, even if the steps must be simulated/verbalized. (If the equipment is available, the competitors would complete all skill steps as the scenario warrants. The competitors will simulate/verbalize the steps if the equipment is unavailable.)

7. Judges will provide information to competitors as directed by the rating sheets. Competitors may ask questions of the judges while performing skills, if the questions relate to patient's condition and will be included in the scenario or judge script.

8. Competitors must use all equipment correctly and safely. Judges will stop a student and not award points for a step if they see a competitor is about to cause a risk of harm or about to damage equipment or other supplies.

Final Scoring

1. The competitor must earn a score of 70% or higher on the combined skill(s) of the event in order to be recognized as an award winner at the ILC.
2. The final rank is determined by adding the round one test score plus the round two skill score. In the event of a tie, the highest test score will be used to determine the final placement.

Genetics

Skill I: DNA Extraction

Time: 20 minutes

Competitor #:_____ **Division: _____**SS **_____**PS/C **Judge's Signature:**_____

	Skill I: DNA Extraction	**Possible**	**Awarded**
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Obtained DNA source, placed in bag, sealed bag, and gently mashed with hands for 2 minutes.	**2 0**	
3.	Measured 10 ml of extraction buffer, poured into bag, and mashed with hands for one additional minute	**2 0**	
4.	Placed funnel into 50 ml centrifuge tube, folded cheesecloth and placed it into the funnel to create a filter.	**2 0**	
5.	Poured mixture into the filter, filtering the contents through the cheesecloth into the 50-ml centrifuge tube	**2 0**	
6.	Carefully poured 2 ml of the filtered contents from the 50 – ml tube into a clean 15 – ml tube.	**1 0**	
7.	Used a transfer pipette to measure and add 5 ml of chilled 95% ethanol to the 15-ml tube	**2 0**	
8.	Inserted and rotated wooden stick or transfer pipette in ethanol directly above the extract layer to wind (or "spool") DNA	**2 0**	
9.	Transferred DNA from wooden stick or transfer pipette into 1.5 ml tube.	**2 0**	
10.	Cleaned up work area by disposing of bags, cheesecloth, and used 50 and 15 ml tubes	**1 0**	
11.	Cleaned work surface with disinfectant	**1 0**	
12.	Removed PPE	**1 0**	
	Total Points- Skill I: 70% Mastery for Skill I: 14	**20**	

The expectation is that competitors read and are aware of all the content within these guidelines and associated links. Successful competitors will study all links for the detailed information.

Genetics

Skill II-A: Perform Gene Transfer with Asexually Reproducing Model Organism (E. Coli) Bacterial Conjugation

Time: 20 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

Skill II-A: Perform Gene Transfer with Asexually Reproducing Model Organism (E. Coli)- Bacterial Conjugation		**Possible**	**Awarded**
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
Observe Confirmation Plates			
2.	Examined the prepared confirmation plates and recorded the observed results.	**2 0**	
Prepare "Mating" Plate			
3.	Used correct sterile technique to dip a sterile inoculating loop into the liquid culture of Strain 1	**2 0**	
4.	Placed a drop of culture on the LB mating plate by touching the inoculated loop to the agar.	**2 0**	
5.	Used a new loop and the liquid culture of strain II to place a drop of strain II 1/2inch from the drop of the strain 1 on the mating plate	**2 0**	
6.	Used a new sterile loop to mix strains 1 and II over surface of mating plate.	**2 0**	
7.	Allowed the liquid on the plate to soak in completely and inverts plate.	**1 0**	
8.	Vocalizes "Incubate plates for 24-48 hours at room temperature (37C)"	**1 0**	
Testing for Recombination: *Transferred some bacterial cells from the mating plate to LB+amp, LB+str, and LB+str+amp plates using correct sterile technique.* ***Judges: one point awarded per step per plate (3 plates total) for steps 9-12 below***			
9.	Used correct sterile technique to remove a sterile inoculating loop from the package by opening it from the handle end	**3 0**	
10.	Slightly lifted the lid of the mating plate and picked up bacteria. Closed lid.	**3 0**	
11.	Streaked some bacteria onto plate (to LB+amp, LB+str, and LB+str+amp). Plate was opened as little as possible during this step	**3 0**	
12.	Discarded the loop in the disposal container or replace it into its wrapper for disposal later.	**3 0**	
13.	Taped plates together	**1 0**	
14.	Vocalizes "Incubate plates for 24-48 hours at room temperature (37C)"	**1 0**	
15.	Cleaned up work area and cleaned work surface with disinfectant	**1 0**	
16.	Removed PPE.	**1 0**	
	Total Points- Skill II-A: 70% Mastery for Skill II-A: 21	**30**	

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Genetics

Skill II-B: Perform Gene Transfer with Asexually Reproducing Model Organism (E. Coli) Bacterial Transduction

Time: 20 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

	Skill II-B: Perform Gene Transfer with Asexually Reproducing Model Organism (E. Coli)- Bacterial Transduction (Essential Lab Skill Performed- Serial Dilution)	**Possible**	**Awarded**
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Labeled four sterile culture tubes "BE." Label four other sterile culture tubes "CR63."	**1 0**	
3.	On one of the BE tubes and one of the CR63 tubes, wrote "undiluted" (or "UD" for short). On a second BE tube and a second CR63 tube, wrote "1:10." On a third BE tube and a third CR63 tube, wrote "1:100." On the remaining tube of each set, wrote "no phage."	**1 0**	
4.	Used a sterile transfer pipet to place 0.5 mL of E. coli BE culture into the four tubes labeled "BE."	**2 0**	
5.	Used a sterile transfer pipet to place 0.5 mL of E. coli CR63 culture into the four tubes labeled CR63.	**2 0**	
	Infect the BE and CR63 cultures with undiluted bacteriophage **** Judge: one point awarded per step per culture tube (2 total) for steps 6-8 below***		
6.	Added 10 µL of undiluted transducing lysate to the tube of BE cells & CR63 labeled "undiluted."***** ***Assessment does not include use of micropipettes. Fixed volume or other methods of liquid transfer are permitted.**	**2 0**	
7.	Disposed of the tip or disposable pipette used to transfer 10 ul in the biological waste container.	**2 0**	
8.	Gently flicked the bottom of the BE cells & CR63 tubes to mix the phages and cells.	**2 0**	
	Infect the BE and CR63 cultures with transducing lysate that has been diluted 1:10 ****Judge: one point awarded per step per culture tube (2 total) for steps 9-11 below***		
9.	Added 10 µL of the 1:10 dilution of the transducing lysate to the tube of BE cells & CR63 labeled "1:10."***** ***Assessment does not include use of micropipettes. Fixed volume or other methods of liquid transfer are permitted.**	**2 0**	
10.	Disposed of the tip or disposable pipette used to transfer 10 ul in the biological waste container	**2 0**	
11.	Gently flicked the bottom of the BE cells & CR63 tubes to mix the phages and cells.	**2 0**	
	Infect the BE and CR63 cultures with transduction lysate that has been diluted 1:100 ****Judges: one point awarded per step per culture tube (2 total) for steps 12-14 below***		

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Skill II-B: Continued...		Possible		Awarded
12.	Added 10 µL of the 1:100 dilution of the transducing lysate to the tube of BE cells & CR63 labeled "1:100."* ***Assessment does not include use of micropipettes. Fixed volume or other methods of liquid transfer are permitted.**	**2**	**0**	
13.	Disposed of the tip used or disposable pipette to transfer 10 ul in the biological waste container.	**2**	**0**	
14.	Gently flicked the bottom of the BE cells & CR63 tubes to mix the phages and cells.	**2**	**0**	
15.	Vocalized "let all the tubes stand at room temperature for 5 to 15 minutes."	**1**	**0**	
Plate the Phage-Bacteria Mixtures				
16.	On the bottom of each LB/amp plate, wrote "BE," the date, and something to identify the plates as belonging to the student. Wrote on the bottom of one of these labeled LB/amp plates, "no phage," on another, "undiluted," on a third, "1:10," and on the fourth, "1:100."	**1**	**0**	
17.	On the bottom of each LB plate, wrote "CR63," the date, and something to identify the plates as belonging to the student. Wrote on the bottom of one of these labeled LB plates, "no phage," on another, "undiluted," on a third, "1:10," and on the fourth, "1:100."	**2**	**0**	
18.	Collected glass beads for spreading the plate. Turned the plates over and, one at time, slightly open each plate and shake four or five glass beads onto the lid.	**1**	**0**	
19.	Used sterile technique, pour the phage and bacteria mixture from each tube onto the correspondingly labeled plate. Lifted the lid of the plate only long enough to pour the contents of the tube onto the plate.	**4**	**0**	
20.	Used a back-and-forth motion (not swirling round and round) to move the glass beads across the entire surface of each plate.	**2**	**0**	
21.	Removed the glass beads from each plate by holding the plate vertically over a container designated for the purpose. Open the plate slightly (like a clamshell) and tap the beads into the container.	**2**	**0**	
22.	Vocalized" Incubate at 37°C for 1–2 days"	**1**	**0**	
23.	Cleaned up work area and cleaned work surface with disinfectant	**2**	**0**	
24.	Removed PPE.	**1**	**0**	
	TOTAL POINTS -- SKILL II-B: 70% Mastery for Skill II-B = 30.1	**43**		

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Genetics

Skill III-A: Perform Test Genetic Cross with Sexually Reproducing Model Organism

Time: 25 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

Skill III-A: Perform Test Genetic Cross with Sexually Reproducing Model Organism Drosophila		**Possible**	**Awarded**
Drosophila Anesthetizing and Sexing			
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	Picked up F1 fly culture, transferred flies to an empty anesthetization vial, and inserted plug into the anesthetization vial.	**2 0**	
3.	Inserted wand dipped in FlyNap into the anesthetization vial between the plug and the wall of the vial.	**2 0**	
4.	Waited until all flies were sleeping and transferred them onto a sorting card for scoring.	**2 0**	
5.	Obtained two additional sorting cards. Labeled one "Male (insert phenotype)" and one "Female (insert phenotype)"	**2 0**	
6.	Identified and sorted flies by sex using sorting brush. Males on one side and females on another side.	**4 0**	
7.	Transferred five males to sorting card labeled "male" and five females to sorting card labeled "female."	**2 0**	
8.	Remaining flies are disposed of in a morgue.	**1 0**	
Drosophila Culture Prep and Cross			
9.	Picked up the following materials: 2 culture vials, 2 plugs, and 2 blank labels.	**3 0**	
10.	Used the measuring cup provided with the Formula 4-24® Instant Drosophila Medium to add one level measure of dry medium to each vial of the two vials	**2 0**	
11.	Used the measuring cup provided to add one level measure of water to each vial.	**2 0**	
12.	Sprinkled four to six grains of yeast on the surface of the medium in each vial. Took care not to add too much yeast, as an excessive amount can damage the culture.	**2 0**	
13.	Marked each label "F2" and the date and initials or group designation. Affixed a label to each vial.	**2 0**	
14.	Cleaned up work area and cleaned work surface with disinfectant.	**1 0**	
15.	Removed PPE.	**1 0**	
	TOTAL POINTS – SKILL III-A: 70% Mastery for Skill III-A: 21	**30**	

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Genetics

Skill III-B: Perform Test Genetic Cross with Sexually Reproducing Model Organism

Time: 25 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

	Skill III-B: Perform Test Genetic Cross with Sexually Reproducing Model Organism- Wisconsin Fast Plants	**Possible**	**Awarded**
Pollination Cross			
1.	Entered testing area wearing closed-toed shoes, then donned proper PPE: glasses/safety glasses/goggles and gloves (lab coat is optional).	**2 0**	
2.	a. Used a pollination wand and obtained pollen from the Stamen of parental phenotype 13-16 day old Wisconsin Fast Plant.	**2 0**	
	b. Pollen was obtained from the correct scenario identified male phenotype.	**1 0**	
3.	a. Applied pollen containing wand to the Pistil of the flowers on the parental phenotype second 13-16 day old Wisconsin Fast Plant ****Self-pollination is not possible. Pollen must be obtained from one plant and applied to a separate plant.**	**2 0**	
	b. Pollen was applied to the correct scenario identified female parental phenotype.	**1 0**	
Seed Extraction and Storage			
4.	Obtained small envelope and labeled it ""F1" and the date and initials or group designation.	**2 0**	
5.	Folded the piece of paper in half lengthwise to create a crease down the middle, opened the paper back up, and laid flat on surface.	**2 0**	
6.	Seed pods are gently opened and seeds are collected on folded paper. Non-seed pod parts are removed	**2 0**	
7.	Paper is folded and used to transport seeds into labeled envelope. Envelope is closed and folded paper is discarded.	**2 0**	
Growing Cross Generation			
8.	Approximately 1 cup of soil was added into a large container.	**1 0**	
9.	35 mL of water is added to the soil containing container and mixed thoroughly until all the soil is evenly moistened.	**1 0**	
10.	A wick is soaked in water until thoroughly wet and placed into the center of the precut X in the bottom of the provided small container.	**1 0**	
11.	1/3 cup moistened soil is evenly spread into the bottom of the small container. The soil should be approximately 1-1.5 cm deep.	**1 0**	
12.	18 fertilizer pellets are placed evenly on top of the soil in the small container	**1 0**	
13.	An additional 1/3 cup of moistened soil is placed on top of the fertilizer pellets. The soil should now be approximately 2.5 – 3 cm deep.	**1 0**	

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Skill III-B: Continued...		Possible	Awarded
14.	A thin layer of moistened soil (approximately 2 tablespoons) is evenly sprinkled over the spaced out Fast Plant Seeds	**1 0**	
15.	10 Wisconsin Fast Plant Seeds are evenly spaced on the surface of the soil	**1 0**	
16.	Large container is rinsed with water and the small container is placed in the top of the rinsed large container	**1 0**	
17.	Seeds are gently watered with 50 ml of water	**1 0**	
18.	One anti-algal square is added to the container	**1 0**	
19.	A permanent marker is used to label the container “F1” and the date and initials or group designation.	**1 0**	
20.	Cleaned up work area and cleaned work surface with disinfectant.	**1 0**	
21.	Removed PPE.	**1 0**	
	TOTAL POINTS -- SKILL III-B: 70% Mastery for Skill III-B: 21	**30**	

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Genetics

Skill IV: Genetic Cross Results Interpretation

Time: 10 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

	Skill IV: Genetic Cross Results Interpretation	Possible		Awarded
1.	identified parental and filial generations of a pedigree demonstrating multiple generations of a genetic cross.	**2**	**0**	
2.	Identified phenotypes and assigned symbols for genotypes for every individual represented on provided pedigree	**3**	**0**	
3.	Correctly identified mode of inheritance for provided pedigree. Inheritance patterns may include Autosomal and sexual dominant or recessive and mitochondrial inheritance.	**2**	**0**	
4.	Accurately sets up and solves Punnett square of provided monohybrid cross with mendelian or non-mendelian inheritance	**3**	**0**	
5.	Accurately sets up and solves Punnett square of provided dihybrid cross with mendelian inheritance.	**4**	**0**	
6.	Accurately sets up and solves Punned square of provided human blood typing cross.	**2**	**0**	
7.	Accurately identifies inheritance resulting from linked genes or genes on different chromosomes.	**2**	**0**	
	TOTAL POINTS -- SKILL IV 70% Mastery for Skill IV= 12.6	**18**		

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Genetics

Skill V: Validate Mode of Inheritance Using Chi-Square Test

Time: 15 minutes

Competitor #:_____ **Division:** _____SS _____PS/C **Judge's Signature:**_____

	Skill V: Validate mode of inheritance using Chi-Square Test	Possible	Awarded
1.	Correctly Identified experimental hypothesis* ***Hypothesis must be a falsifiable prediction**	**2 0**	
2.	Constructed experimentally testable null hypothesis* ***Null hypothesis must include reference to independent and dependent variables**	**2 0**	
3.	Completed expected dihybrid cross.	**2 0**	
4.	Calculated expected population frequency and input values into the expected column of chi-square template.	**4 0**	
5.	Scored traits of observed model organisms (genetic corn, drosophila, Wisconsin fast plants, or provided image).	**4 0**	
6.	Recorded scored traits in observed column of chi-square template.	**1 0**	
7.	Calculated (o-e) and $(o-e)^2$ values in chi-square template.	**2 0**	
8.	Calculated Critical Value (X^2) in chi-square template.	**1 0**	
9.	Identified and calculated degrees of freedom.	**1 0**	
10.	Used critical values table to determine predicted P value.	**1 0**	
11.	Null hypothesis is accepted or rejected accurately based on p value, degrees of freedom, and critical values table interpretation.	**2 0**	
12.	Explained if the mode of inheritance can or cannot be validated based on results of chi-square test.	**2 0**	
	TOTAL POINTS -- SKILL V: 70% Mastery for Skill V= 16.8	**24**	

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