Last updated: February 25th, 2022

Biomedical Laboratory Science

PLEASE NOTE THE FOLLOWING DIFFERENCES IN HOW THIS EVENT WILL BE RUN AT HOSA CANADA'S FALL LEADERSHIP CONFERENCE (FLC) AND SPRING LEADERSHIP CONFERENCE (SLC):

1. Written test time shortened to 40 minutes (still 50 questions) for both FLC and SLC.
2. Written test will take place online and be open book for both FLC and SLC.
3. Only the written test will be evaluated at FLC.
4. Both Rounds One and Two will take place at SLC. The Round Two skill demonstration at SLC will be **virtual**.
    a. *If students participate over Zoom, they must have their cameras on for the entire duration of the event and show the judges their surroundings to help us minimize cheating as much as possible.*
    b. *Students participating over Zoom have the option of demonstrating their skill on a friend/family member.*
    c. *Competitors may verbalize their skill demonstration, especially if they have not purchased the materials required for their event (no points will be deducted).*

Biomedical Laboratory Science

New for 2021 – 2022

Skill step point values have been updated.
Equipment provided by competitor has been updated.

Event Summary

Biomedical Laboratory Science provides members with the opportunity to gain knowledge and skills required for a medical laboratory setting. This competitive event consists of 2 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 biotechnology careers.

Sponsorship This competitive event is sponsored by Bristol Myers Squibb and Bio-Rad Laboratories, Inc.

Dress Code Competitors shall wear proper business attire or official HOSA uniform, or attire appropriate to the occupational area, during both rounds. Bonus points will be awarded for proper dress.

General Rules

1. Competitors in this event must be active members of HOSA and in good standing.
2. Secondary and Postsecondary/Collegiate divisions are eligible to compete in this event.
3. Competitors must be familiar with and adhere to the "General Rules and Regulations of the HOSA Competitive Events Program (GRR)."
4. All competitors shall report to the site of the event at the time designated for each round of competition. At ILC, competitor's photo ID must be presented prior to ALL competition rounds.

Official References

5. All official references, including websites, are used in the development of the written test and skill rating sheets.
   - Estridge and Reynolds. Basic Clinical Laboratory Techniques. Cengage Learning. Latest edition.
   - Daugherty, Ellyn. *Biotechnology: Science for the New Millennium,* Carnegie Learning. Latest edition.
     (*From this link you will click 'view your materials' and then 'proceed to checkout'.)*

- Biotechnology Innovation Organization http://www.bio.org/ as posted as of September 1, 2021
- Additional NEW resource, as of November 17, 2021: Biotechnology A Laboratory Skills Course by J. Kirk Brown. Test question content is not taken from this book; however, competitors and advisors interested in Biotechnology will find the book and other Bio-Rad products extremely beneficial and relevant to their education and classroom.

Round One Test

6. Test Instructions: The written test will consist of 50 multiple choice items in a maximum of 60 minutes.

7. **Time Remaining Announcements:** There will be a verbal announcement when there are 30 minutes, 15 minutes, 5 minutes, and 1 minute remaining to complete the test.

8. **Written Test Plan**

Biotechnology industry, equipment and products	10%
Raw materials of biotechnology	8%
Lab safety and infection control	10%
DNA structure and function	8%
Proteins and enzymes	10%
Genetic engineering	8%
Biotechnology in Health	10%
DNA synthesis, sequencing and genomics	8%
Clinical Chemistry	8%
Hematology and Hemostasis	10%
Careers in medical lab and biotechnology	10%

*NOTE: **Chartered associations** may use a different process for testing, to include but not limited to pre-conference testing, online testing, and testing at a computer. Check with your Chartered Association for the process you will be using.*

9. The test score from Round One will be used to qualify the competitor for the Round Two.

10. **Sample Round One Test Questions**

1. Which step in the scientific method involves the researcher predicting the results of experimentation based on past research or experience?
   A. Conducting an experiment.
   B. Developing a hypothesis.
   C. Formulating the question.
   D. Planning the experiment.
   Daugherty pp 7

2. For the highest possible magnification, the 100x oil immersion lens is used with an ocular strength of 10x. This allows a researcher to see an object how many times its actual size?
   A. 10
   B. 100
   C. 1,000
   D. 10,000

Estridge Page 145

3. Which biotechnology discipline designs mathematical models and uses computers for analyzing and relating sequential data?
   A. Analytic science
   B. Industrialist science
   C. Research analysis
   D. Bioinformatics
   Daugherty Page 441

Round Two Skills

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

    Skill I: Identifying Laboratory Instruments/Equipment *(Including name of instrument/equipment and purpose or use.)* *(15 minutes)*
    15 instruments or photos from the following list:

24-hr Urine Specimen Container	Clinical Centrifuge	N95 Respirator	Single-Use Lancet
Acetest	Coagulation Instrument	Needleless Transfer Device	Slide Staining Rack
Agar Plate	Culture Swabs & Transport Tubes	Perianal Paddle Kit	Sterile Vacuum Tube for Urine
Agar Shield	Disposable Needle Holder with Safety Guard	pH Indicator Strips	Stool Specimen Container
Analytical Balance	Electric Incinerator	pH Meter	Tabletop Autoclave
Automatic Slide Stainer	Emergency Eye Wash Station	Pipet Aids	Test Tubes
Bacteriological Incubator	Eflenmeyer Flask	Plastic Vacuum Tubes	Top-Loading Balance
Beakers	Fume Hood	Platelet Aggregation Profiler	Tourniquet
Beral (Transfer) Pipet	Glucose Meter	Point-of-Care Coagulation Analyzer	Transmission Electronic Microscope
Binocular Bright-Field Microscope	Graduated Cylinders	Rapid-Latex Agglutination Test for D-Dimer	Urine Particle Analyzer
Blood Collection Tubes	Hemacytometer	Refractometer	Urine Reagent Strip
Blood Bank Refrigerator	Inoculating Loop	Saf-T Wing Blood Collection Set	Urine Sterile Collecting Straw
Candle Jar	Manual Differential Cell Counter	Safety Shower	Urine Strip Reader
Capillary Collection Vials	Microhematocrit Centrifuge	Safety Syringes	Urinometer
Chromatographic Immunoassay for Urine hCG	Microhematocrit Tubes with Sealant Pad	Scanning Electron Microscope	Volumetric Flask
Clean-Catch Urine Collection Kit	Micropippettes	Serological Centrifuge	

    Skill II: Infection control and transmission-based precautions *(5 minutes)*
    Skill III: Inoculate and streak an agar plate *(5 minutes)*
    Skill IV: Using a microscope *(10 minutes)*
    Skill V: ABO Grouping *(6 minutes)*
    Skill VI: Gram Stain *(7 minutes)*
    Skill VII: Preparing a Laboratory Solution *(7 minutes)*

    (FOR ALL SKILLS, BODY FLUIDS WILL BE A SIMULATED PRODUCT)

12. 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 and will include a challenging component that will require the competitor to apply critical thinking skills. A sample scenario can be found here.

13. Timing will begin when the scenario is presented to the competitor and will be stopped at the end of the time allowed.

14. 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.

15. 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 physiology and will be included in the scenario.

Final Scoring

16. The competitor must earn a score of 70% or higher on the combined skill(s) of the event (excluding the test and ID lab equipment) in order to be recognized as an award winner at the ILC.

17. Final rank is determined by adding the round one test score plus round two skills score. In case of a tie, the highest test score will be used to determine the rank.

Competitors must provide:

- ☐ Two #2 pencil with eraser
- ☐ Sterile non-latex surgical gloves
- ☐ Disposable masks with ties or loops
- ☐ Watch with second hand (optional-Round Two only)
- ☐ Full Face Shield
- ☐ A photo ID
- ☐ Safety glasses or goggles shield
- ☐ Disposable gown
- ☐ Disposable non-latex gloves

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SKILL I: IDENTIFYING LABORATORY INSTRUMENTS (Time: 15 minutes)

Competitor #: _____ Judge's Initials:_____ Total Points (45 poss.) _____

	Name of Instrument	Points (1 each for name & spelling)	Purpose or Use	Points (1 point for correct purpose/use)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
TOTAL: ID & Spelling (30 poss)			TOTAL: Purpose (15 poss.)	

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Competitor #: _____ Judge's Signature: _____

Skill II: Infection Control and Transmission-Based Precautions (Time: 5 minutes)	Possible	Awarded
1. Assembled equipment and PPE (Personal Protective Equipment - including gloves, mask and gown).	1 0	
2. Washed hands using antiseptic soap a. Turned on warm water using a paper towel to turn the faucet handle, then discarded the towel	2 0	
b. Dispensed soap into hands, then rubbed fronts and backs of hands and between fingers vigorously for 15 – 30 seconds.	2 0	
c. Rinsed hands, fingertips downward, under warm running water.	2 0	
d. Used clean towel to dry hands and turn off faucet.	2 0	
e. Disposed of towel, touching only the clean side.	2 0	
3. Used waterless antiseptic handrub. a. Applied handrub to palm of hand and rubbed hands together vigorously for at least 15 seconds, covering all surfaces of hands and fingers.	2 0	
b. Continued skill until all alcohol has evaporated and hands are completely dry.	2 0	
** Steps for donning PPE must be performed in the order listed below.* 4. Slipped arms into the sleeves of a gown, being careful to touch only the inside of the gown.	2 0	
5. Secured gown at neck and back of waist, covering clothing completely.	2 0	
6. Donned mask a. Picked up mask and place it over the mouth and nose, being careful not to touch the face with the fingers.	2 0	
b. Secured the mask by tying or looping over the ears.	2 0	
7. Donned sterile gloves a. Opened the package of gloves, avoiding touching the outside of the gloves.	2 0	
b. Picked up the right glove by the cuff and inserted the right hand.	2 0	
c. Picked up and held the left glove by inserting the fingertips of the gloved right hand under the cuff of the left glove.	2 0	

Items Evaluated	Possible	Awarded
d. Inserted the left hand into the glove.	2 0	
e. Positioned glove cuffs over the wrists by using gloved fingertips to push cuffs toward the elbow.	2 0	
**** Judge instructs competitor to remove PPE.***		
8. Removed the gloves by folding them down and turning them inside out, avoiding touching the outside of the gloves.	2 0	
9. Discarded gloves in biohazard receptacle.	2 0	
10. Untied gown ties at neck and waist.	2 0	
11. Removed gown by pulling down from the neck and slipping hands back into gown sleeve, touching only the inside of the gown.	2 0	
12. Folded the gown down over the arms inside-out and discarded in biohazard receptacle.	2 0	
13. Removed mask, touching only the ties.	2 0	
14. Held the mask by the ties and discarded in biohazard receptacle.	2 0	
15. Used antiseptic handrub for hand hygiene	2 0	
TOTAL POINTS - SKILL II **70% Mastery for Skill II = 34.3**	**49**	

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Competitor #: _____ Judge's Signature: _____

Skill III: Inoculate and streak agar plate (Time: 5 minutes)			Possible		Awarded
1.	Assembled materials and equipment.		1	0	
2.	Used alcohol-based handrub and put on gloves and face protection.		2	0	
3.	Selected an agar plate to be inoculated and labeled the bottom with a marker.		1	0	
4.	Selected an inoculated swab.		1	0	
5.	Placed package of sterile disposable loops within reach.		1	0	
6.	Removed pre-inoculated swab from package.		1	0	
7.	Opened the lid of the agar plate just enough to insert the swab.		1	0	
8.	Spread the inoculum over the surface of one quadrant of the agar plate.		1	0	
9.	Replaced the lid on the agar plate.		1	0	
10.	Disposed of swab in biohazard receptacle.		1	0	
11.	Picked up a sterile disposable loop and lifted the lid of the agar plate just enough to be able to insert the inoculating loop.		1	0	
12.	a.	Streaked the second quadrant of the plate by touching the loop into the first quadrant and streaking all the way across the second quadrant, and	1	0	
	b.	Made six to eight strokes.	1	0	
13.	Disposed of loop in biohazard receptacle.		2	0	
14.	Picked up a sterile disposable loop and lifted the lid of the agar plate just enough to be able to insert the inoculating loop.		1	0	
15.	a.	Streaked the third quadrant by touching the loop into the second quadrant and streaking into the third quadrant, and	1	0	
	b.	Made six to eight strokes.	1	0	
16.	Disposed of loop in biohazard receptacle.		2	0	
17.	Picked up a sterile disposable loop and lifted the lid of the agar plate just enough to be able to insert the inoculating loop.		1	0	

Items Evaluated			Possible	Awarded
18.	a.	Streaked the fourth quadrant in a manner to produce isolated colonies: Touched the loop to the third quadrant and spread the organism into the fourth quadrant using a continuous streak in a "tornado" pattern.	1 0	
	b.	Decreased the width of the streaks horizontally and increased the distance between the streaks vertically.	1 0	
19.		Replaced the lid on the plate.	1 0	
20.		Disposed of loop in biohazard receptacle.	1 0	
21.		Placed the agar plate upside down in the 35-37°C incubator.	1 0	
22.		Cleaned reusable equipment and returned to proper storage; put disposables in biohazard containers.	2 0	
23.		Cleaned work area with surface disinfectant.	2 0	
24.		Removed gloves and face protection.	2 0	
25.		Used alcohol-based handrub for hand hygiene.	2 0	
TOTAL POINTS - SKILL III **70% Mastery for Skill III = 24.5**			**35**	

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Competitor #: _____ Judge's Signature: _____

Skill IV: Using a Microscope (Time:10 minutes)			Possible		Awarded
1.		Used alcohol-based handrub for hand hygiene.	2	0	
2.		Assembled equipment and materials.	1	0	
3.		Used lens paper to clean the eyepiece and the objectives.	1	0	
4.		Used the coarse adjustment to raise the nosepiece unit.	1	0	
5.		Raised the condenser as far as possible by adjusting the condenser knob.	1	0	
6.		Rotated the low power (10x) objective into position, so it is directly over the condenser.	1	0	
7.		Turned on the microscope light.	1	0	
8.		Opened the iris diaphragm until maximum light comes up through the condenser.	1	0	
9.		Placed and secured the prepared slide on the stage (specimen side up).	1	0	
10.		Positioned the condenser so it is almost touching the bottom of the slide.	1	0	
11.		Located the coarse adjustment and looked directly at the stage and low power objective and turned the coarse adjustment until the objective is as close to the slide as it will go.	1	0	
12.		Looked into the ocular(s) and slowly turned the coarse adjustment in the opposite direction to raise the objective (or lower the stage) until the object on the slide comes into focus.	1	0	
13.		Changed to the fine adjustment and turned the knob until the object came into finest focus.	1	0	
14.		***JUDGE looked in the objective and confirmed the fine focus.***	4	0	
15.	a.	Rotated the high-power objective (40X) into position while observing the objective and the slide to see that the objective does not strike the slide.	1	0	
	b.	Looked through the ocular(s) to view the object on the slide.	1	0	
	c.	Located the fine adjustment and turned it until the object is in fine focus WITHOUT using the coarse adjustment.	1	0	
16.		Rotated the oil-immersion objective slightly to the side.	1	0	
17.		Placed one drop of immersion oil on the portion of the slide that will be directly over the condenser.	1	0	

Items Evaluated		Possible	Awarded
18.	a. Rotated the oil-immersion objective into position, being careful not to rotate the high-power objective through the oil.	1 0	
	b. Looked to see that the oil-immersion objective is touching the drop of oil.	1 0	
19.	Looked through the ocular(s) and slowly turned the fine adjustment until the image is in fine focus.	1 0	
20.	***JUDGE looked in the objective and confirmed the fine focus***.	4 0	
21.	Rotated the low power (10X) objective into position, making sure no other objective comes in contact with the oil on the slide.	1 0	
22.	Removed the slide from the microscope stage, gently blotted the oil from the slide, and returned the slide to the slidebox.	1 0	
23.	Cleaned the oculars and low and high-power objectives with clean lens paper and lens cleaner.	1 0	
24.	Cleaned the oil-immersion objective with lens paper and lens cleaner to remove all oil.	1 0	
25.	Cleaned all oil from the microscope stage and condenser.	1 0	
26.	Positioned the nosepiece in the lowest position using the coarse adjustment.	1 0	
27.	Turned off the microscope light and disconnected the microscope from power source.	1 0	
28.	Centered the stage so it does not project from either side of the microscope and covered the microscope.	1 0	
29.	Cleaned the work area with disinfectant.	2 0	
30.	Used alcohol-based handrub.	2 0	
TOTAL POINTS - SKILL IV **70% Mastery for Skill IV = 29.4**		**42**	

NOTE: For the purpose of this skill performance, a monocular microscope is recommended. If a binocular microscope is used, the normal step of adjusting the oculars to fit the interpupillary distance of the user is omitted because of the need for the judge to see the image as well and to save the time the frequent adjustments would cause.

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Competitor #: _____ Judge's Signature: _____

Skill V: ABO Grouping (Time: 6 minutes)	Possible	Awarded
1. Assembled equipment and materials.	1 0	
2. Used alcohol-based handrub for hand hygiene and put on gloves.	2 0	
3. Performed slide grouping as follows: a. Obtained a slide with two wells and labeled the slide with the patient's name.	1 0	
b. Placed three drops of the patient's blood in each of the A and B wells. Did not allow dropper to touch the slide.	1 0	
c. Placed three drops of the anti-A serum in the A well.	1 0	
d. Placed three drops of the anti-B serum in the B well.	1 0	
e. Obtained two toothpicks (or disposable stirrers). Stirred each well with a separate clean stirrer for 30 seconds.	1 0	
f. Stirring motion was effective. Avoided splattering the simulated blood.	1 0	
g. Recorded agglutination results on ABO worksheet.	1 0	
h. Accurately determined the agglutination, blood type, and transfusion responses on the Laboratory Report form.	4 0	
4. Discarded disposable labware into appropriate biohazard receptacle.	2 0	
5. Returned simulated blood, reagents and unused equipment to proper storage.	2 0	
6. Cleaned work area with surface disinfectant.	2 0	
7. Removed gloves and discarded into biohazard receptacle.	2 0	
8. Used alcohol-based handrub for hand hygiene.	2 0	
TOTAL POINTS - SKILL V **70% Mastery for Skill V = 16.8**	**24**	

COMPETITOR # _____

*Each competitor will receive a copy of this form to complete during the skill demonstration.

ABO LABORATORY REPORT

SKILL V: ABO Typing

Patient Identification _____ DATE _____

Blood Type Analysis

_____

Agglutination Reaction

Patient	Anti-A Serum	Anti-B Serum	Blood Type

1. If the patient needed a transfusion, what blood type(s) could this patient safely receive?

   _____

2. What blood type(s) could safely receive this patient's blood?

   _____

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Competitor #: _____ Judge's Signature: _____

Skill VI: Gram Stain (Time: 7 minutes)		Possible		Awarded
1.	Assembled equipment and materials.	1	0	
2.	Used alcohol-based handrub for hand hygiene and put on gloves and face shield (or equivalent PPE).	2	0	
3.	Obtained prepared smear and placed on staining rack.	1	0	
4.	Flooded the slide with crystal violet for one minute.	1	0	
5.	Rinsed slide with gentle stream of water from a beaker, faucet, or plastic squeeze bottle and tilted the slides to remove excess water.	1	0	
6.	Flooded the slides with Gram's iodine for the recommended time.	1	0	
7.	Rinsed slide with gentle stream of water from a beaker, faucet, or plastic squeeze bottle and tilted the slides to remove excess water.	1	0	
8.	Held the slide by the short edge using forceps or clothespin. Added the decolorizer by squeeze bottle or Pasteur pipette until no more purple color ran off the slide. (*Note: Important not to decolorize more than a few seconds to prevent over-decolorization)*	1	0	
9.	Rinsed the slides immediately to remove the decolorizer; tilted the slides to remove excess water.	1	0	
10.	Counterstain the smears by flooding the slides with safranin for 30-60 seconds.	1	0	
11.	Rinsed the slides, tilted to remove excess water; wiped the back of the slide with paper towel to remove stain; stood slides on end or blotted between bibulous paper to dry.	1	0	
12.	***Judge verified properly stained smear.***	4	0	
13.	Returned slides to storage or discarded into proper biohazard containers for disposal.	2	0	
14.	Cleaned work surfaces with disinfectant.	2	0	
15.	Removed and discarded gloves into biohazard container and used alcohol-based handrub for hand hygiene.	2	0	
TOTAL POINTS - SKILL VI **70% Mastery for Skill VI = 15.4**		**22**		

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Competitor #: _____ Judge's Signature: _____

Skill VII: Preparing a Laboratory Solution (Time: 7 minutes)	Possible	Awarded
1. Worked the math problem in the scenario to determine the percent solution. **Judge: Award a point here if the competitor does the math. The points for accuracy are awarded in step #9.**	1 0	
2. Washed hands with antiseptic. (may verbalize)	2 0	
3. Put on gloves and face protection.	2 0	
4. Obtained the correct equipment and solutions as directed by the scenario – solute, solvent, beaker, graduated cylinder, a TD pipet or volumetric pipet and a pipet-aid or pipet filler-dispenser. ***Judge: The setting should include a "storage" area with different types/sizes of lab equipment. Award points if the competitor selects the correct equipment for preparing the solution.***	2 0	
a. Measured the water (solvent) in a graduated cylinder and poured it into a beaker.	1 0	
b. Fit the pipet-aid securely to the top of a pipet.	1 0	
c. Kept the pipet vertical and inserted the pipet tip well below the surface of the fluid in the beaker containing the solute.	1 0	
d. Drew up fluid slowly into the pipet using the pipet-aid, filling the pipet slightly above the desired volume marking or fill line.	1 0	
e. Removed the pipet from the solute, kept in the vertical position, and wiped the outside of the pipet tip quickly with tissue to remove the excess fluid, being careful not to allow the tissue to touch the opening of the pipet tip.	1 0	
f. Confirmed the correct solute by checking the label name three times (prior to drawing up the solute, while removing the solute and then when finished with the solute).	1 0	
g. Touched the pipet tip to the inner wall of the beaker and slowly lowered the fluid level using the pipet-aid, until the lower point of the meniscus touched the desired volume marking, OR, if using a volumetric pipet, until the lower point of the meniscus touched the etched line on the pipet.	1 0	
h. ***Judge verified the correct measure.***	4 0	
i. Moved the pipet and held it vertically over the beaker containing the solvent.	1 0	
j. Placed the pipet tip against the inner wall of the beaker.	1 0	
k. Released the suction on the pipet-aid and allowed the liquid to drain from the pipet by gravity drainage.	1 0	
l. Left the pipet tip in contact with the inner wall of the container 1 to 3 seconds to allow the correct volume to be delivered.	1 0	

Items Evaluated	Possible	Awarded
m. TD pipet (nonblowout) OR volumetric pipet - Examined the pipet tip – a small drop of fluid should remain in the tip, **OR** TD pipet (blowout) - Used the pipet-aid to force out the last drop of solution from the pipet tip into the beaker.	1 0	
5. Placed used glassware in appropriate cleaning solution as directed by the scenario and returned unused equipment to storage. **Judge: A labeled cleaning solution should be available in the "storage" area. Any equipment the competitor takes to his/her station and does not use should be returned to the storage area as noted in this step.**	2 0	
6. Cleaned work surface with disinfectant.	2 0	
7. Removed gloves and discarded them into biohazard receptacle.	2 0	
8. Washed hands with antiseptic. (may verbalize)	2 0	
9. Correctly calculated and measured the solution.	4 0	
TOTAL POINTS – SKILL VII **70% Mastery for Skill VII = 24.5**	**35**	