

Navigating Biotechnology Certifications

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NOCTI - Biotechnology

- ▶ Written and Skills component
- ▶ Written - proctored online
- ▶ Skills - optional but recommended
 - ▶ At school
 - ▶ All materials provided by the school
- ▶ \$42 for pre-and post-test analysis
- ▶ Pre-Tests and Post-Tests
 - ▶ Administered to determine a student's baseline technical knowledge at the start of a program or course.
 - ▶ Using a pre/post test combination will result in a comparison report after the post-test is completed.
 - ▶ Powerful tool can be used to show individual student improvement and overall program effectiveness.



Written Assessment

Questions to measure an individual's factual theoretical knowledge.

- ▶ Administration Time: **3 hours**
- ▶ Number of Questions: **191**
- ▶ Number of Sessions:
 - ▶ One 3 hour session ... or
 - ▶ Two 1.5 hour sessions ... or
 - ▶ Three 1 hour sessions

Specific Standards and Competencies

▶ Work Habits

- Demonstrate professional work habits
- Demonstrate the ability to organize, implement, and troubleshoot specific tasks
- Demonstrate the ability to work in teams and as an individual

▶ Knowledge of Biotechnology

- Define biotechnology and its role
- Demonstrate knowledge of the history of biotechnology
- Describe the life cycle of biotechnology product development
- Identify the application of the biotechnology industry
- Describe careers in biotechnology

▶ Laboratory Knowledge and Skills

- Demonstrate competency in validating/using laboratory equipment
- Demonstrate competency in computer applications
- Perform basic laboratory math skills
- Apply statistical analysis to interpret data
- Demonstrate the ability to use the scientific method
- Properly prepare buffers and solutions
- Demonstrate concepts of recombinant technology
- Demonstrate principles of DNA isolation
- Perform Polymerase Chain Reaction (PCR)
- Perform electrophoresis
- Perform separation techniques
- Explain and perform aseptic technique
- Demonstrate concepts of microbial culture
- Demonstrate concept of mammalian cell culture
- Demonstrate concept of laboratory automation
- Perform basic spectrophotometer assays

▶ **Ethics**

- Demonstrate the knowledge of bioethics
- Demonstrate the knowledge of professional ethics

▶ **Safety in the Biotechnology Laboratory**

- Demonstrate general requirements for laboratory safety
- Identify and use personal protective equipment (PPE)
- Demonstrate ability to implement safety protocols
- Follow SDS guidelines for handling, storage, and disposal of hazardous material
- Demonstrate knowledge of safety regulatory agencies, such as OSHA

▶ Working in a Highly Regulated Environment

- Perform documentation according to regulatory agency standards
- Demonstrate ability to maintain records in accordance with Intellectual Property Law
- Document lab activities and findings according to guidelines

▶ Appropriate Use of Equipment and Instrumentation

- Use laboratory glassware
- Use volumetric equipment
- Use electrophoresis equipment
- Use a spectrophotometer
- Use balances
- Demonstrate knowledge of laboratory hoods for worker protection
- Demonstrate knowledge of temperature regulating devices (e.g., water baths, incubators)
- Demonstrate knowledge of chromatographic equipment
- * Demonstrate general requirements for laboratory safety
- Use centrifuges
- Use pH meters
- Demonstrate knowledge of thermocyclers
- Use microscopes
- Demonstrate knowledge of autoclaves

Example questions

- ▶ The federal agency that is responsible for funding and overseeing research is
 - A. National Institute of Health
 - B. U.S. Department of Education
 - C. Environmental Protection Agency
 - D. Department of Energy

- ▶ Why is polymerase chain reaction (PCR) an important technique in biotechnology?.
 - A. PCR Sequences DNA
 - B. PCR takes a small amount of DNA and increases the quantity so that it can be analyzed
 - C. PCR digests DNA so fragments can be sequenced
 - D. PCR shows the structure of DNA

- ▶ To create a standard curve, the laboratory technician should do what with the following data

	Abs 500nm	Abs 500nm
BSA u/mL	Run 1	Run 2
0	0.000	0.000
50	0.567	0.432
250	0.987	0.769
500	1.502	0.987

- A. subtract the smaller data set from the larger data set
- B. take an average of both sets of data
- C. repeat the experiment to collect more data
- D. add all the data sets together

Performance Assessment

Demonstrate acquired skills by completing actual jobs using the tools, materials, machines, and equipment related to the technical area..

- ▶ **Administration Time: 2 hours 5 minutes**
- ▶ **Number of Jobs: 6 stations**
- ▶ **Number of Sessions: administered in as many sessions as needed.**

Performance Assessment Areas Covered

- ▶ **27% Colony Isolation and Streaking Bacteria: 15minutes**

Participant will wear PPE, prepare workstation with disinfectant or lab mat, label plates, use inoculating loop, maintain sterile technique, and demonstrate good laboratory practice.

- ▶ **17% Using Volumetric Equipment: 15 minutes**

Using Micropipettes Participant will set micropipettes, choose the P1000 micropipette, and demonstrate good laboratory practice.

- ▶ **11% Using Volumetric Equipment: 30 minutes**

Serological Pipettes Participant will measure volume in tubes to 5.0 ml, record color and volume data, and demonstrate good laboratory practice.

Performance Assessment Areas Covered

- ▶ **18% Making a Molar Solution: 20 minutes**
 - calculate, massing NaCl, prepare and store salt solution, and demonstrate good laboratory practice.
- ▶ **17% Making a Dilution and Using a Spectrophotometer: 20 minutes**
 - wear proper PPE, prepare dilution, use a spectrophotometer, and demonstrate good laboratory practice.
- ▶ **10% Generating and Utilizing a Standard Curve: 25 minutes**
 - generate a standard curve and determine concentrations.

Skills Evaluators

- ▶ One person required per job
 - ▶ (need minimum of 6 qualified evaluators)
- ▶ Provided with
 - ▶ list of equipment, material and supplies
 - ▶ participant instructions
 - ▶ evaluator instructions
 - ▶ grading rubric

Job 1 - Colony Isolation and Streaking Bacteria

▶ Supplies

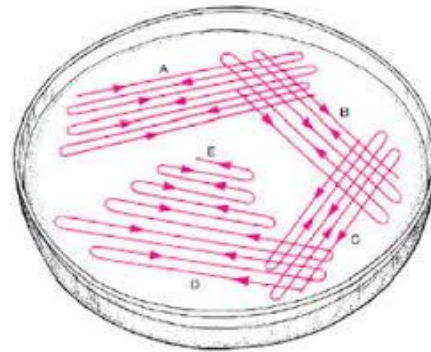
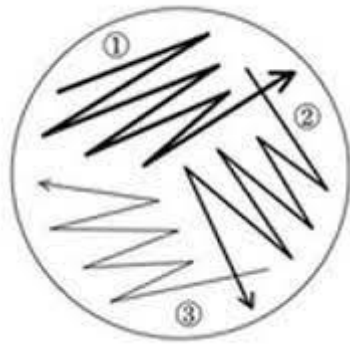
- ▶ Liquid disinfectant with paper towels or lab mat
- ▶ Boxes of various size gloves, eye protection and scrubs or lab coat
- ▶ BioHazard bag container
- ▶ Bulk bag of sterile inoculating loops
- ▶ Test tube rack
- ▶ Prepared agar plates (100mm Petri dishes 1 per participant)
- ▶ “Mock” bacterial broth culture tube with 3 mL of solution labelled E. coli

Job 1 - Participant Instructions

- ▶ 1. Use the equipment provided on the workstation
- ▶ 2. Streak bacteria for single colony isolation from the liquid broth culture onto one agar plate
- ▶ 3. Use sterile technique and good lab practices
- ▶ 4. When finished, place the agar plate in the incubator and alert the evaluator
- ▶ 5. Make sure the workstation is clean and ready for the next lab session
- ▶ NOTE: The broth culture will be left at the workstation for the next participant

Evaluator Instructions

- ▶ 1. Review the participant instructions
- ▶ 2. Closely monitor participants as they perform the job
- ▶ 3. When alerted by the participant that the agar has been placed in the incubator, inspect the participant plate and rate the work according to the scoring criteria provided
- ▶ Ex:



- ▶ 4. Empty the biohazard bag in the designated area and prepare the workstation for the next participant

Performance criteria rubrics

- ▶ Rubric is inside student booklet
- ▶ Student tears out rubric sheet
- ▶ Student hands rubric to each evaluator at the station
- ▶ Evaluator watches and scores student
- ▶ Rubric is returned to student
- ▶ Student moves to next station
- ▶ Rubric is handed to next evaluator

	Job 1	Pt	Highly Proficient A	Competent B	Partially competent/ developing C	Limited D	Very limited E
1	Wear PPE * Gloves/goggles/lab coat	15	Met all 3 criteria	-	Met 2 criteria	Met 1 criteria	Did not meet
2	Prepare station * disinfectant/ pad	5	Prepared workstation	-	-	-	Did not prepare
3	Labelled plates * bottom/initials/date/strain	10	Met all 4 criteria	Met 3 criteria	Met 2 criteria	Met 1 criteria	Did not meet
4	Inoculating loop *removed/used/no touch/3 loops/disposed properly	25	Met all 5 criteria	Met 4 criteria	Met 3 criteria	Met 1-2 criteria	Did not meet
5	Sterile technique *closed plate/held cap/avoid contamination	25	Met all 3 criteria	-	Met 2 criteria	Met 1 criteria	Did not meet
6	Streaking technique *no gouging/use of area/2 crosses/3-4 streak/1st not last	25	Met all 5 criteria	Met 4 criteria	Met 3 criteria	Met 1-2 criteria	Did not meet

Reports

▶ Individual score reports

- ▶ provided for each participant for each standard
- ▶ pre/post-test comparison is provided if a pre test was administered.

▶ Group score reports

- ▶ provided for the entire testing group.
- ▶ gives standard and competency results for each participant
- ▶ can assist with analyzing a group's performance
- ▶ identifying potential program improvements.

Individual Scores
Participant Name: Sample Name
Site: Sample Site
Test Date: 08/08/2008
Participant ID: 0000000
Level: Secondary
Type: Post-test

Test Title and Test Code

Standard	Standard Description	Written						
		Pre-Test	Post-Test	% Change	Range	Use Competency	Mean	Median
1	Standard 1	88.0	88.0	0.0	70.0	81.7	81.4	70.0
2	Standard 2	78.7	78.4	-0.5	67.0	77.0	67.1	68.0
3	Standard 3	76.7	80.0	33.3	71.0	80.0	71.8	76.0
4	Standard 4	80.0	75.0	-6.0	69.0	68.0	67.0	69.0
5	Standard 5	80.0	60.0	-20.0	71.0	67.7	64.0	68.0
6	Standard 6	65.0	65.7	1.0	71.0	65.4	70.0	71.0
7	Standard 7	75.1	76.0	1.0	70.0	72.0	66.0	70.0
Total		68.1	76.4	11.3	69.0	68.7	68.0	69.7

Reports

▶ Group score reports

- ▶ provided for the entire testing group.
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- ▶ can assist with analyzing a group's performance
- ▶ identifying potential program improvements.

Group Score Report												
Site: SAMPLE		Level: Secondary										
Test Date: XX/XX/XXXX		Type: Post-Test										
		Test Title and Test Code										
Written												
Standard	Standard Description	Participant	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Participant 8	Participant 9	Participant 10
1	Standard 1		85.0	55.0	80.0	80.0	75.0	75.0	85.0	80.0	70.0	75.0
2	Standard 2		59.4	37.5	84.4	84.4	31.3	53.1	81.3	84.4	75.0	81.3
3	Standard 3		41.7	62.5	83.3	83.3	79.2	75.0	83.3	83.3	83.3	95.8
4	Standard 4		50.0	60.0	75.0	75.0	70.0	60.0	85.0	75.0	65.0	80.0
5	Standard 5		32.0	24.0	64.0	64.0	20.0	56.0	64.0	60.0	56.0	72.0
6	Standard 6		42.9	57.1	85.7	85.7	21.4	78.6	85.7	85.7	92.9	85.7
7	Standard 7		38.5	38.5	76.9	76.9	23.1	46.2	76.9	76.9	38.5	61.5
		Total	50.7	46.6	78.4	78.4	46.6	62.8	77.7	77.7	69.6	79.7

Reports

▶ College Credit Recommendation Report

- ▶ automatically generated for eligible students meeting the 70% benchmark
- ▶ presented to participating colleges for credit consideration.
- ▶ official transcript obtained through Excelsior College \$60.00 per test per student.



Banking and Related Services (Pathway)	1096	56.9	No Skill-Based Component
Biotechnology	4075	52.5	77.1
Broadcasting and Journalism (Pathway)	1106	60.6	No Skill-Based Component
Building Construction Occupations	4011	62.7	88.0

Biotechnician Assistant Credentialing Exam (BACE)

- ▶ \$150 per student
- ▶ Order minimum of 4 weeks in advance
- ▶ Online (“written”) component
 - administered at high school / lab facility
 - ~ 75 questions ; 3 hours allotted
- ▶ Practical laboratory component
 - ~ 40-50 questions ; 4 hours allotted
 - proctored at high school or approved laboratory
 - Online version available
 - Uses scenarios, pictures, math calculations etc

BACE 2020-2021 Knowledge Exam

Format: Closed Book

Exam Duration: 3 Hours

Subject	# of Q.	Points
General Topics in Biotechnology	21	23.5
Laboratory Skills/Applications	28	32
Biochemistry/Chemistry	10	11.5
Biological Systems	10	10
Research & Scientific Method	10	10
Total	79	87

BACE 2020-2021 Practical Exam

Format:

Closed Book

Exam Duration:

4 Hours

Subject

of Q.

Points

Biotechnology Skills

19

40

Applied Mathematics

11

22

Laboratory Equipment

16

13

Workplace Safety & Behavior

12

12

Total

58

87

BACE Written Exam Subjects

CELLS

Cell Structures & Organelles
Identifying Cell Structures

CHEMISTRY/BIOCHEMISTRY

Bonds
Cell Respiration
Chemistry, Molecules & Macromolecules
DNA Structure & Function
Enzymes & Reactions
Periodic Table
Protein Structure & Function
Reaction Rates
Translation (Gene Expression)

GENETICS

Genomics
Mitosis & Chromosomes
Meiosis
Ploidy

LABORATORY SKILLS/APPLICATIONS

Cell and Tissue Culture
Electrophoresis
Microscopy
Polymerase Chain Reaction (PCR)
pH
Restriction Enzymes
Southern Blotting
Transformation & Transfection
Western Blotting & ELISA

RESEARCH & SCIENTIFIC METHOD

Experimental Design and Scientific Method
Graphing

GENERAL TOPICS IN BIOTECHNOLOGY

Applications
Benefit to Society
Biotech Careers
Ethics
Historical
Regulatory

BACE Practical

- ▶ Proctored in approved laboratory
- ▶ Exams and reagent kit are supplied in advance
- ▶ Requires 1 skills assessor with supplied scantron rubric
- ▶ Exam booklet, Skills Assessment Form and students' work are sent back to Biotility for scoring

BACE Practical Exam Subjects

➤ APPLIED MATHEMATICS

- Graphing
- Beer's Law
- Standard Curves

➤ BIOTECHNOLOGY SKILLS

- Autoclaving
- Culturing Organisms
- Aseptic/Sterile Technique
- Electrophoresis
- Liquid Measurement (Macro and Micro)
- pH Adjustment and Measurement
- Pipetting (Macro and Micro)
- Serial Dilutions
- Spectrophotometry

▶ LABORATORY EQUIPMENT

- Identifying Glassware
- Electrophoresis Equipment
- Spectrophotometer
- Micropipettors
- Weighing/Using Balance

▶ PREPARING SOLUTIONS

- Proper Technique
- Volume/Volume Calculations
- Weight /Volume Calculations
- Molarity Calculations
- Dilutions

▶ WORKPLACE SAFETY & BEHAVIOR

- Identifying Safety Symbols
- Laboratory Safety Protocols
- Understanding Safety Data Sheets (SDS)
- Personal Protective Equipment (PPE)

Practical Lab Exam – Part A

- ▶ MSDS review
- ▶ Equipment naming
- ▶ Logic questions
- ▶ Graph Drawing (by hand)
- ▶ Standard Curve (by hand)
- ▶ Describe and/or Calculate

Practical Exam Math Questions

Solution Dilutions

- ▶ You need 500 mL of LB agar with a final concentration of ampicillin at $100 \mu\text{g/mL}$. Your ampicillin stock is 100 mg/mL . How much ampicillin should you add to the LB agar?

- ▶ Calculate and describe how to make 500mL of a 0.1M NaCl solution from a 2M stock solution

Practical Exam Math Questions

Mass to Volume Solution

- ▶ Calculate the amount of CaCl_2 required to make 50mL of a 7.5mg/mL solution.
- ▶ Calculate the amount of agarose required to make a 100 mL of a 0.8% agarose solution.
- ▶ Describe how to make 350mL of a 15% NaCl solution
- ▶ Answer may require significant figures etc

Practical Lab Exam – Part B

- ▶ Serological Pipetting
- ▶ Micropipetting
- ▶ Volume measurements (images in booklet)
- ▶ pH meters - determining buffers
- ▶ Using balance to weigh out solids
- ▶ Measuring absorbance
- ▶ Streaking bacteria
- ▶ Loading electrophoresis gel
- ▶ Observing Gram stained prepared slides

Things to know

- ▶ Pre-lab set up will take ~1 hour
- ▶ All material supplied as needed
- ▶ Gel preparation required
- ▶ Pre- and post- measuring of pH meter
- ▶ Calibration of equipment is essential
- ▶ Rotating students through stations takes time - duplicate stations
- ▶ Start some students on lab skill section immediately
- ▶ Candidate resources available
- ▶ Online Practice Exam available

Summary

▶ NOCTI

- \$42
- Proctored
- Student resources
- Materials not supplied
- 6 skills tested
- 6 skill evaluators (not teacher)
- Scores entered by proctor
- School enrolls student
- Certificate
- Nationally recognized

▶ BACE

- \$150
- Proctored
- Student resources
- Materials supplied
- 6 - 8 skill stations
- 1 skill evaluator (teacher)
- Scantron scored
- Student enrolls self
- Digital badge
- Recognized in ~15 states