iCEV Pathophysiology

Knowledge and Skill Statement	Student Expectation	Breakout	iCEV Citation			New Location
			Narrative/Activity	Type of Citation (New Content/New Citation)	Lesson Title	
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;	(vii) use engineering practices to design solutions to problems	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout- Designing Solutions
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(ii) organize quantitative data using lab reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(iii) organize quantitative using labeled drawings	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(iv) organize quantitative using graphic organizers	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(vi) organize quantitative using summaries	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(vii) organize quantitative using oral reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(viii) organize quantitative using technology-based reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(ix) organize qualitative data using lab notebooks or journals	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(x) organize qualitative data using lab reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(xi) organize qualitative using labeled drawings	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(xii) organize qualitative using graphic organizers	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods

iCEV Pathophysiology

Knowledge and Skill Statement	Student Expectation	Breakout	iCEV Citation			New Location
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(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(xiv) organize qualitative using summaries	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(xv) organize qualitative using oral reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using lab notebooks or journals, lab reports, labeled drawings, graphic organizers, peer reviewed medical journals, summaries, oral reports, and technology-based reports;	(xvi) organize qualitative using technology-based reports	Narrative	New Content	Conducting Lab & Field Investigations: Pathophysiology	Student Handout-Data Collection Methods
(3) The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	(ii) analyze data by identifying patterns	Activity	New Content	Analyzing Data: Pathophysiology	Activity- Descriptive Statistics Analysis
(3) The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:	(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;	(ii) analyze data by identifying patterns	Activity	New Content	Analyzing Data: Pathophysiology	Activity- Inferential Statistics Analysis
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(i) communicate explanations individually in a variety of settings	Narrative	New Content	Professionalism in the Sciences: Pathophysiology	Student Handout- Communication Strategies
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(i) communicate explanations individually in a variety of settings	Activity	New Content	Developing a Model: Pathophysiology	Activity- Models Explanation Infographic
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(ii) communicate explanations individually in a variety of formats	Narrative	New Content	Professionalism in the Sciences: Pathophysiology	Student Handout- Communication Strategies
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(ii) communicate explanations individually in a variety of formats	Activity	New Content	Developing a Model: Pathophysiology	Activity- Models Explanation Infographic
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(iii) communicate explanations collaboratively in a variety of settings	Narrative	New Content	Professionalism in the Sciences: Pathophysiology	Student Handout- Communication Strategies
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(iii) communicate explanations collaboratively in a variety of settings	Activity	New Content	Developing a Model: Pathophysiology	Activity- Models Explanation Infographic
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(iv) communicate explanations collaboratively in a variety of formats	Narrative	New Content	Professionalism in the Sciences: Pathophysiology	Student Handout- Communication Strategies
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(iv) communicate explanations collaboratively in a variety of formats	Activity	New Content	Developing a Model: Pathophysiology	Activity- Models Explanation Infographic
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(v) communicate solutions individually in a variety of settings	Narrative	New Content	Communicating Findings in Pathophysiology	Student Handout- Proposing Solutions
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(ii) examine changes resulting from mutations by examining tissues	Activity	New Content	Mechanisms of Pathology	Activity: Metabolic & Genetic Disorders
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(iii) examine changes resulting from mutations by examining organs	Activity	New Content	Mechanisms of Pathology	Activity: Metabolic & Genetic Disorders
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(v) examine changes resulting from neoplasms by examining cells	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms

iCEV Pathophysiology

Knowledge and Skill Statement	Student Expectation	Breakout	iCEV Citation			
			Narrative/Activity	Type of Citation (New Content/New Citation)	Lesson Title	New Location
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(vi) examine changes resulting from neoplasms by examining tissues	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(vii) examine changes resulting from neoplasms by examining organs	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(vii) examine changes resulting from neoplasms by examining organs	Activity	New Content	Mechanisms of Pathology	Activity- Neoplasms Observations
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(viii) examine changes resulting from neoplasms by examining systems	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xi) analyze changes resulting from mutations by examining organs	Activity	New Content	Mechanisms of Pathology	Activity: Metabolic & Genetic Disorders
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xii) analyze changes resulting from mutations by examining systems	Activity	New Content	Mechanisms of Pathology	Activity: Metabolic & Genetic Disorders
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xiii) analyze changes resulting from neoplasms by examining cells	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xiv) analyze changes resulting from neoplasms by examining tissues	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xv) analyze changes resulting from neoplasms by examining organs	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xv) analyze changes resulting from neoplasms by examining organs	Activity	New Content	Mechanisms of Pathology	Activity- Neoplasms Observations
(6) The student analyzes the mechanisms of pathology. The student is expected to:	(B) examine and analyze changes resulting from mutations and neoplasms by examining cells, tissues, organs, and systems;	(xvi) analyze changes resulting from neoplasms by examining systems	Narrative	New Content	Mechanisms of Pathology	Student Handout- Effects of Neoplasms
(7) The student examines the process of pathogenesis. The student is expected to:	(D) analyze other mechanisms of disease prevention and treatment such as vaccinations, antibiotics, chemotherapy, and immunotherapy; and	(ii) analyze other mechanisms of disease treatment	Activity	New Citation	Disease Diagnosis & Treatment	Activity- Treatment Mechanisms
(8) The student examines diseases throughout the body's systems. The student is expected to:	(E) research and describe antibiotic-resistant diseases such as methicillin-resistant Staphylococcus aureus;	(i) research antibiotic-resistant diseases	Narrative	New Citation	Disease Diagnosis & Treatment	Student Handout- Antibiotic Resistant Diseases
(8) The student examines diseases throughout the body's systems. The student is expected to:	(E) research and describe antibiotic-resistant diseases such as methicillin-resistant Staphylococcus aureus;	(ii) describe antibiotic-resistant diseases	Narrative	New Citation	Disease Diagnosis & Treatment	Student Handout- Antibiotic Resistant Diseases

Designing Solutions

The use of engineering practices is a process scientists may use to identify and solve problems. The steps of this process are repeated as many times as needed, to make improvements while moving towards a solution. It is important to learn from the failures that may occur and apply the necessary changes to create a viable solution.

To develop a successful solution to a problem the following process should be followed.

- Identify the problem
  - identification occurs that there is a problem that exists and needs to be solved
- Define the problem
  - the step allows scientists to specifically identify what the problem is
- Development of possible solutions
  - Think of as many possible solutions to the problem
  - consider the following questions: who has the problem, how can the solution help everyone and what is the ultimate goal
  - evaluate solutions that may already exist and consider what mistakes were made to come to that solution
- Prototype
  - create a version of the design that is able to function
  - the step may be revisited to improve the overall design
- Evaluate
  - the step is when scientists examine the pros and cons of a potential solution
- Test
  - the step gives the opportunity to see which ideas worked and which need improvement
- Improve
  - fixes the problems which occur during testing and makes the solution better
- Communicate
  - Explain how the design was developed, why it is useful and how it could be used by others

Data Collection Methods

Qualitative data is descriptive while quantitative data is measurable. Many data collection methods can be used for both quantitative and qualitative. The main difference is how the data is collected. For example, interviews provide a direct approach to gathering data directly related to the research question. This method can be completed face-to-face or virtually. Interviews allow for flexibility, as the researcher and participant can guide the interview or a strict script of questions can be followed. When looking at qualitative data, the researcher will ask open-ended questions and review the answers. Whereas with quantitative data, the researcher might ask a group of people the same exact question and look at how many people answered the same way. Focus groups are similar to interviews but rather than the interaction being one-on-one, the scientist gathers data from a group of six to 12 people together in a single setting. Observations allow scientists to gather data by watching and taking notes on the subject. Surveys and questionnaires are generally the easiest and most effective way to collect quantitative data. They can also be used for both quantitative and qualitative data collection as they use open and close-ended questions through multiple choice, scales or yes-or-no questions.

Both qualitative and quantitative data can be collected and organized for use in many ways including:

- Lab reports
  - document experiments and their findings by including an introduction, procedure, results and conclusion
- Lab notebooks or journals
  - are a primary record of research which include documentation of observations, recorded steps of projects or experiments and data collection
  - include information, such as observations, literature review, experimental planning, raw data, procedures, data, observational images and references
- Labeled drawings
  - are visual representations of processes or items to identify various components
- Graphic organizers
  - are a visual way to organize a flow of information
- Medical Journals
  - contain peer-reviewed research which range in medical topics including research and discoveries, clinical practices, procedures and technologies
- Summaries
  - are used to provide an overview of what methods were used in an experiment and how they led to the results
- Oral reports
  - are when researchers present their findings
- Technology-based reports
  - can vary, technology can be used for oral reports by using a voice over, traditional lab reports can be completed using various digital applications, or a presentation can be created using software to present findings

Descriptive Statistics Analysis

Activity Overview:

You will perform a descriptive statistical analysis to describe the data from a breast cancer study.

Directions:

1. Read the scenario about the data to be analyzed.

2. Open the **Pathophysiology Data Student File**.

3. Organize the data in a manner which makes sense to you. Be sure the data is copied exactly.

4. Analyze the data and identify three patterns you notice and respond to the first activity question.

5. Choose two of the data sets to perform the following descriptive statistical analysis on. If necessary, utilize the **Data Analysis Formulas Student Handout**.
   - Mean
   - Median
   - Mode
   - Range
   - Variance
   - Standard deviation
   - Standard error of the mean

6. Report the descriptive calculations for each data set in the table provided and develop a brief description about the significance of the findings.

7. Answer the activity questions about your findings during your analysis.

8. Submit the completed activity according to your instructor's directions

Data Analysis Scenario

A pharmaceutical company held a study to determine the effect of a new estrogen modulator on breast cancer presence. They had 15 male and 15 female participants divided into two groups. One group took a placebo while the other group took the new medication. Each participant's age, estrogen levels and weight was measured prior to taking the placebo or medication and again after 14 days of taking the placebo or medication. The data collected from the study may also be used in future research about the medication's effects.

	Calculation	Calculation	Significance
Title of Data Set			
Mean			
Median			
Mode			
Range			
Variance			
Standard Deviation			
Standard Error of the Mean			

Activity Questions:

1. Which three patterns did you notice within the data? What do you think the patterns represent?

2. Which measurement of central tendency do you think best describes your data and why?

3. Describe the difference between range, variance and standard deviation. Use examples from your analysis to demonstrate what each value represents in the data set.

Inferential Statistics Analysis

Activity Overview:

You will perform an inferential statistical analysis to describe the data from a breast cancer study.

Directions:

1. Read the scenario about the data to be analyzed.

2. Open the **Pathophysiology Data Student File**.

3. Organize the data in a manner which makes sense to you. Be sure the data is copied exactly.

4. Analyze the data and identify three patterns you notice.

5. Perform an inferential statistical analysis by performing the following tests. Before performing each test identify the null hypothesis (H0) and alternative hypothesis (H1) for each test in the table provided. If necessary, utilize the **Data Analysis Formulas Student Handout** and the **Critical Values Tables Student Handout**.
   - T-test: choose two of the quantitative data sets (same pre and post group)
   - Chi-squared test: determine if age could be a factor for being diagnosed with breast cancer
   - Regression analysis: use the estrogen levels and weight data and one other quantitative data set

6. Report the calculations for each data set in the table provided and develop a brief description about the significance of the finding.

7. Answer the activity questions about your findings during your analysis.

8. Submit the completed activity according to your instructor's directions

Data Analysis Scenario

A pharmaceutical company held a study to determine the effect of a new estrogen modulator on breast cancer presence. They had 15 male and 15 female participants divided into two groups. One group took a placebo while the other group took the new medication. Each participant's age, estrogen levels and weight was measured prior to taking the placebo or medication and again after 14 days of taking the placebo or medication. The data collected from the study may also be used in future research about the medication's effects.

	T-Test	Chi-Squared	Regression Analysis
H_0			
H_1			
Result			
Significance			

Activity Questions:

1. Which inferential statistical tests do you think the researchers overseeing the study would be the most interested in and why?

2. Use the data from the regression analysis to create a scatter plot graph. What patterns do you notice within the graph? Submit the graph to your instructor as directed.

3. Which three patterns did you notice within the data? How do they relate to the inferential statistics tests you performed?

Communication Strategies

Communicating scientific explanations and solutions in a variety of formats is crucial for reaching diverse audiences and effectively conveying complex information. Some of the most common formats include:

Scientific Papers:
Publishing research findings and solutions in scientific journals allows for in-depth, peer-reviewed communication within the scientific community. This format typically follows a structured format, including an abstract, introduction, methods, results, discussion, and conclusion sections. Research is typically conducted by a team and requires collaboration and review throughout the initial writing of the paper and through the official peer-review process.

Presentations:
Oral presentations, such as talks at conferences or seminars, provide an opportunity to share scientific findings, explanations and solutions with a live audience. These presentations often use slides or visual aids to support the delivery of information and may include data, graphs, and illustrations.

Posters:
Poster presentations are commonly used at conferences and scientific meetings. Posters allow for visual representation of scientific findings, explanations and solutions through a combination of text, figures, and graphs. Posters are effective for summarizing research findings and facilitating discussions with peers.

Infographics:
Infographics are visual representations that use a combination of text, icons, images, and charts to convey scientific information in a concise and engaging manner. They are useful for simplifying complex concepts, presenting data, and highlighting key findings or solutions.

Scientific Reports & Summaries:
Creating reports or summaries targeted at policymakers, stakeholders, or the general public is an effective way to communicate scientific explanations and solutions in a clear and accessible manner. These documents should include an overview of the problem, the scientific basis, and evidence supporting the proposed solutions.

Websites & Blogs:
Developing websites or blogs dedicated to scientific explanations and solutions allows for the dissemination of information to a wider audience. These platforms can include articles, case studies, FAQs, and interactive content to engage readers and provide access to scientific resources.

Videos & Animations:
Creating videos or animations can be an engaging way to communicate scientific explanations and solutions. These formats can combine visual elements, narration, and graphics to simplify complex concepts and enhance understanding.

Social Media & Podcasts:
Utilizing social media platforms and podcasts can help reach broader audiences and share scientific information in a more accessible and digestible format. These mediums allow for shorter, concise explanations, discussions, and interviews with experts.

Press Releases:
Developing press releases can effectively communicate scientific explanations and solutions to journalists and the media. These documents should highlight the significance of the research or proposed solutions and emphasize key findings in a language accessible to non-experts.

Public Talks & Outreach Events:
Engaging in public talks, workshops, or outreach events allows for direct interaction with the public and provides an opportunity to explain scientific concepts, present research findings, and discuss potential solutions to scientific problems. Often times these talks and events allow for individuals to communicate with a diverse audience and answer questions to further explain their findings, explanations and solutions.

Adapting scientific explanations and solutions to various formats ensures information is accessible, engaging, and relevant to different audiences, including scientists, policymakers, stakeholders, and the general public. It is important to tailor the content, language, and visuals to suit the specific format and target audience, promoting effective communication and understanding.

Model Explanation Infographic

Project Overview:
In groups, you will choose a pathophysiology topic and research models relevant to pathophysiology to help develop explanations of the topic based on scientific ideas, principles and theories.

Directions:
1. Your instructor will divide the class into groups of five.

2. In your group, select one of the topics from the following list:
   - Cellular adaptation
   - Infectious diseases
   - Cancer
   - Cardiovascular diseases
   - Diabetes
   - Autoimmune diseases
   - Respiratory diseases
   - Genetic disorders

3. Based on the topic selected, use the internet to research models which relate to the topic and how the model is supported by scientific ideas, principles and theories.

4. Develop an infographic which details your findings which can be printed or shared digitally to ensure it can be used in a variety of formats. The infographic should contain at least the following information:
   - name of topic chosen
   - an explanation of the topic based on at least one model found relating to the topic
   - at least two supports of the model from either accepted scientific ideas, principles or theories

5. Turn in your completed activity according to your instructor's directions.

Proposing Solutions

Proposing solutions to pathophysiology problems often involves analyzing and interpreting data collected from various sources. A basic approach to utilizing data to propose solutions can include the following processes:

Data Collection:
Gather relevant data from various sources such as research studies, clinical trials, epidemiological surveillance, patient records, and public health databases. The data may include information on microbial pathogens, host responses, treatment outcomes, resistance patterns, epidemiological trends, and diagnostic test results.

Data Analysis:
Analyze the collected data using appropriate statistical and computational methods. This may involve identifying trends, patterns, associations, and correlations within the data. Use tools such as data visualization techniques, statistical tests, and modeling approaches to gain insights from the data.

Identify Patterns & Gaps:
Look for patterns or trends in the data that may provide insights into the underlying problem. Identify gaps in knowledge or areas where the data is insufficient to fully address the problem. For example, if antibiotic resistance is a concern, analyze resistance patterns, identify the most common resistant pathogens, and assess factors contributing to resistance development.

Identify Potential Solutions:
Based on data analysis, propose potential solutions to address the identified problem. Consider evidence-based interventions, strategies, or innovations aligning with the data findings, scientific ideas, principles and theories. For example, if data analysis reveals a rise in a specific antibiotic-resistant strain, propose interventions like antibiotic management programs, development of new drugs, or infection control measures to combat the spread of the resistant strain.

Models can be used to optimize diagnostic testing strategies for infectious diseases. By incorporating test characteristics such as sensitivity or specificity and disease prevalence, models can assess the performance and cost-effectiveness of different testing approaches. This information can guide decisions on test selection, screening procedures, and resource allocation for diagnostic testing. Proposed solutions should be evaluated and validated through real-world studies and trials as well as scientific ideas, principles and theories to ensure their effectiveness and feasibility.

Consider Multidisciplinary Approaches:
Pathophysiology problems often require multidisciplinary approaches. Collaborate with experts from various fields, such as microbiologists, immunologists, epidemiologists,

clinicians, and public health professionals, to develop comprehensive solutions. Incorporate diverse perspectives and expertise to ensure the proposed solutions are well-rounded and effective.

Evaluate Feasibility & Impact:
Assess the feasibility and potential impact of the proposed solutions. Consider factors such as cost, resources, scalability, ethical implications, and the potential for implementation in real-world settings. Conduct cost-effectiveness analyses or modeling studies to evaluate the potential impact of the proposed solutions on disease outcomes or public health.

Iterative Approach:
Proposing solutions based on data is a repetitive process. Continuously gather new data, update analyses, and refine solutions based on emerging evidence and feedback. The field of pathophysiology is dynamic, and new insights may lead to further modifications or alternative solutions over time.

Remember, proposing solutions to pathophysiology problems requires a rigorous and evidence-based approach. Data analysis plays a crucial role in understanding the problem, identifying potential solutions, and informing decision-making.

Metabolic & Genetic Disorders & Diseases

Activity Overview:
You will work with a partner to conduct research and compose tweets about a metabolic or genetic disorder or disease.

Directions:
1. Follow your instructor's directions to identify a partner.

2. Your instructor will provide your group with one of the following:
    - Gaucher's Disease
    - Hemochromatosis
    - Phenylketonuria (PKU)
    - Adrenoleukodystrophy (ALD)
    - Edwards Syndrome
    - Patau Syndrome
    - Klinefelter Syndrome
    - Turner's Syndrome

3. Use the internet to conduct research about how the disorder or disease disrupts normal cell, tissue, organ and body system function. Take notes in the table provided, and remember to use reliable sources, such as websites ending in .gov or .edu.

4. Use the internet and other resources to locate images that show how a cell, tissue, organ, and body system are affected by disease or disorder.

5. Compare each image to a healthy cell, tissue, organ and body system. Examine how the healthy image differs from the affected image in appearance and function.

6. For each set of images, write an analysis summarizing the changes caused by the mutation in the cell, tissue, organ and body system.

7. Compose a tweet for each set of images to explain the effects of the disease or disorder on the cellular, tissue, organ and system levels. Ensure each tweet is no more than 280 characters.

8. Turn in the completed activity according to the instructor's directions.

Notes

Effect on Cells	
Effect on Tissues	
Effect on Organs	
Effect on Body Systems	

Analysis Summary:

Tweet 1:

Tweet 2:

Tweet 3:

Effects of Neoplasms

A neoplasm occurs when cells divide and grow quicker than normal or do not die at the appropriate rate. This results in an abnormal mass classified as malignant (cancerous) or benign (non-cancerous). While neoplasms have differing characteristics and behaviors, they can all affect the body at the cellular, tissue, organ and body system levels.

At the cellular level, neoplasms disrupt cells' signaling patterns for growth, division and death. As a result, neoplasms cause unchecked cellular proliferation leading to a mass forming. Disruptive signaling patterns also occur in pathways related to angiogenesis. This causes the formation of new blood vessels, an essential component for the progression and survival of neoplasms. Additionally, neoplasms can cause dysregulation in other signaling pathways affecting crucial cellular processes. This can lead to a loss in differentiation where the cells no longer maintain specialized functions and structure. Neoplasm appearance usually involves cells of an irregular size or shape with a pale or intense color. Further, these cells have a large nucleus and a shrunken cytoplasm. Other organelles within the cytoplasm are affected, often with poorly developed Golgi apparatus and a decreased number of mitochondria.

Uncontrolled neoplasms may invade nearby tissues and impact the tissue's structure and function. Neoplasm growth is often chaotic, resulting in disorganized tissue structure. Instead of cells arranged in specific patterns and layers, cells grow irregularly with no patterns. This often causes a loss in tissue boundaries and may compress surrounding tissues. Compression of tissues may cause impaired blood flow, mechanical dysfunction and/or nerve compression. As the neoplasm cells grow, they replace the healthy cells in the tissue. The loss of healthy cells causes the tissue to lose its normal function. Additionally, at the tissue level, neoplasms cause a desmoplastic response. This means thick, fibrous tissue forms around the neoplasm to provide an environment for the neoplasm to survive.

As neoplasms permeate into tissues, there is also an effect on the organs. The effects of the neoplasms vary based on the location, size and activity of the neoplasm. For example, a large neoplasm within a large muscle may cause minimal discomfort, while a small neoplasm in the lungs can quickly obstruct the airways. Depending on neoplasm behavior, organs may shrink or enlarge. Enlarged organs are due to the rapid proliferation of cells, resulting in a tumor mass forming. Other organs may shrink due to the neoplasm replacing and destroying the healthy tissue of the organ. The change in organ structure may also cause functional impairment of the organ. For example, neoplasms in endocrine glands will disrupt hormone production, while a neoplasm in the kidney can disrupt blood pH. As neoplasms grow, they can erode the surfaces of organs, causing bleeding and ulcers to form. Alternatively, some neoplasms can induce necrosis if the new growth replaces blood supply areas.

Sometimes, aggressive neoplasms spread throughout the body through blood and lymph, affecting multiple body systems. The entire associated body system is impaired as neoplasms interfere with organ function. For example, a neoplasm in the lungs can affect breathing and respiratory function, while a neoplasm in the bladder impairs urination. The continued growth of a neoplasm may compress nearby structures, causing compression of blood vessels and/or nerves. This may result in neurological symptoms, pain and discomfort. Advanced neoplasms can cause nutritional deficiencies as the cell growth diverts nutrients to feed itself.

Neoplasm Observations

Activity Overview:
You will work in a group to examine benign and malignant neoplasms under the microscope to compare the cellular characteristics.

Directions:
1. Follow your instructor's directions to form a group of four.

2. Gather the following materials at your group's lab station:
    - Compound light microscope
    - Prepared slides of benign neoplasms
    - Prepared slides of malignant neoplasms
    - Prepared slides healthy tissues— without neoplasm development

3. Use the microscope to observe the benign neoplasms slides.

4. Sketch observations of each slide in the space provided. Pay particular attention to the cell shapes and the borders, or outside edges, of the neoplasm. Include a label to identify the tissue type.

5. Repeat Steps 3 and 4 for the malignant neoplasms and healthy tissues slides.

6. Discuss any similarities and differences observed between the benign neoplasms, the malignant neoplasms and the healthy tissues.

7. Write a paragraph summarizing the similarities and differences between the appearance of benign neoplasms, malignant neoplasms and healthy tissue.

8. Use the internet and other resources to locate three images of organs affected by neoplasms.

9. Place each image side by side with a healthy image of each organ.

10. Under each set of images, write a brief description of how the neoplasm affects organ appearance and function.

11.Turn in your completed activity according to your instructor's directions.

Type of Tissue	Slide Observations	Slide Observations

Benign Neoplasms		
Malignant Neoplasms		
Healthy Tissue		

Tissues Similarities & Differences:

Organ Comparison:

Treatment Mechanisms

Activity Overview:
You will research three different diseases or conditions to determine how the treatments work to overcome the cause.

Directions:
1. Consider different diseases and conditions you have heard about before.

2. Write three different diseases and conditions of interest to you in the left column of the table provided.

3. Use the internet, library or other resources to research each disease or condition. Identify and include the following information for each in the provided table:
    - Description of what the disease or condition is
    - Cause of the disease or condition
    - Treatment for the disease or condition

4. With your research, write one to two sentences for each disease or condition about the mechanisms of the treatment. Consider what is happening at a cellular level and how the treatment disrupts the cause.

5. Turn in the completed activity according to your instructor's directions.

Disease/Condition	Description	Cause	Treatment

Antibiotic-Resistant Diseases

Antibiotic-resistant diseases are bacterial infections that do not respond to antibiotics. Bacteria able to evade the effects of an antibiotic continue to survive and replicate in the body. This means the microorganisms continue to disrupt bodily functions and cause disease. Mutations of a bacterial strain cause antibiotic resistance. The mutation allows the bacteria to stop the medicine's effects or avoid the medicine's mechanisms of action altogether. A significant factor contributing to this mutation is improper use and overuse of antibiotics.

While the list of diseases caused by antibiotic-resistant bacteria is continuously changing, three common antibiotic-resistant diseases are; methicillin-resistant *Staphylococcus aureus*, carbapenem-resistant *Enterobacteriaceae* and *Clostridiodes difficil*e.

Methicillin-resistant *Staphylococcus aureus*
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain of *Staphylococcus aureus* commonly found on the skin of healthy people. While usually harmless, these bacteria can cause an infection when they enter an open wound. MRSA is resistant to all beta-lactam antibiotics, including many of the most common antibiotics, penicillins and cephalosporins. MRSA typically affects the skin and mucous membranes. However, the bacteria may spread to underlying tissues or into the bloodstream. An MRSA skin infection is noted by a bump or infected area on the skin that is red, swollen, painful, warm to the touch and full of pus or fluid. Symptoms may become more severe if the infection spreads to other tissues. Many MRSA infections are associated with hospitalization and pose a looming public health concern.

Carbapenem-resistant *Enterobacteriaceae*
Carbapenem-resistant *Enterobacteriaceae* (CRE) is a group of highly resistant bacteria, including *Klebsiella, Salmonella* and *Escherichia coli* (E. coli). Some of these bacteria are resistant to almost all available antibiotics and an infection can be life-threatening. CRE spreads through contact with infected stool or another infected individual. Common infections caused by CRE are pneumonia, meningitis, urinary tract infections (UTI) and bloodstream infections. Symptoms will vary based on the infection site. Most cases of CRE infections occur in hospitalized patients, as the bacteria thrive on medical devices such as ventilators and catheters.

Clostridiodes difficile
Clostridiodes difficile (C. diff) is a bacterial strain resistant to multiple commonly used antibiotics. This bacterium is spread to humans through contact with stool or contact with an infected individual or object. Once in the body, C. diff infects individuals' colon, causing symptoms of diarrhea, fever, stomach tenderness and pain, nausea and loss of appetite. If untreated, C. diff can be life-threatening. Most C. diff infections occur after an individual completes an antibiotic treatment. This is because the course of

antibiotics destroys a community of microbes in the digestive system that typically prevents C. diff growth.