Course

Pathophysiology

Unit V

Process of Pathology

Essential Question

What happens to the cells and tissues when cancer develops?

TEKS

*130.208(c)
2 A,B,C,D,E,F, G,H
3 A,B
4 A,C,D,E
5 D,E
6 A,B
7 C*

Prior Student Learning

Understanding of cells

Estimated time

2-4 hours

Rationale

Normally the growth of cells in the body is precisely regulated; this regulation is fundamental to the process of development across the life span. Cancer develops due to the loss of growth control in cells. Loss of control occurs as a result of mutations in genes that are involved in cell cycle control.

Objectives

Upon completion of this lesson, the student will be able to:
- understand that there are many types of cancer;
- identify terms related to neoplasia;
- differentiate between benign and malignant tumors;
- understand that some people make choices that increase their risk for cancer;
- explain some of the causes of abnormal cell growth; and
- describe the classifications of tumors, grading and staging of cancer.

Engage

Show students the chart from the National Cancer Institute with the numbers of new cases of different types of cancer and the estimated number of deaths from 2010. Which cancer is the most common? Which one is the least common? Which cancer has the highest death rate? For more information, the web site is www.cancer.gov.

National Cancer Institute 2010 Cancer Statistics

Cancer Type	Estimated New Cases	Estimated Deaths
Bladder	70,530	14,680
Breast (Female – Male)	207,090 – 1,970	39,840 – 390
Colon and Rectal (Combined)	142,570	51,370
Endometrial	43,470	7,950
Kidney (Renal Cell) Cancer	53,581	11,997
Leukemia	43,050	21,840

Lung (Including Bronchus)	222,520	157,300
Melanoma	68,130	8,700
Non-Hodgkin's Lymphoma	65,540	20,210
Pancreatic	43,140	36,800
Prostate	217,730	32,050
Thyroid	44,670	1,690

Key Points

I. General Aspects of Neoplasia

    A. Cells
1. Many cells of the body are constantly undergoing reproduction and maturation
2. All cell lines go through the process of **differentiation** (primitive non-specialized cells that matures into specific cell types based on functions they will perform)
3. A cell that is non-differentiated is one that has remained in a rudimentary state (or regressed back to earlier stage) -- Cancer (Ca) cells are less differentiated (more primitive) or completely non-differentiated

II. Classification of Neoplasia by Tissue Origin

    A. Epithelial Tissue – malignant growths arising from this tissue are called **carcinomas --** Epithelial tissue includes: internal organs, linings of body cavities, and glands

    B. Connective Tissue – malignant growths arising from this tissue are called **sarcomas --** Connective tissue includes: bone, muscle, and blood

    C. Special Tissue Malignancies -- Glial Tissue: malignant growths arising from connective tissue of brain are called **gliomas**

    D. Benign Tumors Are Named On Basis of Involved Tissue -- Name of tissue involved + suffix *–oma* (as opposed to *–carcinoma* and *-sarcoma*); ex. **osteoma**

EPITHELIAL TISSUE:

Tissue Type	Benign	Malignant
Gland	aden**oma**	adeno**carcinoma**
Papilloma	papill**oma**	papillo**carcinoma**

CONNECTIVE TISSUE:

Bone	oste**oma**	osteo**sarcoma**
Cartilage	chondr**oma**	chondro**sarcoma**
Fat	lip**oma**	lipo**sarcoma**

SPECIAL TISSUE:

Glia nerve tissue		gli**oma**

III. Uncontrolled Growth of Cancer Cells

    A. Cancer cells grow without the stop controls that characterize normal cell growth

        1. there is rapid cell division and reproduction (mitoses)
        2. at certain stage of development, cancer cells fail to mature
        3. when squamous epithelial cancer has not moved past the basement membrane, it is temporarily contained and said to be in situ -- this can be seen in early lesions of the cervix, mouth, and larynx
        4. cancers break through the underlying tissue and metastasize

    B. cancer cells can metastasize in three ways

        1. cancer can "shed" cells that can circulate into the blood and lymphatic systems
        2. by accidental transplantation during invasive (surgical) procedures
        3. progressive, invasive growth that spreads to adjacent organs

IV. Etiology of Cancer (Proven and Suspected)

    A. Carcinogenesis has no single cause

    B. Carcinogenesis may result from complex interactions between viruses, physical and chemical carcinogens, and genetic, dietary, immunologic, and hormonal factors

        1. <u>The Virus Aspect</u> – animal research has shown that viruses can transform cells
            a. Epstein-Barr virus that causes infectious mononucleosis is associated with Burkett's

lymphoma and nasopharyngeal Ca
   b. Types of human papilloma virus are linked to cervical Ca
   c. Hepatitis B virus can cause liver Ca
   d. Human T-cell lymphotropic virus is suspected of causing adult T-cell leukemia

2. <u>Exposure & Environmental Chemical Factors</u> – relationship between excessive exposure to sun's UV rays and skin Ca is well established; substances in the environment can cause cancer by damaging DNA in cells
   a. UV exposure and sunburn linked to melanoma
   b. radiation exposure suspected to provoke tumor development and leukemia
   c. also contributing to the exposure aspect are individual's tissue type, age, hormonal status, health status
   d. chemicals from tobacco contain common carcinogens and are related to cancers such as lung, pancreatic, kidney, bladder, and esophageal Ca
   e. asbestos and airborne hydrocarbons are related to lung Ca

3. <u>Specific Dietary Suspects</u> – some types of foods, additives and preparation methods are considered cancer risks
   a. high-protein and high-fat diets
   b. food additives such as nitrates
   c. charbroiling

4. <u>Familial Tendencies -- The Genetic Factor</u>
   a. Some cancers have a familial link and share the following characteristics:
      i. early onset
      ii. increased incidence of bilateral cancer in paired organs (breasts, adrenal glands, kidneys)
      iii. increased incidence of multiple primary cancers in non-paired organs
      iv. unique tumor site combinations
      v. two or more family members in same generation with same cancer

5. <u>The Hormone Factor</u>
   a. The role hormones play in cancer is controversial
   b. excessive hormone use (estrogen) has shown increased risk for certain types of cancer (ovarian, breast)

V. Grading and Staging of Malignant Neoplasia
    A. Classification process that is helpful in determining prognosis and treatment

        1. **Grading** – a histologic method used by pathologists when they examine tissue or cell specimens
            a. Looking for differentiation
            b. Severity of malignancy can be assessed by degree of dysplasia or anaplasia present (*remember* anaplastic cells have de-differentiated or regressed from normal mature form)
            c. Growth rate can be loosely determined by number of mitotic cells present—an increase in numbers means that cells are reproducing faster

        2. Recognized grades of malignancy:
            a. Grade I – cells are well differentiated (closely resemble tissue of origin), with little mitoses. Prognosis is good.
            b. Grade II – cells are moderately differentiated (some structural similarity to parent tissue), with moderate mitoses. Prognosis is fair.
            c. Grade III – Cells are poorly differentiated (little resemblance to their origin), with many mitoses. Prognosis is fair to poor.
            d. Grade IV – Cells are de-differentiated (bizarre and primitive with unrecognizable origins), with many mitoses. Prognosis is poor.

        3. **Staging** – a classification based on clinical findings by the physician (often oncologist)
            a. stage relates to degree of spread (whereas grade relates to malignancy)
            b. staging is based on size of primary tumor and amount of metastasis or secondary tumors

        4. Rules of Staging
            a. Follow **TNM** protocol:
                i. **T** refers to **tumor** size (1 to 4)
                ii. **N** refers to **numbers** of lymph nodes affected (local invasion)
                iii. **M** means the extent of **metastasis**
            b. Staging usually has a better correlation with prognosis

Activity
I. Complete a Disease Report on a specific type of cancer
II. Complete the Neoplasm Laboratory Investigation

Assessment

Case Study Rubric
Laboratory Investigation Rubric

Materials

Neoplasm PowerPoint
Key Terms
Key Terms Answers
http://science-education.nih.gov/supplements/nih1/cancer/guide/pdfs.htm
http://www.cancer.gov

Microscope
Prepared histology slides: hyperplasia, metaplasia, dysplasia and anaplasia
Prepared histology slides of normal tissues and organs. (Note: these slides
should correspond to the abnormal slides)
Prepared cytology slides: various structures showing cancerous tissues;
provide at least two -- one benign and one malignant
Gloves
Laboratory coat or apron
Goggles
Biohazard containers
Surface disinfectant
Paper towels

Accommodations for Learning Differences

For reinforcement, the student will define the <u>key terms</u>.

For enrichment, the student will contact the American Cancer Society, Texas
Department of Health, and the Center for Disease Control to do an
epidemiological study of the prevalence of cancer in their community.

National and State Education Standard

National Health Science Cluster Standards
HLC01.01 Academic Foundations
Health care workers will know the academic subject matter required (in
addition to state high school graduation requirements) for proficiency within
their area. They will use this knowledge as needed in their role.

TEKS

130.208(c)(2) (A) know the definition of science and understand that it has
limitations, as specified in subsection (b)(2) of this section;
130.208(c)(2)(B) know that hypotheses are tentative and testable statements
that must be capable of being supported or not supported by observational
evidence. Hypotheses of durable explanatory power which have been tested

over a wide variety of conditions are incorporated into theories;

130.208(c)(2) (C) know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;

130.208(c)(2) (D) distinguish between scientific hypotheses and scientific theories;

130.208(c)(2) (E) plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology;

130.208(c)(2) (F) collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools such as calculators, spreadsheet software, data-collecting probes, computers, standard laboratory glassware, microscopes, various prepared slides, stereoscopes, metric rulers, electronic balances, hand lenses, Celsius thermometers, hot plates, lab notebooks or journals, timing devices, Petri dishes, lab incubators, dissection equipment, meter sticks, and models, diagrams, or samples of biological specimens or structures;

130.208(c)(2) (G) analyze, evaluate, make inferences, and predict trends from data;

130.208(c)(2) (H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports;

130.208(c)(3)(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

130.208(c)(3)(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

130.208(c)(3)(H) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.

130.208(c)(4)(A) identify biological and chemical processes at the cellular level;

130.208(c)(4)(C) identify factors that contribute to disease such as age, gender, environment, lifestyle, and heredity;

130.208(c)(4)(D) examine the body's compensating mechanisms occurring under various conditions;

130.208(c)(4)(E) analyze how the body attempts to maintain homeostasis when changes occur;

130.208(c)(5)(D) evaluate the effects of chemical agents, environmental pollution, and trauma on the disease process;

130.208(c)(5)(E) research stages in the progression of disease.

130.208(c)(6)(A) describe on the nature of diseases according to etiology, signs and symptoms, diagnosis, prognosis, and treatment options;
130.208(c)(6)(B) explore advanced technologies for the diagnosis and treatment of disease; and
130.208(c)(7)(C) evaluate treatment options for diseases.

Texas College and Career Readiness Standards

Science Standards
A. Cognitive skills in science
1. Utilize skepticism, logic, and professional ethics in science
E. Effective communication of scientific information
1. Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic and kinesthetic
2. Use essential vocabulary of the discipline being studied
III. Foundation Skills: Scientific Applications of communication
A. Scientific writing
1. Use correct applications of writing practices in scientific communication
B. Scientific Reading
1.Read technical and scientific articles to gain understanding of interpretations, apparatuses, techniques, or procedures and data
3.Recognize scientific and technical vocabulary in the field of study and use this vocabulary to enhance clarity of communication
D. Research skills/information literacy
1. Use search engines, databases and other digital electronics tools effectively to locate information
2. Evaluate quality, accuracy, completeness, reliability and currency of information from any source

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Pancreatic	43,140	36,800
Prostate	217,730	32,050
Thyroid	44,670	1,690

www.cancer.gov

Key Terms

CA or Ca –

Differentiation (cell) –

Stem cells –

Neoplasia –

Hyperplasia –

Dysplasia or Atypia –

Hypoplasia –

Anaplasia –

Hypertrophy –

Atrophy –

Agenesis –

Tumor –

Benign –

Malignant –

Metastasis –

Carcinoma –

Sarcoma –

Carcinogen –

Carcinogenesis –

In situ –

Oncogenic viruses –

Oncologist –

Familial condition –

Grading –

Staging –

Key Terms — Neoplasm
Answers

CA or Ca – medical acronym for cancer

Differentiation (cell) – a process of changing from original unspecialized form to a different, more specialized form or function; a primitive nonspecialized cell that matures into a specific cell type according to function it is to perform

Stem cells – primitive, undeveloped cells

Neoplasia – "new growth;" formation is abnormal and serves no useful purpose

Hyperplasia – an increase in the *number* of cells that leads to increased mass in particular tissue (note: cells are normal size; the increase is in the number of cells)

Hypoplasia – a decreased number of cells leading to underdevelopment of tissue or organ

Anaplasia – "without form;" regression of fully developed cells to its primitive form (occurs in some tumors)

Dysplasia or Atypia – describes cells that looks abnormal or atypical

Hypertrophy – increased *size* of individual cells, which leads to increased size of affected tissue (normal number of cells) note: both hyperplasia and hypertrophy can exist within the same tissue

Atrophy – decrease in size of cells that results in smaller tissue or organ

Agenesis – "without development/origin;" nondevelopment of a part or organ

Tumor – a solid, localized mass or lump that new growth produces; space-occupying lesion

Benign – non-spreading; non-cancerous

<u>Malignant</u> – causing harm; serious condition; cancer that is invasive

<u>Metastasis</u> – spread of cancer from original tumor to other parts of body by means of tiny clumps of cells transported by blood or lymph

<u>Carcinoma</u> – a malignant tumor that starts in epithelium of organ or body part and may spread to other parts of body

<u>Sarcoma</u> – a malignant tumor that begins growing in connective tissue (muscle, bone, fat, cartilage)

<u>Carcinogen</u> – a substance or agent that can cause cancer (radiation exposure, certain chemicals, some viruses)

<u>Carcinogenesis</u> – cell's transformation from normal to cancerous cell

<u>In situ</u> – in natural place of origin; has not spread

<u>Oncogenic viruses</u> – cancer producing viruses; virus genes transform normal cells into deviant mutations that grow wildly without a "stop" mechanism

<u>Oncologist</u> – physician who specializes in tumors

<u>Familial condition</u> – conditions that tend to run in certain families

<u>Grading</u> – classification process that is a tissue-based method used by pathologists when they examine a tissue biopsy or cell specimens; looking for differentiation as to the degree of dysplasia or anaplasia; relates to **malignancy**

<u>Staging</u> – classification based on size of primary tumor and amount of metastasis or secondary tumors; relates to degree of **spread**

Disease Report Template

Disease	
Alternate Name(s)	
Definition	
Etiology	
Signs & Symptoms	
Diagnostic Tests	
Treatment	
Complications	
Prognosis	
Bibliography	

Disease Report Rubric

Criteria	Possible Points	Points Awarded
Disease Correctly names the disease.	3	
Alternate Names If applicable, includes any alternate names for the disease or disorder.	2	
Definition Includes an in-depth discussion of the history and general description of the disease with interesting facts	10	
Etiology Includes the cause or origin of the disease or disorder.	15	
Signs & Symptoms Accurately describes the common physical and medical symptoms.	15	
Diagnostic Tests Identifies tests performed to aid in the diagnosis or detection of disease or disorder.	15	
Treatment Identifies the mode or course pursued for remedial ends for the disease or disorder.	15	
Complications Identifies any diseases or injuries that may develop during the treatment of the disease or disorder.	10	
Prognosis Includes the prediction of the probable course, outcome, frequency, and life expectancy of the disease or disorder.	10	
Bibliography Follows proper format and includes more than 3 sources.	5	
TOTAL	100	

Name:	Date:	Course:

NEOPLASTIC LABORATORY INVESTIGATION

Purpose:

In this laboratory investigation, the student will differentiate between normal and neoplastic tissues and know the terms associated with neoplastic diseases.

Background Information:

Materials:

Microscope
Prepared histology slides: hyperplasia, metaplasia, dysplasia and anaplasia
Prepared histology slides of normal tissues and organs. (Note: these slides should correspond to the abnormal slides)
Prepared cytology slides: various structures showing cancerous tissues; provide at least two -- one benign and one malignant
Gloves
Laboratory coat or apron
Goggles
Biohazard containers
Surface disinfectant
Paper towels

Procedure:

1. Wash hands and put on gloves and goggles.
2. Assemble equipment and materials.
3. Prepare work area.
4. View the normal and abnormal slides.
5. Clean work area with surface disinfectant. Remove goggles and gloves and wash hands.

Data:

Draw and label observations.

a.   Non-neoplastic

b.   Neoplastic

Conclusions:

1. Compare and contrast the normal tissue from the non-neoplastic tissue slides.

2. Compare and contrast the normal tissue from the neoplastic tissues.

3. Explain what differentiates the neoplastic tissue from the non-neoplastic tissue. Why is the neoplastic tissue considered cancerous?

4. How can a pathologist determine the difference between a benign and a malignant tumor?

5. Why is dysplastic tissue sometimes considered to be a premalignant lesion?

Laboratory Investigation Rubric

Name: _____ **Date:** _____ **Course:** _____

Scoring Criteria	4. Excellent	3. Good	2. Needs Some Improvement	1. Needs Much Improvement	N/A
Problem is appropriately identified					
Problem is precise, clear, and relevant					
Association between the problem and the predicted results is direct and relevant					
All variables are clearly operationalized					
Student demonstrates comprehension of the use of scientific concepts and vocabulary					
All significant data is measured.					
Data is recorded effectively and efficiently					

Data table is well-designed to the requirements of the task					
All graph forms are appropriate					
All data is accurately plotted					
Graph is visually compelling; highlights conclusions of the study					
Conclusion relates directly to the hypothesis					
Conclusion has relevancy in the resolution of the original problem					
Conclusion relates the study to general interest					