Complete activities 1-4.

Activity #1:
PhysioEx - Exercise 7 - Respiratory System Mechanics
- Go to www.physioex.com, or click the link on the pathophysiology web page.
- Click on the PhysioEx 6.0 For Human Physiology graphic.
- Enter login name: patholab and password: wildcat.
- Click on “proceed to PhysioEx 6.0” (bottom-right corner).

Read through the Respiratory System Mechanics instructions, and answer the workbook questions.

Activity #2:
PhysioEx - Exercise 9 - Renal System Physiology

Read through the Renal System Physiology instructions, and answer the workbook questions.

Activity #3:
Complete the pulmonary case studies on the laboratory worksheet. Use the graphics from the lab webpage as indicated.

Activity #4:
Go to the patho webpage, and under activity 4, click on renal case studies 1 & 2. Review the case studies.
Case #1

A 49 year-old man with a 25 pack-year smoking history presented to you at the homeless clinic with complaints of increasing cough that had gradually been getting worse over the previous six months. He noted that the sputum was blood-tinged on one occasion. He also felt extremely tired. His x-ray showed upper lobe cavitations with nodular infiltrates.

Slide 1a - Chest x-ray

This chest radiograph reveals upper lobe granulomatous disease marked by irregular reticular and nodular densities and upper lobe cavitation due to central caseous necrosis.

Slides 1b, 1c, and 1d

Demonstrate the lung lesions at increasingly higher powers of magnification. Granulomas can be seen surrounded by epithelioid macrophages.

An acid fast stain demonstrated slender, red rods.

a. What disease do you suspect?

b. What causes the granulomas seen in the biopsy?

c. What contributed to the patient’s susceptibility to the disease?

d. How is this disease transmitted?

Case #2

A 67 year-old veteran with a 50 pack-year history of smoking is hospitalized with fever, a productive cough with thick yellow sputum, and hypotension. He had an elevated WBC count with left shift. A chest radiograph shows increased AP diameter and areas of patchy consolidation.

See slide 2a.
The chest radiograph in posterior-anterior view demonstrates a marked increase in size of the chest cavity. Note the increased lucency due to the loss of lung parenchyma.

See slide 2b

This slide is a gram stain of the sputum. Note the many neutrophils and gram positive diplococci (cocci in pairs).

a. This patient presents with a chronic and acute disease. Based on the chest x-ray and history, what chronic disease do you suspect?

b. What secondary condition is evident?

Case #3

A 9 year-old girl has the sudden onset of severe dyspnea with wheezing. She has had similar episodes in the past. She is taken to the ER. Physical exam shows rapid respirations, difficulty breathing, and tachycardia. ABG’s demonstrate acidosis.

a. What is the most likely diagnosis?

b. What immediate treatment would you suggest? Long-term treatment?

c. What is the cause of this disease?

Case #4

A neonate was born prematurely at 28 weeks gestation; weighing 700 grams (normal for 28 weeks is 950 grams). The baby was cyanotic, demonstrating tachypnea and dyspnea. The mother was a two-pack-per-day smoker who refused to cut down or stop smoking during her pregnancy. The baby survived.
for 6 days on a respirator requiring very high oxygen levels. Diffuse infiltrates were seen on chest x-ray, with a "ground glass" appearance, and the \( pO_2 \) was low on blood gas analysis.

See slide 4a

Supine chest radiograph demonstrates a bell shaped thorax with diffuse and symmetrical ground glass infiltrates.

See slide 4b

Lung biopsy shows respiratory bronchioles and alveolar ducts, being surrounded by collapsed alveoli filled with debris in a near uniform distribution. This leads to the classic "ground glass" appearance on the chest x-ray.

a. What is your diagnosis?

b. What causes this disease?

Case #5

A 20 year-old female college student presented with right back and flank pain. She was treated with anti-inflammatories and physical therapy. She was admitted to the hospital one month later after being seen in the outpatient clinic for recurrent symptoms of back pain. She indicated she has a six-year history of smoking and currently uses birth control pills.

On physical exam the respiratory rate was 16, the rest of the vitals were normal. She was a young woman in moderate distress secondary to pain. She had a friction rub at the right base, but the remainder of her examination was unremarkable.

Room air arterial blood gas showed pH 7.41, \( pCO_2 \) 35 and \( pO_2 \) 91. The EKG was normal, and the chest x-ray showed no infiltrates. A pulmonary angiography was performed and demonstrated an oblong filling defect (cutoffs in the vascular tree) within the interlobar branch of the right pulmonary artery.

See slide 5.
a. What problem do you suspect?

b. What are common risk factors?

c. What treatment do you recommend?
ANSWERS TO PULMONARY CASE STUDIES

Case #1

A 49 year-old man with a 25 pack-year smoking history presented to you at the homeless clinic with complaints of increasing cough that had gradually been getting worse over the previous six months. He noted that the sputum was blood-tinged on one occasion. He also felt extremely tired. His x-ray showed upper lobe cavitations with nodular infiltrates.

Slide 1a. Chest x-ray

This chest radiograph reveals upper lobe granulomatous disease marked by irregular reticular and nodular densities and upper lobe cavitation due to central caseous necrosis.

Slides 1b, 1c, and 1d show the lung lesions at increasingly higher powers of magnification. Granulomas can be seen surrounded by epithelioid macrophages.

An acid fast stain demonstrated slender, red rods.

a. What disease do you suspect? TUBERCULOSIS

b. What causes the granulomas seen in the biopsy? GRANULOMAS ARE CAUSED BY A CHRONIC INFLAMMATORY PROCESS. NEUTROPHILS AND MACROPHAGES WALL OFF THE COLONIES FORMING GRANULOMATOUS LESIONS. CELLS WITHIN THE TUBERCLES DIE CAUSING A CASEOUS NECROSIS (CHEESE-LIKE MATERIAL).

c. What contributed to the patient's susceptibility to the disease? HISTORY OF SMOKING; HOMELESS; LIVING IN CLOSE QUARTERS IN HOMELESS SHELTER

d. How is this disease transmitted? SPREAD BY AIRBORNE DROPLETS

Case #2

A 67 year-old veteran with a 50 pack-year history of smoking is hospitalized with fever, a productive cough with thick yellow sputum, and hypotension. He had an elevated WBC count with left-shift. A chest radiograph shows increased AP diameter and areas of patchy consolidation.
See slide 2a

The chest radiograph in posterior-anterior view demonstrates a marked increase in size of the chest cavity. Note the **increased lucency** due to the loss of lung parenchyma.

See slide 2b

This slide is a gram stain of the sputum. Note the many neutrophils and gram positive diplococci (coci in pairs).

a. This patient presents with a chronic and acute disease. Based on the chest x-ray and history, what chronic disease do you suspect? **EMPHYSEMA** (ENLARGED CHEST CAVITY WITH DESTRUCTION OF ALVEOLI, HISTORY OF HEAVY SMOKING)

b. What secondary condition is evident? **PNEUMONIA**. THE GRAM-POSITIVE DIPLOCOCCI ARE DIAGNOSTIC FOR STREPTOCOCCUS PNEUMONIA, A COMMON FORM OF COMMUNITY ACQUIRED PNEUMONIA IN ADULTS.

**Case #3**

A 9 year-old girl has the sudden onset of severe dyspnea with wheezing. She has had similar episodes in the past. She is taken to the ER. Physical exam shows rapid respirations, difficulty breathing, and tachycardia. **ABG's** demonstrate acidosis.

a. What is the most likely diagnosis? **ASTHMA**

b. What immediate treatment would you suggest? Long-term treatment? ACUTE TREATMENT CONSISTS OF GIVING A RAPID-ACTING BRONCHODILATOR SUCH AS ALBUTEROL. A SYSTEMIC STEROID MAY ALSO BE GIVEN. LONG-TERM TREATMENT VARIES BUT TYPICALLY CONSISTS OF BRONCHODILATORS AND STEROIDS INHALED BY A NEBULIZER.

c. What is the cause of this disease? **IN CHILDREN, ASTHMA IS A TYPE I HYPERSENSITIVITY REACTION TO AN EXTERNAL ALLERGEN.** THE OFFENDING ALLERGEN REACTS WITH IGE COATING MAST CELLS LINING THE AIRWAYS, RESULTING IN RELEASE OF MAST CELL...
GRANULES CONTAINING CYTOKINES SUCH AS HISTAMINE THAT LEAD TO BRONCHOCONSTRICTION AND EDEMA. EOSINOPHIL CHEMOTACTIC FACTOR IS ALSO RELEASED.

Case #4

A neonate was born prematurely at 28 weeks gestation; weighing 700 grams (normal for 28 weeks is 950 grams). The baby was cyanotic, demonstrating tachypnea and dyspnea. The mother was a two-pack-per-day smoker who refused to cut down or stop smoking during her pregnancy. The baby survived for 6 days on a respirator requiring very high oxygen levels. Diffuse infiltrates were seen on chest x-ray, with a "ground glass" appearance, and the \( \text{pO}_2 \) was low on blood gas analysis.

See slide 4a

Supine chest radiograph demonstrates a bell shaped thorax with diffuse and symmetrical ground glass infiltrates.

See slide 4b

Lung biopsy shows respiratory bronchioles and alveolar ducts, being surrounded by collapsed alveoli filled with debris in a near uniform distribution. This leads to the classic "ground glass" appearance on the chest x-ray.

a. What is your diagnosis? **RESPIRATORY DISTRESS SYNDROME (HYALINE MEMBRANE DISEASE).**

b. What causes this disease? **CAUSED BY SURFACTANT DEFICIENCY. THE ALVEOLI IN PREMATURE INFANTS ARE SMALL AND DIFFICULT TO INFLATE. THOSE THAT DO INFLATE DO NOT HAVE ADEQUATE SURFACTANT TO MAINTAIN ALVEOLAR DISTENTION. THIS CAUSES WIDESPREAD ATELECTASIS (COLLAPSED LUNG TISSUE).**

Case #5

A 20 year-old female college student presented with right back and flank pain. She was treated with anti-inflammatories and physical therapy. She was admitted to the hospital one month later after being seen in the outpatient clinic for recurrent symptoms of back pain. She indicated she has a six year history of smoking and currently uses birth control pills.
On physical exam the respiratory rate was 16, the rest of the vitals were normal. She was a young woman in moderate distress secondary to pain. She had a friction rub at the right base, but the remainder of her examination was unremarkable.

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See slide 5.

a. What problem do you suspect? **PULMONARY EMBOLISM**

b. What are common risk factors? **PROLONGED BED REST, OBESITY, NEUROLOGIC DISEASE, OLD AGE, PREGNANCY, CHF, AND INFLAMMATORY DISEASE. BIRTH CONTROL PILLS CARRY A MINOR RISK THAT IS COMPOUNDED WITH SMOKING.**

c. What treatment do you recommend? **ANTICOAGULANT THERAPY. IV HEPARIN FOLLOWED BY ORAL DOSE OF COUMADIN. ELIMINATE RISK FACTORS WHEN POSSIBLE**