

**Supplementary Table S1. Mapping of Learning Objectives to Embedded Student Questions**

Discipline	Learning Objective	Associated Case Questions for Students
Anatomy	<ol style="list-style-type: none"> <li>1. Review the structures that make up the upper and lower airways and the structure that divides them</li> <li>2. Describe the anatomical structures affected by asthma and contrast them with structures affected by other respiratory illnesses like rhinovirus or pneumonia</li> </ol>	<p>Review embryonic lung development and why preterm children often have lung issues.</p> <p>Describe the anatomical structures affected by asthma and contrast them with structures affected by other respiratory illnesses like rhinovirus or pneumonia</p> <p>How is a diagnosis of asthma made?</p> <p>Describe the structures of and the boundary between upper and lower airways. Compare normal airway structures with that of an asthmatic.</p>
Allergy/ Immunology	<ol style="list-style-type: none"> <li>1. Explain the sequence and manifestations of a Type I hypersensitivity Reaction</li> <li>2. Explain the immediate and late phases of allergy</li> <li>3. Explain asthma as a manifestation of allergy</li> </ol>	<p>What are the hypersensitivity reactions?</p> <p>Which type (of hypersensitivity reaction) is playing a role in the pathology of asthma?</p> <p>How do changes in upper vs. lower airway structures correlate with presenting symptoms/signs?</p> <p>How do you know when a patient is in respiratory distress?</p> <p>What on physical exam indicates this?</p> <p>Think not just about vital signs and auscultation but also what you will observe when you walk into the room.</p> <p>What are the risk factors for asthma here? (consider: preterm birth, stress, air pollution, tobacco smoke, physical activity)</p>
Biochemistry	<ol style="list-style-type: none"> <li>1. Given a patient presenting with a severe asthma attack, identify the major factors that can contribute to a mixed acidosis.</li> <li>2. Given a patient that with a lactic acidosis secondary to a hyperadrenergic state, provide a biochemical model that integrates lipid and carbohydrate metabolism in liver, adipose and muscle tissue to account for the metabolic acidosis</li> </ol>	<p>What are possible consequences of the patient's prolonged tachypnea on the ABG?</p> <p>What is the cause of the elevated lactate levels? Comment on potential causes of hypoglycemia. How do you explain the CBC results?</p> <p>Differentiate Type A from Type B lactic acidosis and identify the clinical findings that help differentiate between the two acidosis.</p> <p>Compare the physical exam findings of a patient presenting with active asthma to a patient presenting with metabolic acidosis secondary to a hyperadrenergic state.</p> <p>Review the biochemistry of the metabolic acidosis created by a hyperadrenergic state (including catecholamine regulation of carbohydrate metabolism in liver and adipose tissue and the effect of fatty acid oxidation on pyruvate metabolism).</p>
Microbiology	<ol style="list-style-type: none"> <li>1. Describe epidemiology of respiratory viruses as a cause of asthma exacerbations</li> <li>2. List respiratory viruses commonly causing asthma exacerbations</li> <li>3. Analyze the pathophysiology of why certain respiratory viral infections increase the risk of asthma exacerbations and secondary bacterial infections</li> <li>4. Describe classic presentations of respiratory viral infections in a child with asthma</li> <li>5. Describe and compare commonly used diagnostic tests for respiratory viruses</li> <li>6. List available therapeutic options for common respiratory viruses and their indications in children</li> <li>7. Analyze what system-based practices can be taken in a pediatric practice to reduce the risk of respiratory viral infections and their complications in children with a known diagnosis of asthma</li> </ol>	<p>What are the risk factors for asthma here? (consider: preterm birth, stress, air pollution, tobacco smoke, physical activity)</p> <p>Do you think this child's symptoms could be due to an infection?</p> <p>If yes, which organisms could be responsible, and how would you confirm your suspicion?</p> <p>Would you start Marcus on antibiotics?</p> <p>What needs to be done before starting?</p> <p>What is the role of infection in hyperreactive airway disease?</p> <p>Which organisms are usual causative agents in children's lung disease?</p> <p>Describe the change in cellular functioning and how it relates to observable clinical symptoms.</p> <p>How do changes in upper vs. lower airway structures correlate with presenting symptoms/signs?</p>

Physiology	<ol style="list-style-type: none"> <li>1. Explain the mechanisms of action and potential side effects of medications used in asthma management</li> <li>2. Interpret pulmonary function tests (PFTs) and compare normal PFTs with those observed in obstructive lung disease</li> <li>3. Interpret arterial blood gas measurements in the context of a patient's course and make decisions about subsequent patient care</li> </ol>	<p>How is a diagnosis of asthma made?</p> <p>What are the mechanisms of action of albuterol and dexamethasone?</p> <p>In a patient with an obstructive lung disease, what changes in pulmonary function tests (PFTs) may occur following albuterol administration?</p> <p>Interpret PFTs given in a series of graphs in the context of obstructive and restrictive lung disease.</p> <p>Calculate the anion gap and explain the results.</p> <p>Explain the bicarbonate level.</p> <p>Brainstorm some explanations for the mixed acidosis that Marcus is experiencing at this time.</p> <p>What are possible consequences of the patient's prolonged tachypnea on the ABG?</p> <p>What is the cause of the elevated lactate levels? How do you explain the CBC results?</p> <p>Compare the physical exam findings of a patient presenting with active asthma to a patient presenting with metabolic acidosis secondary to a hyperadrenergic state.</p>
Pharmacology	<ol style="list-style-type: none"> <li>1. Provide rationale for using bronchodilators and steroids during acute asthma</li> <li>2. Describe the side effects of frequent administration of Albuterol</li> </ol>	<p>What is the mechanism of action of dexamethasone?</p> <p>Why was Marcus administered IV steroids rather than via inhaler or a nebulizer?</p> <p>The patient's blood pressure drops following additional nebulizer treatments: explain how might excess albuterol be related to hypotension and the acid-base disturbances that the patient is experiencing.</p> <p>What medications should Marcus be discharged on?</p>
Social and Family Determinants	<ol style="list-style-type: none"> <li>1. Recognize the psychosocial impact of asthma on pediatric patients and their families</li> <li>2. Assess addressable asthma exacerbation risks and educational needs for patients and families</li> <li>3. Recognize inequities, and our own assumptions/biases, in assessing and engaging with patients and families</li> </ol>	<p>Is there anything different about taking an ABG from a child vs. an adult?</p> <p>How is the whole family affected by asthma?</p> <p>Think about how chronic, life-long, and life-threatening illnesses impact individual patients and their families throughout the lifespan.</p> <p>Think about the experience of a child left alone overnight in a hospital.</p> <p>What social determinants of health, and other environmental and socioeconomic factors, might affect short- and long-term prognosis and morbidity and mortality risks in a child with asthma? How would knowledge of these factors affect the provider's treatment decisions and discharge planning, as well as patient and family education strategy?</p> <p>Develop a discharge plan.</p> <p>What discharge instructions are to be given to the father?</p>

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