Cardiovascular/Respiratory/Renal Unit
(CRR)
Overview

2020

Brent Bany, Ph.D.
Unit Director

Rodney Weilbaecher, Ph.D.
Unit Director

Nicholas Weshinskey, Ph.D.
Year 1 Curriculum Director

Cris Anderson, M.D.
Year 1 Doctoring Director

Merit Sullivan, M.S.
Year 1 Curriculum Coordinator

December 2020

Primary Discipline Faculty

Discipline	Faculty	Home Department
Anatomy	C.-S. Li	Anatomy
	R. Clough	Anatomy
	D. Sarko	Anatomy
	M. Thurber	Anatomy
Histology	J. Cheatwood	Anatomy
	N. Henry	Anatomy
Renal	P. Jensik	Physiology
Respiratory	B. Bany	Physiology
Cardiology	R. Weilbaecher	Biochemistry & Molecular Biology
	Biochemistry	R. Weilbaecher Biochemistry & Molecular Biology
	J. Davie	Biochemistry & Molecular Biology
	S. Bhaumik	Biochemistry & Molecular Biology
	F. Kadyrov	Biochemistry & Molecular Biology
	M. Young	Biochemistry & Molecular Biology
BSS	L. DiLalla	Family & Community Medicine
	C. Hamilton	Family & Community Medicine
Immunology	D. Torry	Medical Microbiology, Immunology & Cell Biology (Springfield)
Genetics	K. Hales	Physiology
Embryology	M. Thurber	Anatomy
Pharmacology	A. Pond	Anatomy
PSP	S. Vohra	Population Science & Policy (Springfield)
	M. Volle	Population Science & Policy (Springfield)
	T. Johnson	Population Science & Policy (Springfield)
Doctoring	C. Anderson	OEC
	S. Shelton	Family & Community Medicine

Tutors

Name	Rank	Full or partial Unit	Department
B. Bany	Associate Professor	partial	Physiology
M. Barton	Instructor	partial	Biochemistry & Molecular Biology
S. Bhaumik	Associate Professor	partial	Biochemistry & Molecular Biology
M. Gastel	Instructor	full	Physiology
K. Hales	Assistant Professor	full	Physiology
N. Henry	Instructor	full	Anatomy
Phil Jensik	Assistant Professor	full	Physiology
C.-S. Li	Associate Professor	full	Anatomy
A. Raymer	Instructor	partial	Physiology
A. Pond	Assistant Professor	full	Anatomy
M. Thurber	Instructor	full	Anatomy
R. Weilbaecher	Res. Assist. Professor	full	Biochemistry

Outside Clinicians and Basic Scientists

Session	Name	Specialty
case wraps (4)	M. Khan	cardiology
case wrap (1)	Kamran	renal
resource session	D. Fulk	radiology

OEC Staff

Clinical and Nurse Educators	G. Hoffman
	J. Davis
	M. Hof
Office Staff	V. Dasher

CRR Overview

As the first unit of Year 1, CRR must develop not "just" the Learning Issues (LIs) of cardiovascular, respiratory and renal in all the basic science disciplines listed in the following pages, but the introduction to small group learning, self-directed learning, problem-based learning and introduction to clinical skills in both tutor groups and practical lab settings. All the skills that are habitual later in the year and in Year 2, from developing learning issues, to history taking, to Problem Lists, to Patient Summaries to giving feedback, are new to the incoming class. Progress is slow, and sometimes frustrating (students continue to request additional resource sessions, no matter how small (or limited) the topic), early in the unit, but by the end of the unit many of these skills and tactics have become second nature.

In addition to an introduction to the PBL process itself, the basic and clinical science goals of the CRR unit are for the student to acquire a molecular, cellular and clinical understanding of:
1) Biological bases for cardiovascular, respiratory and renal processes;
2) Clinical and laboratory diagnoses of CRR processes;
3) Mechanisms of action for medications related to CRR processes;
4) Introduction to physician/patient interaction.

Successes for 2020 include:

- Continued use of the new rubric for the tutor group assessments which increased the detail level of the mid- and end-of-unit tutor group assessments
- Moving SAQ's off of ExamSoft and back to D2L as requested by the students which did not like the Examplify SAQ format last year.
- Re-entering the midunit Exam onto ExamSoft to better match the EOU exam format.
- Successful participation of Rod Weilbaecher as Acidosis/Alkalosis expert and our new Cardiac Physiology expert.
- Continued refinement of the programmatic assessment of student performance and use of the new Y1SCC
- Updating all case materials and mini cases
- A new Year 1 director on-board, Dr. Weshinskey.
- Exams were mostly taken remotely with some students choosing to come into Lindegren testing room. Secondary devices were used for proctoring. Seemed effective.
- During the ePBLMs, student use of D2L discussion forum was outstanding compared to previous years.

Struggles included:

- A unique struggle this year was due to the pandemic. Many students hesitated to reach out to the faculty for impromptu office hours (online) and complained about pre-recorded resource sessions. Although there was a good use of the Discussion forum on D2L this year, students felt they needed more live online sessions and faculty needed to have "set in stone" office hours. The students were encouraged to contact faculty to make arrangements to meet and ensured them that most faculty would be more than willing to meet with them individually or in groups and if not they needed to inform the year and unit directors.
- Remote exam proctoring some students found noises distracting, we tried to improve for End-of-unit exam and was better but not perfect.
- Exposing students to content of mini-cases (the order of the final four mini-cases appears effective, although there are still students who view these as a distraction from their studies)
- Implementation of (and student anxiety over) the programmatic assessment model was difficult partially due to the lack of the deployment of the student dashboard and advisor experience.
- For the End-of-Unit exam, the coding of exam questions in ExamSoft did not properly translate to category scores (coding) that were accurate and some categories that were labeled properly reported inaccurate concern/review metrics that were not fully customizable. This was despite the Unit Directors assurance that they fixed the coding of the exams this year. This limitation of the software to enable changing the coding of previous years exam questions is not understood. This was overcome by manual coding, re-calculation and reporting of the data. This will remain to be an issue even if the plans to release the Dashboard next year comes to fruition.

Challenges for 2021 will include:

- Improving use of ExamSoft and Examplify (i.e. including the addition of rationales for questions for exam review?) computer-based testing system and decide what to do with the SAQ's pending how it goes in the other 2 units this year.
- Incorporation of the Dashboard for student use into the programmatic assessment model.
- Unit directors appeared to have satisfactory interactions with the students and will continue to share coordination. We continue to work with our colleagues in Y2 and the other Y1 unit directors to integrate material within and across the pre-clinical years. We also continue to monitor the USMLE Graduation Questionnaire for appropriate actions.

CRR Cases, Fall 2019

Jamal Johnson	ePBLM	sickle cell disease	4	M	African
Jonah Self	ePBLM	atrial septal defect	40	M	African-American
Louis Welker	ePBLM	acute pulmonary embolism	55	M	African-American
Franco Dombkoski	ePBLM	chronic obstructive pulmonary disease (COPD)	71	M	Caucasian
Janet Inman	ePBLM	mitral valve prolapse with associated episodes of supraventricular tachycardia	30	F	Caucasian
Ellen Cole	ePBLM	myocardial infarction (MI)	39	F	Caucasian
Toussaint Durand	ePBLM	acute poststreptococcal glomerulonephritis	15	M	Haitian
Helen Leek	ePBLM	hyponatremia; severe extracellular volume and electrolyte depletion	58	F	Caucasian
John Biggs	ePBLM	congestive heart failure (CHF) and psychogenic polydipsia	43	M	Caucasian

Rashid Bhikha	Shortness of Breath Mini Case A1	V/Q mismatch & possible diffusion impairment	50	M	Indian
Guy Schlosser	Shortness of Breath Mini Case A2	respiratory center damage (pure hypoventilation)	63	M	French
Mirka Ogorzalek	Shortness of Breath Mini Case A3	respiratory distress syndrome of the newborn	new-born	F	Polish
Zhong Wang	Shortness of Breath Mini Case A4	arterial-venous fistula caused by hemangiomas	42	M	Chinese
Naomi Feldshuh	Shortness of Breath Mini Case A5	scleroderma	52	F	Israeli
Oleg Brin	Shortness of Breath Mini Case A6	normal physiological response to exercise	27	M	Russian
Dante LoGrasso	Shortness of Breath Mini Case A7	asthma	33	M	Italian
Richie Elias	Genetics Mini Case B1	Alport syndrome	15	M	Caucasian
Lucy Grace	Genetics Mini Case B2	Marfan syndrome	15	F	not specified
Billy Talbot	Genetics Mini Case B3	hemophilia A	4	M	not specified
Liza Bird	Genetics Mini Case B4	cystic fibrosis	8 mo.	F	Caucasian
Conchita Wilson	Genetics Mini Case B5	polycystic kidney disease	42	F	Hispanic
James Bell	Genetics Mini Case B6	hemochromatosis	42	M	Caucasian
Alan Merkin	Lifestyle Changes Mini Case C1	low aerobic capacity, hypertension, obesity	42	M	Caucasian
Myriah Hughes	Lifestyle Changes Mini Case C2	elevated blood glucose	14	F	African-American
Jeff Jones	Lifestyle Changes Mini Case C3	stress-induced insomnia	24	M	Caucasian
Frances Bean	Lifestyle Changes Mini Case C4	perimenopausal excessive bleeding	42	F	Caucasian
Johnny Dunn	Lifestyle Changes Mini Case C5	alcohol dependence or maladaptive use of alcohol	38	M	Asian
Ruth Drill	Lifestyle Changes Mini Case C6	inadequate coping/anger management skills	60	F	Caucasian
Giselle Petit-Duran	Shock Mini Case D1	hemorrhagic shock	57	F	French
Kairys Motekaitis	Shock Mini Case D2	septic shock	not spec.	M	Lithuanian
Adriano Celentano	Shock Mini Case D3	cardiogenic shock	22	F	Greek
Poady Sirleaf	Fluid & Electrolyte Mini Case E1	dehydration	61	M	Liberian
Anita Scheving	Fluid & Electrolyte Mini Case E2	primary aldosteronism; Conn's syndrome	43	F	Icelandic

Juan Fujimori	Fluid & Electrolyte Mini Case E3	diabetes insipidus	28	M	Peruvian
Rafael Coto	Fluid & Electrolyte Mini Case E4	acute renal failure	72	M	Argentine
LeRoy Jose Amate Perez	Fluid & Electrolyte Mini Case E5	adrenocortical insufficiency; Addison's disease	32	M	Mexican
Sameera Fanous	Fluid & Electrolyte Mini Case E6	syndrome of inappropriate ADH secretion	56	F	Egyptian
Denis Glazov	Acid Base Mini Case F1	hysterical hyperventilation (acute respiratory alkalosis)	23	F	Ghanan
Bayo Lamitey	Acid Base Mini Case F2	cardiogenic shock (normochloremic metabolic acidosis with increased anion gap & compensatory response)	60	M	Russian
Ursula Engels	Acid Base Mini Case F3	type I distal renal tubular acidosis (mixed hyperchloremic metabolic acidosis with normal anion gap & respiratory acidosis)	37	F	German
Winston Churchhorse	Acid Base Mini Case F4	COPD & diuretic excess (mixed metabolic alkalosis and respiratory acidosis)	56	M	British
Nigel Weatherin	Acid Base Mini Case F5	hypoperfusion, vomiting & dehydration (mixed metabolic acidosis with increased anion gap & metabolic alkalosis)	72	M	British
Michael Lemann	Acid Base Mini Case F6	salicylate toxicity (mixed metabolic acidosis with increased anion gap & respiratory alkalosis)	37	M	French/Swiss
Nima Razak	Cardiovascular Disease Mini Case G1	pulmonary atresia with restrictive ventricular septal defect	3 mo.	F	Malaysian
Stefan Richter	Cardiovascular Disease Mini Case G2	aortic stenosis	60	M	Swiss
Paulina Formichetti	Cardiovascular Disease Mini Case G2	aortic stenosis	76	F	Italian
Rudo Neshamba	Cardiovascular Disease Mini Case G3	hypercholesterolemia, hyperlipidemia, myocardial infarction	32	M	South African
Mariposa Marlin	Cardiovascular Disease Mini Case G4	primary/essential hypertension	68	F	Spanish
Nu Paowsong	Cardiovascular Disease Mini Case G4	secondary hypertension	14	F	Thai
Michaela/Michael Rarebit	CCX (MU exam)	pulmonary embolism	50	2F/3M	not specified
Emily Richards	CCX (EOU exam)	chronic thromboembolic pulmonary hypertension	59	F	not specified

Year One CRR Unit Final Learning Issues, 2020

Anatomy & Histology

Jamal Johnson
structure & function of the spleen – gross anatomy & histology
red blood cell – structure and function – histology

Jonah Self
embryology of heart, great vessels, and lungs with connection to physical examination and clinical/radiologic workup

Louis Welker
thoracic cavity and lungs, musculature, vasculature, and innervation – gross anatomy along with connection to physical examination and clinical/radiologic workup
mechanics of breathing – gross anatomy
anatomic and physiological dead space – gross anatomy
histology of the lung

Franco Dombkoski
Embryological development of lungs along with connection to physical along with examination and clinical/radiologic workup
extracellular matrix – proteases (elastase) and antiproteases (α1-antitrypsin) – histology

Janet Inman
heart and conduction system – gross anatomy and histology with connection to physical examination

Ellen Cole
coronary circulation – anatomy, histology, and regulation with connection to physical examination

Toussaint Durand
kidney and excretory system – gross anatomy and histology with connection to physical examination
histology – mechanics of glomerular filtration: structure of filtration barrier, forces driving filtration, selectivity of filtration barrier, terminology
histology – immune mechanisms of acute poststreptococcal glomerulonephritis: antibodies & complement

Behavioral Science

Jamal Johnson
introduction to child development – Denver developmental chart, normal milestones
population science and policy – incidence, prevalence and screening

Jonah Self
lifestyle changes – anxiety and smoking
incidence, prevalence and prevention of atrial septal defect

Louis Welker
weight management

Franco Dombkoski
smoking cessation and the role of smoking in the pathogenesis of chronic obstructive pulmonary disease (COPD), emphysema, and chronic bronchitis

Janet Inman
smoking cessation

Lifestyle Changes Mini Cases
role of family in life style modification
life style modification – options, effectiveness, physician impact, success rates
life style modification techniques – psychiatric, pharmacological, behavior modification, support groups, family support
cardiac risk factors – smoking, alcoholism, obesity, non-compliance with medication, anger, stress
patient compliance

Ellen Cole
cardiovascular disease – risk factors

John Biggs
pathogenesis of cardiomyopathy and congestive heart failure

Biochemistry

Jamal Johnson
complete blood count and iron indices – RBC parameters (Hct, Hb content, MCV, MCHC), WBCs (differential count), serum iron, total iron binding capacity, transferrin, and ferritin
red blood cells – structure and function, glycolysis, pentose phosphate pathway, glutathione synthesis, heme synthesis, molecular basis for ABO/Rh blood groups
hemoglobin structure – HbA ($\alpha_2\beta_2$), HbF ($\alpha_2\gamma_2$), HbA_2 ($\alpha_2\delta_2$), HbS; overview of hemoglobin function
introduction to molecular biology of gene expression – transcription, translation, protein processing, and epigenetics

Jonah Self
regulation of pulmonary blood flow
O_2 exchange between alveolus and pulmonary blood
chemistry panels (basic and comprehensive metabolic panels)

Louis Welker
regulation of pulmonary blood flow
interpretation of arterial blood gases – respiratory alkalosis
mechanism of blood clotting – coagulation pathway, mechanisms of action of anticoagulants (heparin, warfarin, other drug classes), clinical markers, defects or deficiencies
transport of O_2 and CO_2 between lung and peripheral tissues
gas exchange between alveolar gas and pulmonary capillary blood

Franco Dombkoski
Pharmacokinetics/pharmacology – classes of medications, mechanism of action, and routes of administration
O_2 & CO_2 transport between alveolus and blood
extracellular matrix – proteases (elastase) and antiproteases (α1-antitrypsin)

nutrition – body mass index (BMI) and estimated energy requirements

Janet Inman
ion channels: Na^+, K^+, Cl^-, Ca^{2+}
pharmacology of antiarrhythmic drugs – drug classes
signal transduction – neurotransmitters, hormones, and receptors

Ellen Cole
cholesterol synthesis and turnover, lipid processing – chylomicrons, VLDL, LDL, IDL, HDL, apolipoproteins, HMG CoA reductase inhibitors, hyperlipidemia classification
atherosclerotic plaque formation and dissolution – thrombolytic agents, tPA, anti-platelet drugs
heart muscle contraction and energy production
clinical markers for myocardial infarction – LDH, CPK, troponin, AST, ALT
nutrition – body mass index (BMI) and estimated energy requirements
pharmacokinetics: drug metabolism and interactions, cytochrome P450

Toussaint Durand
clinical evaluation of renal function – serum creatinine, blood urea nitrogen, creatinine clearance, urinary casts, tissue biopsy
blood urea nitrogen – urea cycle and amino acid processing

Helen Leek
renal handling of Na^+ and K^+ (sites and mechanisms of reabsorption)
regulation of Na^+ excretion (renin-angiotensin-aldosterone; sympathetic nervous system) and of K^+ excretion (diuretics, acid base status, aldosterone)
acid-base balance (interpretation of arterial blood gas analysis, regulation of H^+ excretion)
regulation of osmolality, regulation of water excretion, ADH (actions, regulation)
site of action, mechanism of action, pharmacokinetics (volume of distribution), and side effects (K^+ depletion, metabolic alkalosis) of thiazide diuretics

John Biggs
pharmacology of thiazide loop (furosemide) and K^+ sparing (spironolactone) diuretics
source, regulation of release, and actions of brain natriuretic peptide
heart contraction and energy (ATP) production

Clinical Medicine

Jamal Johnson
introduction to child development – Denver developmental chart, normal milestones
pathogenesis and natural history of sickle cell disease with connection to physical examination
complete blood count and iron indices – RBC parameters (Hct, Hb content, MCV, MCHC) and WBCs
spleen – structure and function along with connection to physical examination
population science and policy – incidence, prevalence and screening, weight management

Jonah Self
embryology of heart, great vessels, and lungs with connection to physical examination
cardiac cycle (emphasizing the right heart and pressures in the pulmonary circulation)
use of the Swan-Ganz and cardiac catheters
O_2 exchange between alveolus and pulmonary blood
introduction to cardiovascular and respiratory examinations – heart sounds

electrocardiogram
population science and policy, incidence and prevalence
chemistry panels (basic and comprehensive metabolic panels)

Louis Welker
gross anatomy of thoracic cavity and lungs, musculature, vasculature, and innervation along with connection to physical examination
interpretation of arterial blood gases – respiratory alkalosis
mechanism of blood clotting – coagulation pathway, mechanisms of action of anticoagulants (heparin, warfarin, other drug classes), clinical markers, defects or deficiencies
lung sounds

Franco Dombkoski
interpretation of pulmonary function tests – spirometry, flow volume loops, diffusing capacity; distinction between obstructive and restrictive disease; lung sounds
pathogenesis of chronic obstructive pulmonary disease, emphysema, and chronic bronchitis; role of smoking; pathogenesis of obstruction in COPD with connection to physical examination
interpretation of arterial blood gas data
nutrition – body mass index (BMI) and estimated energy requirements

Janet Inman
arrhythmias and conduction disturbances with connection to physical examination
pharmacology of antiarrhythmic drugs – drug classes
pharmacokinetics – the routes by which drugs are administered, how acidic drugs differ from basic drugs in the absorption from the stomach, how the absorption of propranolol compares with phenytoin, why the oral bioavailability of propranolol is a concern
cardiac cycle and heart sounds (including murmurs)
electrocardiography
population science and policy – incidence, prevalence and screening of mitral valve prolapse

Ellen Cole
cardiovascular disease – risk factors
clinical markers for myocardial infarction – LDH, CPK, troponin, AST, ALT
population science and policy – incidence, prevalence, screening and prevention of coronary artery disease
blood pressure – carotid sinus and baroreceptors
nutrition – body mass index (BMI) and estimated energy requirements

Toussaint Durand
kidney and excretory system – gross anatomy and histology with connection to physical examination
clinical evaluation of renal function – serum creatinine, blood urea nitrogen, creatinine clearance, urinary casts, tissue biopsy
body water spaces and volume of distribution (disposition)
hypertension – what it is and how it is classified
population science and policy – incidence, prevalence and prevention of post-streptococcal glomerulonephritis
immune mechanisms of acute poststreptococcal glomerulonephritis – antibodies and complement

Helen Leek

cardiovascular responses to vascular volume depletion
acid-base balance (interpretation of arterial blood gas analysis, regulation of H^+ excretion)
site of action, mechanism of action, pharmacokinetics (volume of distribution), and side effects (K^+ depletion, metabolic alkalosis) of thiazide diuretics
effects of dehydration on serum creatinine and blood urea nitrogen levels (pre-renal azotemia)

John Biggs
pathogenesis of cardiomyopathy and congestive heart failure – connection to physical examination
pathogenesis and differential diagnosis of hyponatremia
pharmacology of thiazide loop (furosemide) and K^+ sparing (spironolactone) diuretics
pharmacokinetics (distribution of drugs into fluid compartments)
source, regulation of release, and actions of brain natriuretic peptide
population science and policy – incidence and prevalence of alcoholic cardiomyopathy

Genetics

Jamal Johnson
introduction to molecular biology of gene expression – transcription, translation, protein processing, and epigenetics
introduction to genetics (basic principles)

Genetics Mini Cases
Genetics terminology: pleiotropy, allelic heterogeneity, variable expressivity, incomplete penetrance, locus heterogeneity, proband, incidence, prevalence, germ line mosaicism, haploinsufficiency, autosomal recessive, autosomal dominant, x-linked recessive, x-linked dominant, y-linked, obligate carriers, homozygous, heterozygous, hemizygous, silent mutation, null mutation, missense mutation, frame shift mutation, polymorphism, linkage analysis, genotype vs. phenotype, sex-limited trait, sex-influenced trait
Analysis of pedigrees, use of symbols in pedigrees, predicting normal, carrier, or affected status of individuals
Analytical techniques and use of: targeted sequencing, whole exome sequencing, whole genome sequencing, and protein truncation test (PTT)
Inheritance patterns, molecular basis, and clinical manifestations of: Alport syndrome, hemophilia, Marfan syndrome, adult polycystic kidney disease, cystic fibrosis, neurofibromatosis I, and hemochromatosis

Immunology

Jamal Johnson
complete blood count – RBC parameters (Hct, Hb content, MCV, MCHC) and WBCs
introduction to immunology – cause of inflammation and pain (cytokines and phagocytes)

Toussaint Durand
immune mechanisms of acute poststreptococcal glomerulonephritis – antibodies and complement

Pathology

Jamal Johnson
pathogenesis and natural history of sickle cell disease, incidence and prevalence, screening tests

Pharmacology

Jamal Johnson
Pharmacokinetics – routes of administration

Louis Welker
mechanism of blood clotting – coagulation pathway, mechanisms of action of anticoagulants (heparin, warfarin, other drug classes), clinical markers, defects or deficiencies
pharmacokinetics – the routes by which drugs are administered, how acidic drugs differ from basic drugs in the absorption from the stomach

Franco Dombkoski
pharmacokinetics/pharmacology – classes of medications, mechanism of action, and routes of administration

Janet Inman
ion channels: Na^+, K^+, Cl^-, Ca^{2+}
pharmacology of antiarrhythmic drugs – drug classes
pharmacokinetics – the routes by which drugs are administered, how acidic drugs differ from basic drugs in the absorption from the stomach, how the absorption of propranolol compares with phenytoin, why the oral bioavailability of propranolol is a concern
signal transduction – neurotransmitters, hormones, and receptors

Ellen Cole
cholesterol synthesis and turnover, lipid processing – chylomicrons, VLDL, LDL, IDL, HDL, apolipoproteins, HMG CoA reductase inhibitors
atherosclerotic plaque formation and dissolution – thrombolytic agents, tPA, anti-platelet drugs
pharmacokinetics: drug metabolism and interactions, cytochrome P450

Toussaint Durand
body water spaces and volume of distribution

Helen Leek
site of action, mechanism of action, pharmacokinetics (volume of distribution), and side effects (K^+ depletion, metabolic alkalosis) of thiazide diuretics

John Biggs
pharmacology of thiazide loop (furosemide) and K^+ sparing (spironolactone) diuretics
pharmacokinetics (distribution of drugs into fluid compartments)

Physiology

Jamal Johnson
hemoglobin structure – HbA ($\alpha_2\beta_2$), HbF ($\alpha_2\gamma_2$), HbA_2 ($\alpha_2\delta_2$), HbS; overview of hemoglobin function
red blood cell – structure and function, glycolysis, pentose phosphate pathway, glutathione synthesis, heme synthesis, molecular basis for ABO/Rh blood groups

Jonah Self
cardiac cycle (emphasizing the right heart and pressures in the pulmonary circulation)
use of the Swan-Ganz catheter
regulation of pulmonary blood flow
O_2 exchange between alveolus and pulmonary blood

introduction to cardiovascular and respiratory examinations – heart sounds
electrocardiogram

Louis Welker
normal distribution of blood flow in pulmonary circulation
regulation of pulmonary blood flow
interpretation of arterial blood gases – respiratory alkalosis
mechanism of blood clotting – coagulation pathway, mechanisms of action of anticoagulants (heparin, warfarin, other drug classes), clinical markers, defects or deficiencies
anatomic and physiological dead space
transport of O_2 and CO_2 between lung and peripheral tissues
gas exchange between alveolar gas and pulmonary capillary blood

Franco Dombkoski
interpretation of pulmonary function tests – spirometry, flow volume loops, diffusing capacity; distinction between obstructive and restrictive disease
O_2 and CO_2 transport between alveolus and blood
ventilation perfusion matching – regulation of pulmonary blood flow, regulation of air flow, V/Q mismatching in chronic obstructive pulmonary disease
control of ventilation
interpretation of arterial blood gas data

Janet Inman
ion channels: Na^+, K^+, Cl^-, Ca^{2+}
arrhythmias and conduction disturbances
pharmacology of antiarrhythmic drugs – drug classes
pharmacokinetics – the routes by which drugs are administered, how acidic drugs differ from basic drugs in the absorption from the stomach, how the absorption of propranolol compares with phenytoin, why the oral bioavailability of propranolol is a concern
cardiac cycle and heart sounds (including murmurs)
signal transduction – neurotransmitters, hormones, and receptors
electrical conduction in the heart
electrocardiography

Shortness of Breath Mini Cases
Given a case of a patient who is short of breath, present a synopsis of the case and offer a diagnosis and description of the pathogenesis, basing your discussion on an understanding of the:

- mechanisms for regulation of ventilation in the healthy subject.
- use of the alveolar gas equation to calculate $PA.O_2$, and hence the A-a $P.O_2$ difference.
- use of the relationship between alveolar ventilation rate and $Pa.CO_2$ to estimate the expected $Pa.CO_2$, or to deduce the alveolar ventilation rate.
- use of the Fick principle to calculate pulmonary blood flow.
- use of the Bohr equation to calculate the physiologic dead space.
- use of the following procedures to differentiate between the four primary causes of hypoxemia (hypoventilation, diffusion impairment, shunt, & ventilation-perfusion inequality):
  - ✓ determination of $Pa.CO_2$
  - ✓ determination of diffusing capacity
  - ✓ determination of alveolar-arterial O_2 difference
  - ✓ the effect of breathing 100% O_2 on arterial O_2 saturation and $Pa.O_2$

- ✓ excluding the other three
- ➢ value of pulmonary function tests in differentiating between obstructive and restrictive lung disease.
- ➢ Keep in mind how each patient is different from a healthy normal person.

Ellen Cole

coronary circulation – anatomy, histology, and regulation
cholesterol synthesis and turnover, lipid processing – chylomicrons, VLDL, LDL, IDL, HDL, apolipoproteins, HMG CoA reductase inhibitors, hyperlipidemia classification
atherosclerotic plaque formation and dissolution – thrombolytic agents, tPA, anti-platelet drugs
heart muscle contraction and energy production
blood pressure – carotid sinus and baroreceptors

Cardiovascular Disease & Hypertension Mini Cases

Given a clinical problem of a patient with cardiovascular disease and/or hypertension, apply the following considerations to an analysis of the problem:

- ➢ Cholesterol biosynthesis and approaches (including diet and nutrition) to control serum levels.
- ➢ Compliance, contractility, preload, afterload and hemodynamics.
- ➢ Embryological development of the heart.
- ➢ Lipoprotein metabolism & hereditary hyperlipidemias (hypercholesterolemias, hypertriglyceridemias).
- ➢ Major determinants of arterial blood pressure and how changes in these determinants normally alter cardiac output and total peripheral resistance; how do these variables change during the maintenance phase of essential and secondary hypertension?
- ➢ Normal and abnormal features of electrocardiogram (rate, rhythm, waves, axes).
- ➢ Normal and abnormal heart sounds.
- ➢ Normal metabolism in heart and changes during ischemic events.
- ➢ Normal and pathophysiology, normal and pathobiochemistry, and clinical manifestations associated with cardiovascular disease.
- ➢ Normal regulation and effect on the cardiovascular system of the baroreceptor/autonomic nervous system reflex. How are these systems implicated in the development and maintenance of hypertension?
- ➢ Number of Americans estimated to have hypertension; percentage of this hypertensive group thought to have "essential hypertension." Besides essential, what are other conditions that can lead to hypertension? Of these secondary causes, which is the most common? Which primary hemodynamic determinant of blood pressure is altered during the maintenance phase of essential and secondary hypertension?
- ➢ Number of Americans estimated to have a particular cardiovascular disease.
- ➢ Pathophysiology and clinical manifestations associated with long standing systemic hypertension; long-term effects of increased pressure (afterload) on the myocardium and the long-term effects of diastolic hypertension on arteriole reactivity, wall thickness, and lumen diameter.
- ➢ Risk factors, symptoms, and complications frequently associated with cardiovascular disease.
- ➢ Risk factors, symptoms, and complications frequently associated with hypertension.

Toussaint Durand

body water spaces and volume of distribution

mechanics of glomerular filtration – structure of filtration barrier, forces driving filtration, selectivity of filtration barrier, terminology
mechanisms of development of peripheral edema – Starling forces, volume overload, nephrotic syndrome
hypertension – what it is and how it is classified
renal handling of creatinine and urea

Helen Leek
renal handling of Na^+ and K^+ (sites and mechanisms of reabsorption)
regulation of Na^+ excretion (renin-angiotensin-aldosterone; sympathetic nervous system) and of K^+ excretion (diuretics, acid base status, aldosterone)
cardiovascular responses to vascular volume depletion
acid-base balance (interpretation of arterial blood gas analysis, regulation of H^+ excretion)
regulation of osmolality, regulation of water excretion, ADH (actions, regulation)
site of action, mechanism of action, pharmacokinetics (volume of distribution), and side effects (K^+ depletion, metabolic alkalosis) of thiazide diuretics
effects of dehydration on serum creatinine and blood urea nitrogen levels (pre-renal azotemia)

Fluid & Electrolyte Mini Cases
Given a case of a patient who has a disruption of fluid and electrolyte balance (from the list of possibilities below), 1) present a synopsis of the case, 2) interpret the physical and laboratory findings, 3) analyze the diagnostic possibilities, 4) choose a diagnosis explaining your reasoning, and 5) suggest appropriate treatments.

<u>Possible diagnoses:</u>
Acute kidney injury (acute renal failure)
Addison disease (adrenocortical insufficiency)
Chronic salt loss (e.g., sweating with replacement of water but not salt)
Conn's syndrome (Primary hyperaldosteronism)
Cushing disease
Dehydration (sweating, vomiting, diarrhea, hemorrhage)
Diabetes insipidus (nephrogenic or neurogenic)
Essential hypertension
Excessive diuretic use
Pheochromocytoma
Renovascular hypertension (Secondary hyperaldosteronism)
Syndrome of inappropriate ADH secretion (SIADH)
Water intoxication (psychogenic polydipsia)

Acid Base Mini Cases
- Given the etiologies of respiratory acidosis, respiratory alkalosis, metabolic acidosis, & metabolic alkalosis, use the history, physical examination, and other clues in the laboratory data to suggest possible causes of the condition.
- Given a problem case of a patient with an abnormal set of serum chemistries and arterial blood gases, describe the condition in terms of simple or mixed, metabolic or respiratory, acidosis or alkalosis, and comment on the compensation and, where appropriate, on the anion gap and bicarbonate gap (or delta ratio, ΔR).
- The following is an incomplete list of the more important causes of acid-base disorders. Look at each cause and think about the possible mechanisms by which each could cause the listed acid base condition.

<u>Respiratory acidosis (respiratory failure):</u>

central nervous system depression – drug overdose (e.g., opiates), anesthesia

chest weakness or dysfunction – weakness of respiratory muscles (e.g., myasthenia gravis, polio, diaphragm paralysis), flail chest, paralyzing agents, extreme obesity

disease of lungs and/or upper airway – sleep apnea, administration of O_2 to a "blue bloater" type of COPD, severe pulmonary edema, severe asthma attack, severe pneumonia, pneumothorax, upper airway obstruction

Respiratory alkalosis:

acute pulmonary problem – pneumonia, pulmonary embolus, mild asthma attack, mild pulmonary edema, hypoxemia (e.g., high altitude)

interstitial lung disease – interstitial fibrosis, sarcoidosis,

hyperventilation – anxiety hyperventilation syndrome, mechanical ventilation, voluntary hyperventilation

other causes – liver failure, salicylate overdose, sepsis

Metabolic acidosis:

with reference range (normal) AG (hyperchloremic) – diarrhea, carbonic anhydrase inhibitors, aldosterone deficiency, types I & II renal tubular acidosis, Addison disease, interstitial nephritis, excess NH_4Cl administration, enterocutaneous fistula (e.g., pancreatic)

with increased AG (normochloremic) – diabetic ketoacidosis, lactic acidosis, chronic renal failure, poisoning and overdose (e.g., salicylate, methanol, ethylene glycol, formaldehyde, paraldehyde, phenformin/metformin), pyroglutamic acidemia, massive rhabdomyolysis

Metabolic alkalosis:

chloride-responsive – antacid ingestion, vomiting, nasogastric suction, discontinued use of loop or thiazide diuretics, contraction alkalosis, congenital chloridorrhea

chloride-resistant – with hypertension: any hyperaldosterone state (e.g., Cushing syndrome), current use of loop or thiazide diuretics in hypertension, congenital adrenal hyperplasia, Liddle syndrome, renovascular hypertension; without hypertension: severe potassium depletion, Bartter syndrome, Gitelman syndrome, current use of loop or thiazide diuretics

other causes – milk alkali syndrome, hypercalcemia, intravenous penicillin, massive blood transfusion

John Biggs

cardiac function curves; pressure volume curves; vascular function curves
pathogenesis of cardiomyopathy and congestive heart failure
pathogenesis and differential diagnosis of hyponatremia
pharmacology of thiazide loop (furosemide) and K^+ sparing (spironolactone) diuretics
pharmacokinetics (distribution of drugs into fluid compartments)
source, regulation of release, and actions of brain natriuretic peptide

Shock Mini Cases

Be able to define circulatory shock and apply this definition correctly in the context of clinical situations involving patients who are in circulatory shock.

When given a description of a patient in circulatory shock (i.e., cardiogenic, hemorrhagic or septic), be able to:

- Classify the type of shock condition that the patient exhibits and give a rationale for your answer.
- Outline the typical compensatory mechanisms, both immediate and long-term, that will assist in returning tissue blood flow and arterial blood pressure back to normal.

- Outline a logical regimen for treatment of the patient.

Population Science and Policy

Jamal Johnson
pathogenesis and natural history of sickle cell disease
incidence, prevalence and screening of sickle cell disease

Jonah Self
incidence and prevalence and prevention of atrial septal defect
chemistry panels (basic and comprehensive metabolic panels)

Louis Welker
incidence and prevalence and prevention of pulmonary embolism
weight management

Franco Dombkoski
incidence, prevalence and prevention of chronic obstructive pulmonary disease
pathogenesis of chronic obstructive pulmonary disease, emphysema, & chronic bronchitis: role of smoking; pathogenesis of obstruction in chronic obstructive pulmonary disease
smoking cessation

Janet Inman
incidence, prevalence and screening of mitral valve prolapse
smoking cessation

Ellen Cole
incidence, prevalence, screening and prevention of coronary artery disease

Toussaint Durand
strategies for primary, secondary, and tertiary prevention, incidence and prevalence of acute poststreptococcal glomerulonephritis

John Biggs
incidence, prevalence and prevention of alcoholic cardiomyopathy