Lesson plan with Deck 1 (Puffing and Pumping) of the WhatThePharma card game

Timing	Activity
0-5 minutes	Explain aim of the workshop is to teach students how to play the game
5-25 minutes	Explain each set below
25-45 minutes	Play the game (6 players on a table)
45-55 minutes	Collect feedback; adjust workshop for next time

adenosine + arrythmia + breaks re-entry circuit + avoid in asthma

In this example, **arrhythmia** refers to one of the four types of supraventricular tachycardia (SVT). **Adenosine** stimulates specific adenosine receptors, which **break the re-entry circuit** set up by new pacemaker regions in the atria or atrioventricular node (AVN) that disrupt the normal sinus rhythm of the heart. The SAN re-exerts control and sinus rhythm is restored. Adenosine receptors are also involved in the constriction of bronchial smooth muscles, reducing airway diameter; thus, adenosine should be **avoided in asthma**.

Tip: *Make an explanation that suits you at your level of understanding and test it out with your peers. They will surely correct you if needed!*

amiodarone + arrythmia + reduces ventricular rate + avoid in heart block

Amiodarone is used in **arrhythmia** to **reduce the ventricular rate** and improve heart rhythm**.** Amiodarone acts in this way by affecting several ionic channels and adrenoreceptors. Heart block is a slow or irregular heart rate because of a block in conduction pathways; thus, amiodarone should be **avoided in heart block**.

Tip: *Try the Solitaire version of the game to learn these sets. Remember that the sets given here are only examples of one set with each drug. There will be many more sets to discover with each drug during game play because players provide new clinical information in their explanations of sets.*

digoxin + atrial fibrillation + Na^+/K^+-ATPase inhibitor + therapeutic drug monitoring

Digoxin is a **Na^+/K^+-ATPase inhibitor**, leading to an increase in intracellular Na^+, the consequent reduction of Ca^{2+} efflux by the Na^+/Ca^{2+} exchanger, and an increase in intracellular Ca^{2+} concentration in cardiac myocytes. Consequently, contractility and stroke volume increases, with improved symptoms in **atrial fibrillation** and heart failure. Because of potential toxicity, **therapeutic drug monitoring** of serum digoxin levels is required.

Tip: *Always refer to the latest guidance about monitoring of drugs.*

atropine + bradycardia + muscarinic receptor antagonist + constipation

Atropine is a **muscarinic receptor antagonist** that blocks the stimulatory effects of acetylcholine in the parasympathetic nervous system. Whereas normal cholinergic stimulation reduces heart rate, constricts airway diameter, and increases secretion of saliva and intestinal fluid, blockade with atropine induces tachycardia (and is used to treat **bradycardia**), dilates airways (see the "-tropium" drugs for asthma/COPD), causes dry mouth, and **constipation** (as in this example).

Tip: *Check the BNF for common or very common (systemic) side effects of atropine. These are applicable to all antimuscarinics and follow from a block of parasympathetic responses.*

rivaroxaban + prevent / treat blood clots + direct factor Xa inhibitor + interaction with warfarin

Rivaroxaban is a **direct factor Xa inhibitor**, and a direct oral anticoagulant (DOAC) used to **prevent or treat blood clots.** In contrast, **warfarin** is a vitamin K antagonist, and indirect anticoagulant, because vitamin K is required to produce several clotting factors. Following the principle of not using two drugs that act on the same pathway, an **interaction with warfarin** should be avoided.

Tip: *Be aware of drug-drug interactions, where one drug interferes with another. Common types of interaction are 1) both drugs target the same mechanism of action, and 2) one drug increases or reduces the metabolism of the other drug. The problem of drug-drug interactions is a good reason for knowing something about the mechanism of action of drugs!*

warfarin + prevent / treat blood clots + vitamin K antagonist + take in the evening

Warfarin is an anticoagulant because of its action as a **vitamin K antagonist**, which prevents the production of several clotting factors, and thus is used to **prevent or treat blood clots**. The advice to **take in the evening** coordinates well with measurements of blood clotting time (International Normalised Ratio, INR) and any dose adjustments made during the day.

Tip: *Four wildcards (any drug, any indication, any mechanism of action, any side effect) are included in each deck of the WhatThePharma card game. The wildcards are used to maintain the speed of game play and ensure that everyone can take part on their turn. Nominate a meaning for the wildcard when you play it. For example, in this set, playing "Any side effect" could include a description of how women of child-bearing age should be warned of the danger of teratogenicity associated with the use of any vitamin K antagonist. The meaning of the wildcard lasts all game.*

enoxaparin + prophylaxis of VTE + low MW heparin + bleeding

Enoxaparin is a **low molecular weight heparin** (heparin is a large polysaccharide that can be divided into fractions of different molecular weights). Heparin is an anticoagulant and suitable for the **prophylaxis of VTE** (venous thromboembolism, blood clots in veins). Because heparin favours lysis of blood clots, too much enoxaparin or unusual sensitivity to it may lead to **bleeding**.

Tip: *Note that side effects may apply to more than one drug in the WhatThePharma game. This is to make game play as easy as possible and to promote players being able to play a card every go. Bleeding is a good example of a common side effect in this deck that can apply to rivaroxaban, warfarin, enoxaparin, aspirin, and clopidogrel.*

aspirin + prophylaxis of CVD + COX-1/2 inhibitor + gastrointestinal discomfort

Aspirin inhibits both forms of cyclooxygenase (**COX-1 and COX-2**). COX-1 is a housekeeping enzyme making eicosanoids (including prostaglandins, thromboxanes, and leukotrienes) for basic cellular and tissue functions, such as cell and tissue repair, blood vessel regulation, mucus production etc. COX-2 is induced during inflammation. Reduction in thromboxane A2 (platelet aggregator, vasoconstrictor) is the main mechanism behind aspirin being used for **prophylaxis of CVD** (cardiovascular disease). Some people are sensitive to aspirin, and symptoms vary from **gastrointestinal discomfort** (e.g. dyspepsia) to bleeding (haemorrhage), intestinal ulcers, and serious breathing or skin problems.

Tip: *The BNF lists side effects as common, uncommon, rare, or very rare. The WhatThePharma card game uses common side effects.*

clopidogrel + prevent blood clots + P2Y12 receptor antagonist + check pharmacogenetics

Clopidogrel is a **P2Y12 receptor antagonist**. Activation of the P2Y12 receptor on platelets leads to platelet aggregation as part of blood clotting. Clopidogrel is therefore an anticoagulant used to **prevent blood clots**. However, clopidogrel is a pro-drug and is converted to its active form in the liver by the CYP2C19 enzyme. Some people express CYP2C19 enzyme variants with insufficient activity to produce "active clopidogrel". Hence, the note to **check the pharmacogenetics** of patients for their CYP2C19 status.

Tip: *The use of pharmacogenomic data in prescribing is not commonplace in the UK but it holds great potential for the future.* [*Personalised-prescribing-full-report.pdf.aspx (bps.ac.uk)*]

bisoprolol + heart failure + β1-adrenoceptor antagonist + avoid in asthma

Bisoprolol is a **β1-adrenoceptor antagonist** (beta-blocker). Bisoprolol is used in **heart failure** to protect the heart from the upregulated activity of the sympathetic nervous system. Because beta-blockers may affect β2-receptors in bronchial smooth muscle (and constrict airways), the advice is to **avoid in asthma**.

Tip: *Sympathetic – noradrenaline – alpha and beta adrenoceptors – alpha or beta antagonists*

ipratropium + asthma/COPD + short-acting antimuscarinic + dry mouth

Ipratropium ("atrop" as in atropine) is a **short-acting antimuscarinic** (a muscarinic receptor antagonist). **Asthma/COPD** is the indication because of the need to block cholinergic-mediated bronchoconstriction. Side effects are like those of atropine and include **dry mouth**.

Tip: *Parasympathetic – acetylcholine – muscarinic – atropine-like drugs*

salbutamol + reversible airway disease + β2-adrenoceptor agonist + emergency medicine adult 5mg

Salbutamol is a **β2-adrenoceptor agonist**. Activation of β2 adrenoceptors relaxes bronchial smooth muscle and dilates the airways, relieving some of the symptoms of **reversible airway disease** (e.g. asthma, COPD). Salbutamol is an **emergency medicine (adult 5 mg)** at the time of writing (May 2014).

Tip: *Always refer to the latest guidance about emergency medicines.*