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overfishing or
involve human

Check answer

Design for learning

This webpage can also be viewed
on your mobile phone



Sample 1

Quantum Technologies for Decision Makers

- **eye-catching banners** provide for a futuristic feel through the capturing of the changes in colour of the soap bubble
- **a themed font** and elegant side lighting for the page banners and subhead banners elevate the mood for the learner when viewing the course materials.
- each module was designed to provide only **3 learning outcomes**: modelled on the phraseology of ‘Relate, Describe, and Explain’.

- **responsive design**
- **slick graphics implementation**
- **a comprehensive project featuring 13 contributors from industry around the world**

1. Quantum communications
Module 1 | Quantum beginnings

2. Quantum sensing
Module 2 | Beyond dualities

3. Quantum computation
Module 3 | Unlocking new capabilities

4. Quantum strategy
Module 4 | Navigating quantum innovation

Simulate weather on earth

By the end of this module, you will be able to:

- Relate the phenomena of wave-particle duality to the general enabling principle for an array of quantum technologies
- Describe how to craft a strategy kernel that identifies what you can adopt in your own organisation to harness quantum technologies
- Explain which product or service offerings in your organisation could re-invigorate and how quantum technologies could re-invigorate them

By the end of this module, you will be able to:

- Relate the phenomena of superposition to set of capabilities that enable a new class of products and services
- Describe the key attributes of an entrepreneurial culture to your own organisation to leverage strengths and opportunities
- Explain the guiding principles for your strategic development of your innovation portfolio for quantum technologies

By the end of this module, you will be able to:

- Relate the principle of entanglement to the unique capabilities of quantum computers to classical technologies to emerge
- Describe which integrated actions leverage digital technologies to generate new value networks with quantum technologies
- Explain when growth can be unlocked as quantum technologies mature across time horizons, positioning your own organisation for advantage

By the end of this module, you will be able to:

- Relate your crafted principles to a coherent set of actions as an innovation thesis that guides your development of novel quantum technologies
- Describe what success will look like in adopting these quantum technologies as innovation investments proceed
- Explain how to de-select those innovation projects that do not meet performance metrics and where released investments will be re-directed

- **responsive design** for optimum accessibility means that content is designed so that it adapts to different viewing formats.

- **informational support panels and formatting** enables similar or different learning content to be clustered or differentiated.

- a '**Learning Check**' area incorporates a multiple choice question that corresponds to the video content (*re: use of ai*). This enables lower-level learners to review and re-establish the key learnings, while higher-level learners have an opportunity to 'test' their knowledge expertise.

National frameworks for quantum technologies

Peter made reference to a number of [national frameworks for quantum technologies](#), not only for the UK where he has most actively worked. [Linked below](#) are some national quantum strategy papers that show an array of approaches and emphases for particular capabilities.

From the list of links below:

- Identify the national strategy that applies for your primary location. If your location is not covered by one of these papers, select a strategy paper that most closely aligns with your own national setting.
- Peruse the document and **select three (3) items** articulated in the strategy document that may unlock new strategic opportunities for your own organisation.
- Craft 2-3 bullet points for each of these items to indicate how you could leverage value from that strategic option.

This list of quantum policy documents will be updated as new strategic plans become available.

- Australia <https://www.industry.gov.au/publications/national-quantum-strategy>
- Canada <https://isid-isde.canada.ca/site/national-quantum-strategy/en/canadas-national-quantum-strategy> and <https://isid-isde.canada.ca/site/national-quantum-strategy/en/canadas-national-quantum-strategy>
- China 5 year plan: [Stanford translation including quantum](https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informationization-dec-2021/), <https://digichina.stanford.edu/work/translation-14th-five-year-plan-for-national-informationization-dec-2021/> and [Asian Development Bank policy note](https://www.adb.org/publications/14th-five-year-plan-high-quality-development-prc-note), <https://www.adb.org/publications/14th-five-year-plan-high-quality-development-prc-note>
- Europe <https://digital-strategy.ec.europa.eu/en/policies/quantum>
- France <https://www.cnrs.fr/en/cnrsinfo/french-quantum-national-rd-strategy-just-started>
- Germany <https://qbn.world/wp-content/uploads/2023/04/Action-Plan-Quantum-Technologies-by-German-Government-2023-2026.pdf>
- India <https://www.psa.gov.in/technology-frontiers/quantum-technologies/346>
- Netherlands <https://quantumdelta.nl/>
- Switzerland <https://quantum.snat.ch/>
- UK <https://www.gov.uk/government/publications/national-quantum-strategy> and <https://www.gov.uk/government/publications/national-quantum-strategy/national-quantum-strategy-accessible-webpage>
- USA <https://www.quantum.gov/strategy>

We do not present this list above as an exhaustive compilation of national quantum strategy policies. If you know of or have access to a published policy document that is cleared for public exchange, please send us a link and we'll consider it for addition to this list.

Email us at uqx@unq.edu.au with "Quantum Strategy Policy" in the subject line

Course Overview: Quantum Technologies For Decision Makers

Who should take this course?

Bookmark this page

Course Overview: Quantum Technologies For Decision Makers

Quantum precision

Recall in the opening part of this module, **Dr Glen Harris** introduced precision as a core feature of quantum measurement. Below, he expands on that reasoning to also consider bandwidth.

(video)

What can these quantum sensors achieve that we can't already do? You said "about precision", is that it? Because more precise? Or there's some other... because quantum computing gives us the feeling of speed. Mm hmm. Yeah. Beyond exponential. Like complete game-changing capability. My sense with ... my view with sensors is that maybe that's not quite true. Yeah. They're more precise. Is there some other quality that quantum sensors have? So in any sensing platform, there's two primary figures of merit.

As you digest and reflect on Glen's outline of the performance advantages of quantum sensing, deepen your grasp with the next reading from one of our contributors, [linked in the next unit](#).

Learning check

Question 2.3

0.0/1.0 point (ungraded)

What are the two primary figures of merit in any sensing platform?

Precision and speed

Precision and bandwidth

Bandwidth and accuracy

Accuracy and speed

Submit

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Accuracy and speed

Submit



Portfolio

Sample 2

- responsive design
- slick graphics implementation
- a comprehensive 4-course project
- interactive H5Ps (*over the next pages*)

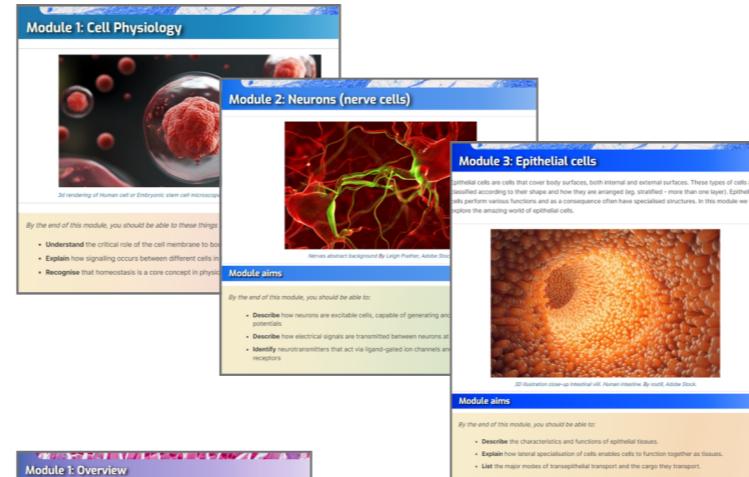
1. Specialised Cells (CELLS I)

2. Tissue Biology (CELLS II)

1. Cardiovascular and Respiratory Systems (SYSTEMS II)

2. Endocrine, Renal and Gastrointestinal Systems (SYSTEMS II)

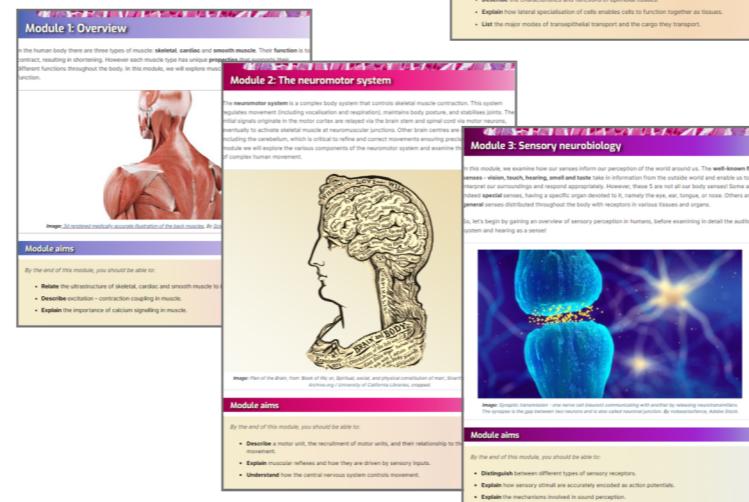
Comprises two Professional Certificate Courses (Cell Physiology and Systems Physiology): Courses are Cells I & Cells II, and Systems I & Systems II respectively. 12 Modules in total.



Module 1: Cell Physiology

Module 2: Neurons (nerve cells)

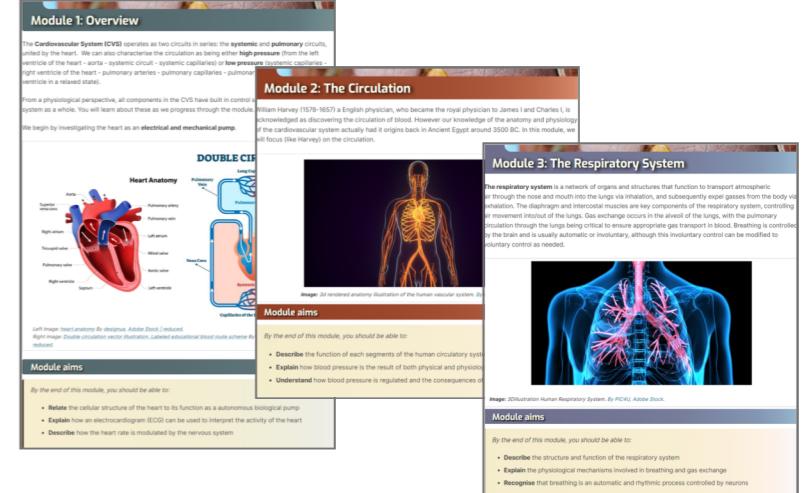
Module 3: Epithelial cells



Module 1: Overview

Module 2: The neuromotor system

Module 3: Sensory neurobiology



Module 1: Overview

Module 2: The Circulation

Module 3: The Respiratory System

Module 4: The Endocrine System



Module 1: The endocrine system

Module 2: The Renal System

Module 3: The gastrointestinal system

Module 4: The stomach

- **responsive design** for optimum accessibility means that content is designed so that it adapts to different viewing formats.

- **learning objectives** on each page

- **informational support panels and formatting** enables similar or different learning content to be clustered or differentiated.

- **a number of pedagogical strategies** were implemented to improve cognition over text-heavy areas of content, and to overcome barriers relating to the existing content difficulty (re: use of ai).

- an **ungraded practice quiz section** is included before each graded quiz section

ETIQUETTE

Please be aware and respect **net etiquette**: we hope all communication on this forum will remain courteous and respectful. We will remove all offensive posts. Keep your posts on-topic and constructive, and respect others and their opinions.



MODERATORS

We will regularly be looking at the discussion forums and adding our voice to the crowd. If we see particular themes emerging that warrant clarification or commenting on, then we will contribute to the discussion as a moderator and pin the post, or perhaps place an announcement on the [Update](#) page.

Discussion forums are a great way to help you to be able to develop your thoughts based on **both** opinion and factual evidence, *and* to communicate it succinctly. We also encourage you to browse through the discussions to read other people's comments . This will further develop your understandings about how other people interact with the content from different perspectives.

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Module 2: The circulation

The systemic circulation starts with the left ventricle of the heart. During systole, blood is ejected from the ventricle into the aorta, then on to the large arteries, before being ever increasingly subdivided into medium and small arteries, followed by the arterioles. Altogether this part of the circulatory system (aorta - arterioles) transmits blood quickly away from the heart to the tissues and organs. The **large arteries** maintain blood pressure to drive blood flow, whilst the **smaller arteries and arterioles** are responsible for appropriately distributing blood to meet the requirements of cells-tissues-organs.

Learning objectives

By the end of this unit, you should be able to:

- Relate the structure of arteries to their function.
- Describe why arterioles are resistance vessels.
- Describe the important extrinsic and intrinsic factors that control vascular tone of arterioles and therefore control of blood flow to tissues.

Arteries and arterioles

Watch the following video to learn about arteries and arterioles in the systemic circulation.



(Caption will be displayed when you start playing the video.)

Module 1: Muscle cells

Module 1 practice quiz (ungraded)

Instructions

- Answer each of the questions below after completing all of the content in the module.
- Questions on this page are ungraded, but are to be used as an example of the Graded Quiz. This page does NOT contribute to the calculation of your overall mark for the course.
- Click or tap **Submit** after answering each question. Responses are marked automatically.
- If you answer a question incorrectly, you can see what the correct answer was by clicking or tapping **Show answer** at the bottom-right of the question box. This link will only appear once you have attempted a question.

Note: The Graded Quiz is on the next page.

Question 1

0 points possible (ungraded)

Which of the following is characteristic of skeletal muscle?

Involuntary muscular response.

Found in the walls of the bladder.

Controlled by the somatic nervous system.

Contains single nucleated cells.

Has intercalated discs, with gap junctions.

Submit

Metabolic muscle fatigue

Discovery > Causes of Muscle fatigue

What about lactic acid as the cause of metabolic fatigue?

Lactic acid build-up in muscle was identified in 1929 during a fatiguing stimulation by A.V. Hill. As a result, lactic acid build-up was therefore assumed to be the causative factor of muscle fatigue. However, the presence of lactate has more recently been shown not to affect the normal process of excitation contraction coupling (ECC) in muscle.

It is now thought that the main factor in metabolic fatigue appears to be inorganic phosphate (Pi), causing calcium precipitation in the sarcoplasmic reticulum (SR). The molecular structure of the **phosphate ion** (Pi) is shown here.

Image: Structure of the phosphate ion by Neurotiker, Public Domain, via Wikimedia Commons.

Metabolic muscle fatigue

The energy source for muscles is **Adenosine triphosphate (ATP)**. Hence, when a muscle is vigorously stimulated for a sufficient period of time, metabolic changes can occur within the muscle. To comprehend metabolic muscle fatigue, let's first run through the ATP utilisation in the muscle.

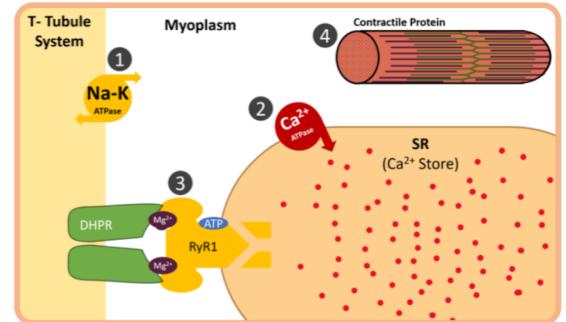
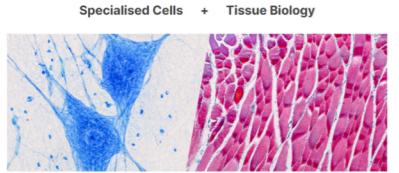


Image: School of Biomedical Sciences, UQ.

Recall the sites of the muscle that utilise ATP:

1. **T-tubules** - ATP is utilised by Na^+K^+ ATPase to re-establish resting membrane potential for action potential propagation.
2. **Ca^{2+} Pump** - Powered by ATP, it pumps Ca^{2+} ions back into the SR; reducing $[\text{Ca}^{2+}]$ around the myosin and actin filaments.
3. **RyR1 Ca^{2+} Release Channels** - ATP is required for RyR1 channels activation for Ca^{2+} release from SR stores.
4. **Contractile Proteins** - ATP binds to the myosin and is hydrolysed during the power stroke of the muscle contraction cycle.

- a range **colour themes** in topic banners (based on the visceral colours of body parts from the main course image) provide a thematic connection.



Course overview: Endocrine, Renal and Gastrointestinal Systems

The human body is an amalgamation of specialised and complex systems. Normal, healthy body functions rely on a symphony of these systems, dynamically working in concert to keep us in a stable homeostatic state.



SYSTEMS2x begins by examining the **endocrine system** which produces signalling molecules called **hormones**. In this module, the hypothalamus and the pituitary gland are investigated as key endocrine glands that regulate a variety of body processes.

The course then explores the **renal and gastrointestinal systems** in depth, providing an integrative perspective. We investigate the key roles of the kidneys in filtering blood, and maintaining solute and fluid

Module 1: Cell physiology

Water makes up most of the body's volume. Typically, infants are about 70% water, whilst adults are about 55-60% water, with the amount of water progressively declining with age mainly due to an increase in body fat. More importantly, the water in the body is subdivided between **different physiological fluid compartments**, each having a distinct composition of solutes.

Learning objectives

By the end of this unit, you should be able to:

- List the body fluid compartments
- Compare and contrast solute composition between body fluid compartments
- Explain the physiological basis of volume and composition characteristics

Body fluid compartments

Most (two thirds) of total body water is located within cells, **intracellular fluid (ICF)**, whilst the remainder (one third) is located outside of cells, **extracellular fluid (ECF)**.

Within ECF we further distinguish between the fluid surrounding or bathing cells called **interstitial fluid**, from the fluid found in circulating blood called **plasma**. Most (80%) of ECF volume is interstitial fluid.

In the figure below, note the fluid compartments and the barriers between the compartments.

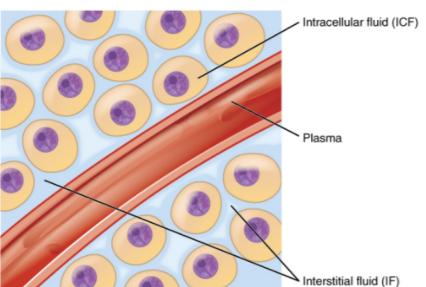


Image source: Body Fluid Compartments. Access for free at <https://openstax.org/books/anatomy-and-physiology>

The separate body fluid compartments are a direct result of barriers; the cell membrane (separating ICF and interstitial fluid), and the endothelial cells that form the blood vessel wall (separating interstitial fluid and plasma). However, it should be noted that water can move between the compartments via osmosis. Indeed, such fluid shift between compartments is necessary for normal body function.

Module 1: Muscle tissue

There are about 320 different skeletal muscles in humans, on each side of the body. The main function of skeletal muscle is to enable the body to interact with our environment through the production of movement. Skeletal muscle exhibits properties of excitability, contractility, extensibility and elasticity. Here we explore the complex microstructure of skeletal muscle that supports its functionality.

Learning objectives

By the end of this unit, you should be able to:

- Describe the main attributes of skeletal muscle.
- Explain how the connective tissue arrangement in skeletal muscle supports contractility.
- Describe the ultrastructure of the sarcomere.

Skeletal muscle characteristics

There are about 320 different skeletal muscles in humans, on each side of the body. These muscles can be broadly characterised into muscles used for postural, fine motor, and gross motor control, although many muscles have multiple roles.



Image source: Anatomical Overlays - right arm - 3D render. By AllenCat, Adobe Stock.

All skeletal muscles have the following attributes:

- **Contractility:** the ability to shorten, thicken, and develop tension.
- **Excitability:** the ability to respond to stimuli through generation of action potentials.
- **Extensibility:** the ability to be stretched without damage.
- **Elasticity:** the ability to store some energy, and recoil to resting length.

To examine these further, we need to examine the structures of skeletal muscle that support these functionalities.

Image source: anatomical overlays 2. By AllenCat, Adobe Stock, cropped.



Refresher ➤ Binding and release of oxygen to Hb

Hb in erythrocytes carries most of the oxygen in the bloodstream, circulating and releasing it according to the partial pressure of oxygen in interstitial fluid surrounding the cells. If PO_2 decreases at the tissue level, Hb releases oxygen more readily. For example, doing a few bicep curls on the right arm would decrease the partial pressure of oxygen (is utilised in cells) in the right arm compared to the left. The Hb in erythrocytes flowing through the right arm will release more oxygen compared to erythrocytes in capillaries in the left arm.

The oxygen-haemoglobin dissociation curve (or oxygen-haemoglobin saturation curve) describes the relationship between haemoglobin saturation and the partial pressure of oxygen under normal conditions.

Watch the following video below to remember about the curve and the factors that influence $\text{O}_2\text{-Hb}$ dissociation.

[Click here](#)

Haemoglobin binding to other gases

Nitric Oxide (NO) not nitrous oxide N_2O or laughing gas!



Is a vasodilator that plays a role in blood pressure regulation. Hb is a nitric oxide scavenger (haeme destroys NO) and therefore cell-free Hb is a vasoconstrictor.

"In 2004, trauma due to automobile accidents claimed more than 43,000 lives in the US, and many of these individuals had hemorrhagic shock when they arrived at the hospital. Although clear fluids can be used for resuscitation for brief periods, the availability of a safe and effective oxygen-carrying fluid, like a hemoglobin (Hb)-based oxygen carrier (HBOC), could provide far more effective metabolic support for the organs of the injured body during transport to a facility where type-matched blood would be available for transfusion.

It has been known for 30 years (Savitsky et al. 1978) that infusions of tetrameric Hb produce severe vasoconstriction and hypertension in patients. Vasoconstriction appears to result from scavenging of NO by plasma ferrous (Fe^{2+}) heme, thereby lowering the concentration of NO available to smooth muscle cells in the vascular wall. When the intracellular NO concentration falls, the activity of the NO receptor, soluble guanylate cyclase decreases; levels of its product, the intracellular second messenger cGMP, decline; and vascular smooth muscle cells contract. In the course of designing HBOCs, several strategies have been explored to reduce NO scavenging by extracellular ferrous Hb...."

B. Yu et al. (2009) Hemoglobin Based Red Blood Cell Substitutes and Nitric Oxide. *Trends in Cardiovascular Med.* 19(3): 103-107.

Carbon monoxide (CO)

CO has 210 times greater affinity for Hb than does O_2 . It reduces O_2 carrying capacity and the ability of Hb to unload O_2 to tissues. Carbon monoxide at small environmental concentrations will cause toxic levels of carboxyhaemoglobin. The carbon monoxide binds to haemoglobin and shifts the oxygen-haemoglobin dissociation curve of the remaining oxyhaemoglobin to the left, reducing oxygen release (see video above). Also the affinity of CO for myoglobin is even greater than for haemoglobin. CO binding to cardiac myoglobin causes myocardial depression, hypotension and arrhythmias and immediate death due to poisoning is most likely cardiac in origin.

Carbon monoxide poisoning is a serious public health issue.

"CO poisoning occurs frequently; has severe consequences, including immediate death; involves complications and late sequelae; and often is overlooked. Efforts in prevention and in public and medical education should be encouraged."

JA Raub et al. (2000) Carbon monoxide poisoning—a public health perspective. *Toxicology* 145(1):1-14.

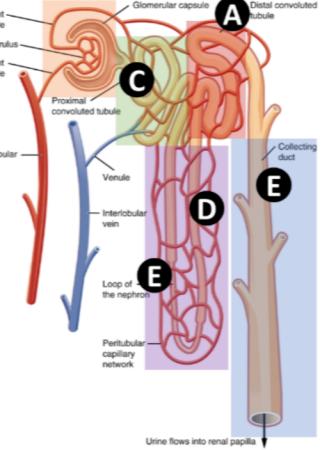
"The deadly effect of carbon monoxide was known as long ago as Greek and Roman times, when the gas was used for executions. In 1857 Claude Bernard postulated that its noxious effect was caused by reversible displacement of oxygen from haemoglobin to form carboxyhaemoglobin.....

Carbon monoxide is known as the silent killer since it has no colour or smell. Each year in Britain about 50 people die and 200 are severely injured by carbon monoxide poisoning. Some poisonings are caused by self-harm but most are accidental. It is the commonest cause of accidental poisoning and, according to one estimate, as many as 25000 people in the UK have symptoms due to faulty gas appliances. In the 1960s and 1970s the conversion from coal gas to carbon-monoxide-free natural gas caused a dramatic reduction in poisoning....."

I Blumenthal (2001) Carbon monoxide poisoning. *J R Soc Med* 94(6): 270-272.

Activity

Refer to the image (below) of the nephron structure and function to answer the following two questions (below the image).



Question

Text Input

1 point possible (ungraded)

In the above image, which letter shows where water is NOT reabsorbed in the nephron?

Submit

Multiple Choice

1 point possible (ungraded)

In the image above, which part of the nephron would most glucose be reabsorbed from?

- A.
- B.
- C.
- D.
- E.

Submit



overfishing or
involve human

Check answer

Design for learning

gavink7@gmail.com

