



# Learning outcomes and knowledge levels in anatomy

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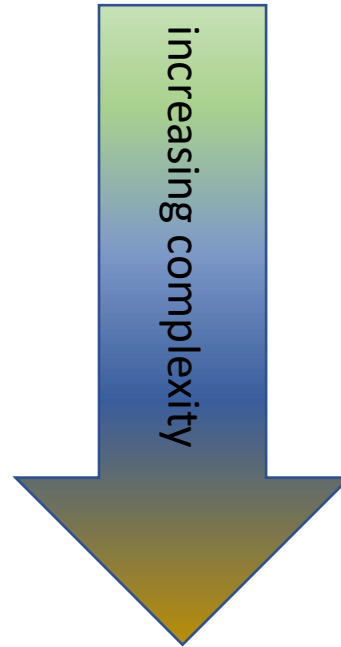


# Bloom's taxonomy

- cognitive domain – “knowledge”, cognition
- affective domain – attitudes, interests, motivation
- psycho-motor domain – skills

# Cognitive domain

1. Remembering/recalling
2. Understanding
3. Application
4. Analysis
5. Evaluation
6. Creation/Synthesis



# Remembering/recalling

The answer to the question can be found in the teaching materials.

## Learning outcomes:

- define
- list
- name
- show

## Example questions:

1. Define the organization of the skeleton of the upper extremity.
2. List the bones of the carpus.
3. Name the anatomical structures of the distal humerus.
4. Show anatomical structures on the human body and on anatomical preparations.

How we **reach**: repetitoria, practicals, demonstration practicals

How we **test**: practical thematic colloquium, repetitoria, practice colloquia in the A1 block, practical part of the final exam, written exam (the simplest questions)

# Understanding

The answer to the question can be found in the teaching materials.

1. translation – student expresses acquired knowledge in *own words*
  - Learning outcome: describe

Outcome: Describe the structure, vascularization, lymphatic drainage, and innervation of anatomical structures in the human body

Example question: Describe the structure, vascularization and innervation of the skin

How **we achieve**: in lectures, seminars and practicals, using teaching materials and activities

How **we test**: written exam, oral exam and open-ended questions (written and oral) in practice colloquium

# Understanding

To answer the question, student must interpret the teaching materials and activities; i.e. must be able to explain the concept, but does not have to apply it on complex examples (only on typical ones).

## 2. interpretation – interpretation and clarification of a concept

- Learning outcome: explain

Outcome: Explain the topographical relationships between anatomical structures in the human body

Example question: Explain the layering of the structure of the chest wall.

How **we achieve**: in lectures, seminars and practicals, using teaching materials and activities

How **we test**: written exam, oral exam and open-ended questions (written and oral) in practice colloquium

# Understanding

To answer the question, student must extrapolate what is described in the teaching materials and covered in teaching activities; i.e. student must explain a concept using a complex example.

## 3. extrapolation – assessment of importance/significance

- **Learning outcome:** explain the significance/importance/particularity/reason

Outcome: Explain the significance of transferred pain.

Example question: Explain the significance of referred pain in the external ear.

Explain the particularity of proprioceptive innervation of the head.

How **we achieve:** in lectures, seminars and practicals, using teaching materials and activities

How **we test:** written exam, oral exam and open-ended questions (written and oral) in practice colloquium

# Application

In order to answer the question student must understand the concept well and then apply it to concrete examples (not only learned examples – necessary to be able to generalize and then apply to any example).

The concept is described in the teaching materials and covered during classes, and the examples (usually complex, atypical) test if student is able to apply the concept in special anatomy.

- Learning outcomes:

1. Use relevant sources of data on the structure of the human body
2. Apply official anatomical terminology in the classification and descriptions of anatomical structures
3. Apply the concepts of general anatomy in special anatomy

Example question: Explain the types of muscle insufficiency with examples.

- How **we achieve**: in seminars and practicals, using teaching materials and activities
- How **we test**:
  - written exam (test)
  - practical colloquium (application of knowledge of topography in the section)
  - oral exam



# Analysis

In order to answer the question, student must analyze the material and draw correct conclusions based on that analysis. The background needed to answer the question is found in teaching materials or is covered during teaching activities, there is **NO** sentence in the textbook that gives the "correct answer".

- Learning outcomes:

1. Classify anatomical structures according to common morphological and functional features  
Example question: **Classify** continuous junctions according to tissue type between joint bodies

Classify: we don't expect the student to just list the continuous connections in a particular classification category, but to analyze the basis of the classification (eg. why are the interosseous membrane and syndesmosis different classification categories)?

How **we achieve**: in lectures and seminars, using teaching materials and activities

How **we test**: written exam, oral exam and open-ended questions (written and oral) in practice colloquium

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- Learning outcomes:

2. Differentiate between the structure and function of organs and organ systems in the human body.

Example question: **Explain the difference** between the role of the lymphatic system in immunity and its role in draining tissue fluid.

Distinguish: the student is not expected to list characteristics of one role and then list characteristics of another role, but to **explain key differences** and the **importance** of individual roles

How **we achieve**: in lectures and seminars, using teaching materials and activities

How **we test**: written exam, oral exam and open-ended questions (written and oral) in practice colloquium

# Analysis

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- Learning outcomes:

3. Compare the principles of anatomical organization in different parts of the human body.  
Example question: **Compare (explain similarities and differences)** the principles of venous drainage of the head and neck with the principles of venous drainage in other parts of the body.

Compare: the most complex outcome in the analysis because it requires the student to notice similarities and not only differences; again, the point is not to list characteristics, but to **compare** key similarities and differences

How **we achieve**: in lectures and seminars, using teaching materials and activities

How **we test**: written exam, oral exam and open-ended questions (written and oral) in practice colloquium

# Evaluation/evaluation

In order to answer the question, student must independently investigate the problem, critically appraise it and come to a conclusion/opinion/solution. The answers to the questions are not necessarily unequivocal, often there is no single correct answer.

- Verbs: evaluate, judge, assess, rank (by priority), investigate
- Learning outcomes:
  1. Critically assess the accuracy and relevance of data on the structure, organization and function of anatomical structures in the human body
  2. To investigate the anatomical basis of selected clinical entities
- How **we reach**: most often in seminars
- How **we test**: usually in combination with other results on the written and oral exams

# Creation/Synthesis

To answer the question, student must create new knowledge from existing information. A student who has learned the branching, areas of innervation, and topography of a nerve has the prerequisites to answer the question with the nerve injury scenario, but in order to do so, must create new knowledge – must predict the consequences of the injury, analyze what is required in the selected scenario, evaluate sensory and motor effects of the injury and create a "clinical picture" from it and explain how to test it on the patient.  
This level of knowledge is closest to real life.

- Learning outcomes:

1. Connect the morphological organization with the functional anatomy of the human body
2. Predict the consequences of loss of function of individual anatomical structures

- How **we achieve:** in seminars and clinical cases

- How **we test:**

- practice colloquium – open-ended questions with unannounced scenarios
- written exam – questions with scenarios
- oral exam – questions with scenarios

# Affective domain

## *Values*

1. Recognize the importance of appropriate academic behavior within basic medical sciences and recognize specific requirements within Anatomy

## *Motivation*

1. Align student expectations about the scope, level, goal, and purpose of the anatomy course with the requirements of the curriculum

## *Opinions*

1. To evaluate the role of the human body in the process of learning anatomy
2. To determine the importance of the body donation program and sending off the body
3. Develop an ethical attitude towards donated bodies and anatomical dissection

How **we achieve**: in lectures, seminars and practicals – interaction and the hidden curriculum are key

How **we test**: OSPI (behavior), student evaluation of teaching (attitudes), body donor send-off ceremony

# Psycho-motor domain

1. Apply skills of anatomical dissection in the presentation and study of anatomical structures in the human body
2. To sketch the principles of the organization of anatomical structures and the three-dimensionality of topographical relationships in the human body
  - in sketches we recognize several levels of knowledge:
    - a. sketching branches, sketching projection lines, sketching organ projections – lowest level
    - b. sketching of selected topographical regions – intermediate level
    - c. sketching three-dimensionally complex areas in certain sections – highest level

How **we achieve it:** by sectioning during practicals, sketching in class, using worksheets

How **we test:** practice colloquium, practical and oral part of the final exam

# A few final notes

- Learning outcomes always contain an active verb that clearly describes what the student should be able to do in order to demonstrate a certain level of knowledge (NEVER use verbs like "know" and "understand" in the outcomes – these verbs don't tell the student how to reach a certain level knowledge).
- Learning outcomes should be achieved in the way they are stated (for example: outcomes related to sketching should be achieved by sketching).
- Learning outcomes should be examined in the way they were achieved (sketching should be examined by sketching, section skills by OSPI, synthesis by integrative questions, etc.).



# A few final messages

- Questions that examine learning outcomes in the cognitive domain should also contain appropriate verbs (eg. "innervation of the upper limb" is a topic, NOT a question).
- When reaching higher levels of knowledge, it is not possible to "skip" reaching lower levels of knowledge (eg. a nerve injury scenario cannot be adequately resolved without knowing the "factography").