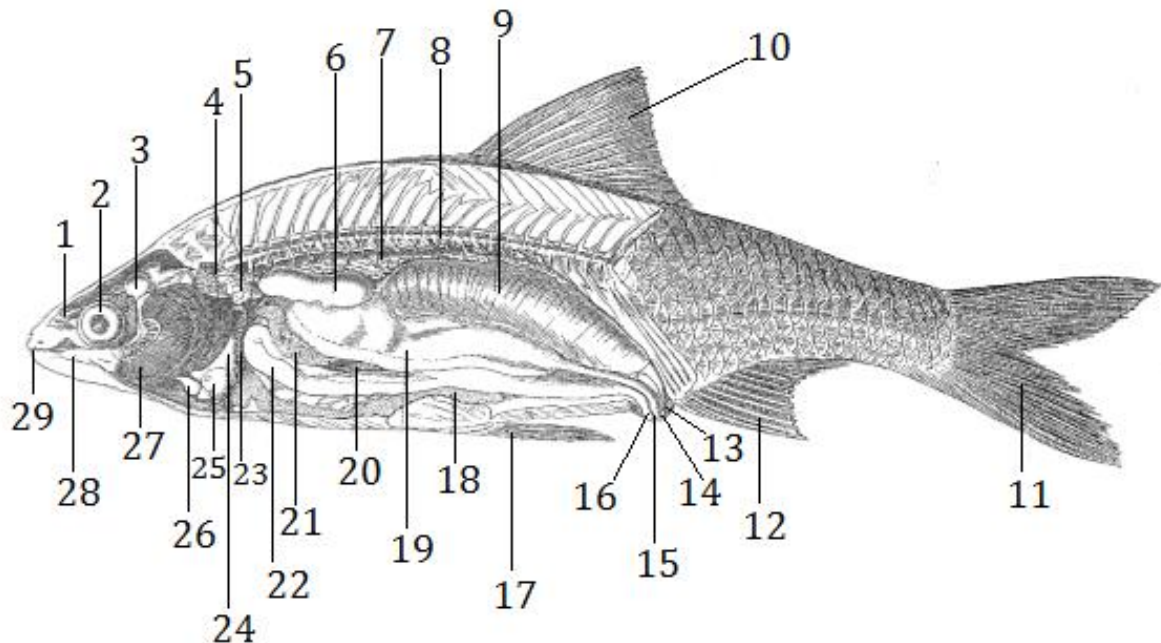


# Fish anatomy/histology

## Anatomy



### 1) Lobus olfactorius:

- Also known as olfactory brain
- Processes odours

### 2) Eye:

- Serves the perception of visual stimuli

### 3) Brain:

- Central organ of the nervous system
- Processes sensory perceptions
- Coordinates behaviour

### 4) Pharynx:

- Makes the connection between the oral cavity and the oesophagus
- Makes the connection between the nasal cavity and the larynx

### 5) Pronephros:

- Also known as head kidney
- No longer present in all fish species
- May be involved in blood formation

### 6) Swim bladder:

- Helps fish to stay at their current water depth
- Helps fish to save energy while swimming

**7) Kidney:**

- Most fish species have several kidneys
- Excretes waste products from the body
- Produces urine

**8) Ribs:**

- Part of the skeleton of bony fish

**9) Swim bladder**

- See 6)

**10) Dorsal fin:**

- Stabilization against rolling and assistance in sudden turns

**11) Caudal fin:**

- Also known as tail fin
- Serves the propulsion

**12) Cloacal fin:**

- Also known as anal fin
- Stabilises the fish while swimming

**13) Bladder:**

- Temporary storage of urine

**14) Ureteral opening:**

- Serves the excretion of urine

**15) Genital Opening:**

- Used for reproduction (female)

**16) Anus:**

- Outlet of the intestinal canal
- Used for defecation

**17) Ventral fin:**

- Also known as pelvic fin
- Assistance in going up or down through the water, turning sharply, and stopping quickly

**18) Liver:**

- Production of biochemicals necessary for digestion and growth
- Detoxification of various metabolites
- Protein synthesis

**19) Testicle:**

- Used for reproduction (male)

**20) Liver:**

- See 18)

**21) Liver:**

- See 18)

**22) Intestines:**

- Absorption of nutrients and water

- Production of faeces
- 23) Peritoneum:**
  - Serous membrane
- 24) Atrium:**
  - Part of the heart
  - Chamber through which blood enters the ventricles of the heart
- 25) Ventricles:**
  - Part of the heart
  - Pumps blood to the rest of the body
- 26) Aorta:**
  - Transports oxygenated blood to the body periphery
- 27) Gills:**
  - Serves for breathing under water
  - Supplies oxygen to the blood
- 28) Tongue:**
  - Used in the act of swallowing
  - Manipulates food for mastication
- 29) Mouth opening:**
  - Used for food intake

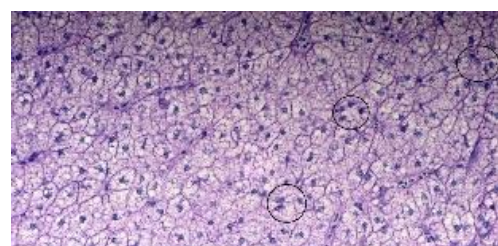
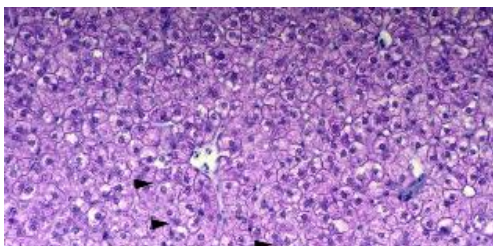
## **Pollution of waters due to psychoactive substances**

Water pollution is becoming a growing environmental problem, which can cause damage on aquatic organisms. Traces of psychopharmaceuticals and illegal drugs have been reported in effluents, influents and surface waters. These psychoactive substances cause damages, which can be detected in the tissue of the organs. These substances got filtered by the liver. Psychoactive substances are released by humans into wastewater. However, they cannot be completely filtered from water by sewage treatment plants, which leads to a residual content of psychoactive substances in water. Manly the following substances are found in the wastewater:

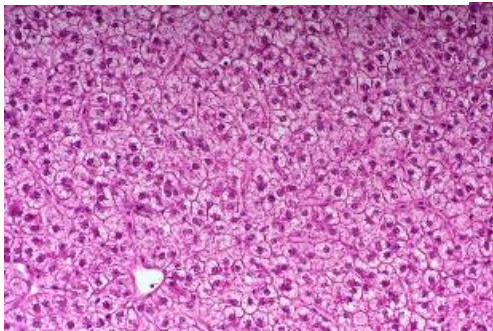
- Citalopram
- Sertraline
- Oxazepam
- Tramadol
- Venlafaxine
- Methamphetamine



## Liver tissue

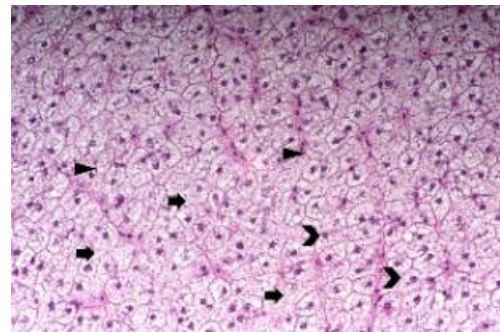


Healthy liver - PAS stain



Healthy liver – Haematoxylin & Eosin stain

Damaged liver - PAS stain

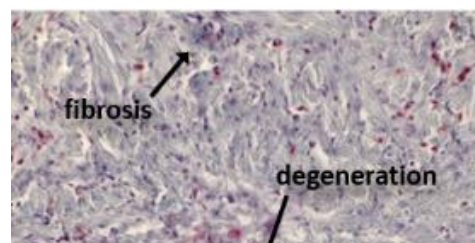
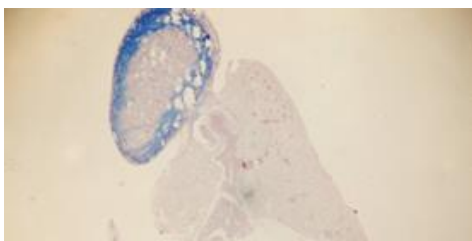


Damaged liver – Haematoxylin & Eosin stain

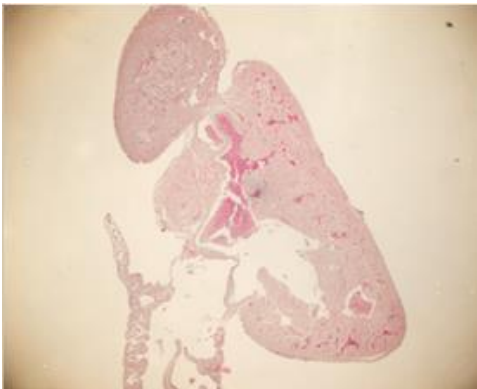
The pictures of the healthy liver show structures of healthy cells. The nucleus is located in the middle of the cell and is surrounded by glycogen. In order to be able to detect the glycogen more precisely, the additional stain Alcian blue and PAS (upper picture) is applied. This stain colours the glycogen reddish.

On the right a damaged liver is shown. In the figure below, which is stained with Hematoxylin and eosin, changes are clearly visible. The open arrow heads mark vacuoles. Due to misinformation, which is caused by psychoactive substances in this case, increased accumulation of neutral fat produced by the liver arises. The pressure in the cell becomes stronger and the glycogen decreases (compared to the upper picture, no reddish coloration can be seen, which means there is no glycogen in the cell). This leads to a delocalization of the nucleus. If the fat concentration and thus the pressure increases, a rupture of the membrane may occur (marked by arrows). This can lead to macrovacuoles (closed arrow heads) where the nucleus exits through the ruptured membrane, this process is irreversible.

## Heart tissue

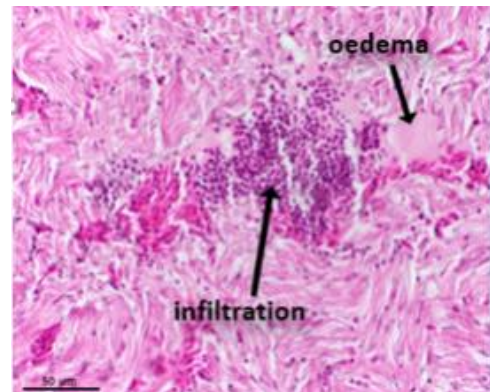


Healthy heart – Masson's stain



Healthy heart – Haematoxylin & Eosin stain

Damaged heart – Masson's stain



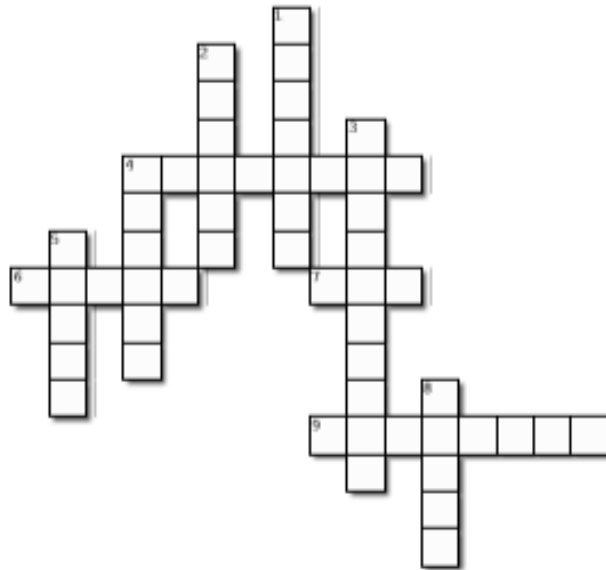
Damaged heart – Haematoxylin & Eosin stain

The heart was stained with two different staining methods. The upper bluish images show the Masson's trichrome stain, the lower images show the Hematoxylin and Eosin stain. The Masson's trichrome stain confirms that there is infiltration in the tissue. It also shows degeneration and fibrosis in the heart.

Fibrosis, degeneration, infiltration and oedema are damages often found in the tissue due to harmful impacts. Fibrosis leads to scars in the tissue, in an advanced stage it can lead to a restriction of the heart function. Degeneration refers to a regression of the tissue and thus also its function. Another damage that is clearly visible in the tissue of the sick fish is oedema. Oedema is an accumulation of fluid that leads to swelling of the tissue. Infiltration refers to the penetration of various substances, the so-called infiltrate, into the tissue.

These mentioned damages are fatal for humans, but a fish can regenerate its heart very quickly. For this regeneration it needs clean water.

Complete the crossword puzzle below



Created using the Crossword Maker on TheTeachersCorner.net

### **Horizontal**

4. Name a psychoactive substance starting with the letter O.
6. In the tissue of which organ do macrovacuoles arise when exposed to psychoactive substances?
7. What accumulates in a liver's cell leading to vacuolation?
9. What leads to scars in the heart's tissue?

### **Vertical**

1. What is located in the middle of a cell?
2. Who releases psychoactive substances into wastewater?
3. Which fin is also known as tail fin?
4. What fluid can be found in the heart's tissue after exposure to psychoactive substances?
5. What do fish use for breathing under water?
8. What is the central organ of the nervous system?

*Good luck!* 