Contraction of the smooth muscles in the small intestine

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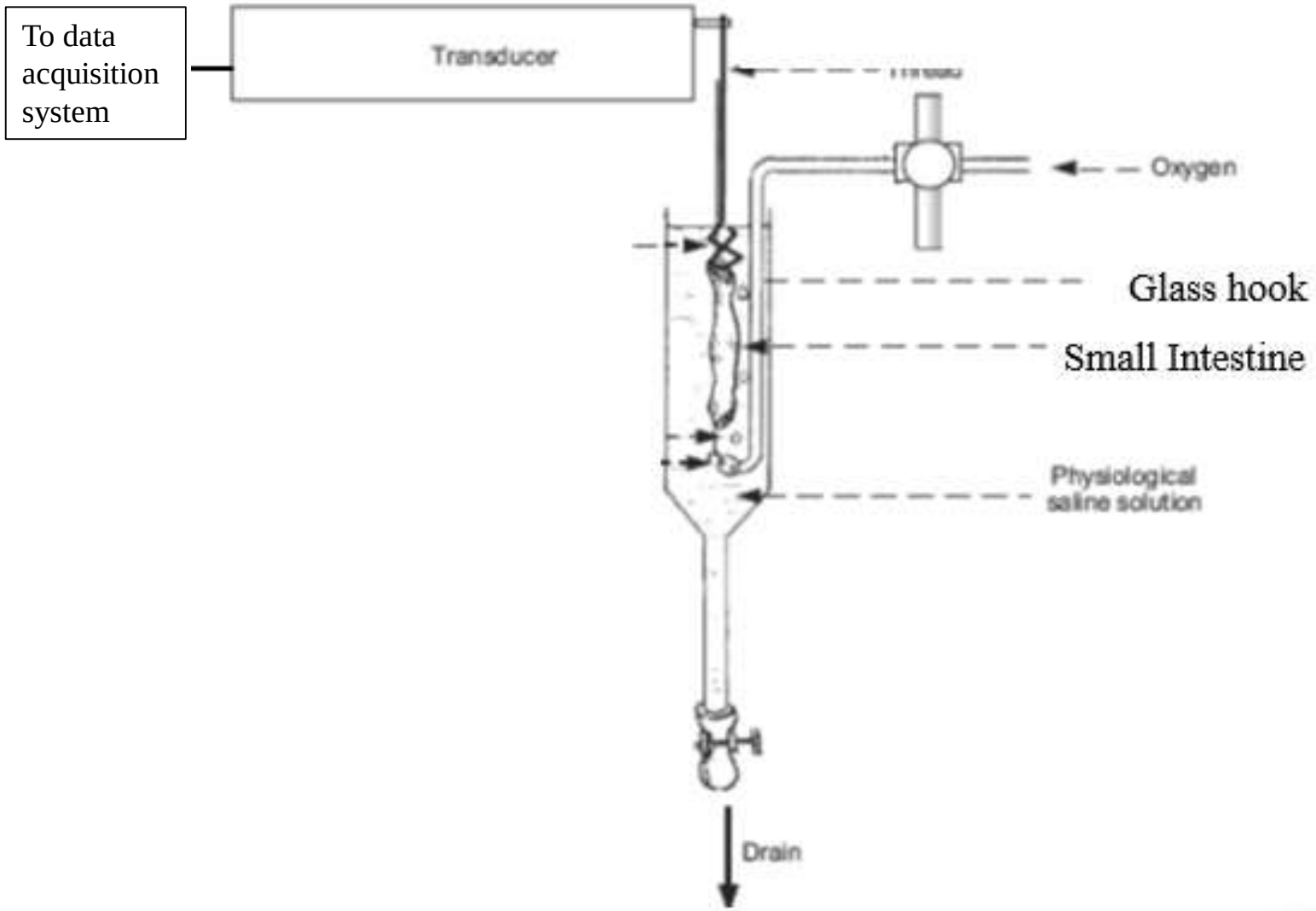
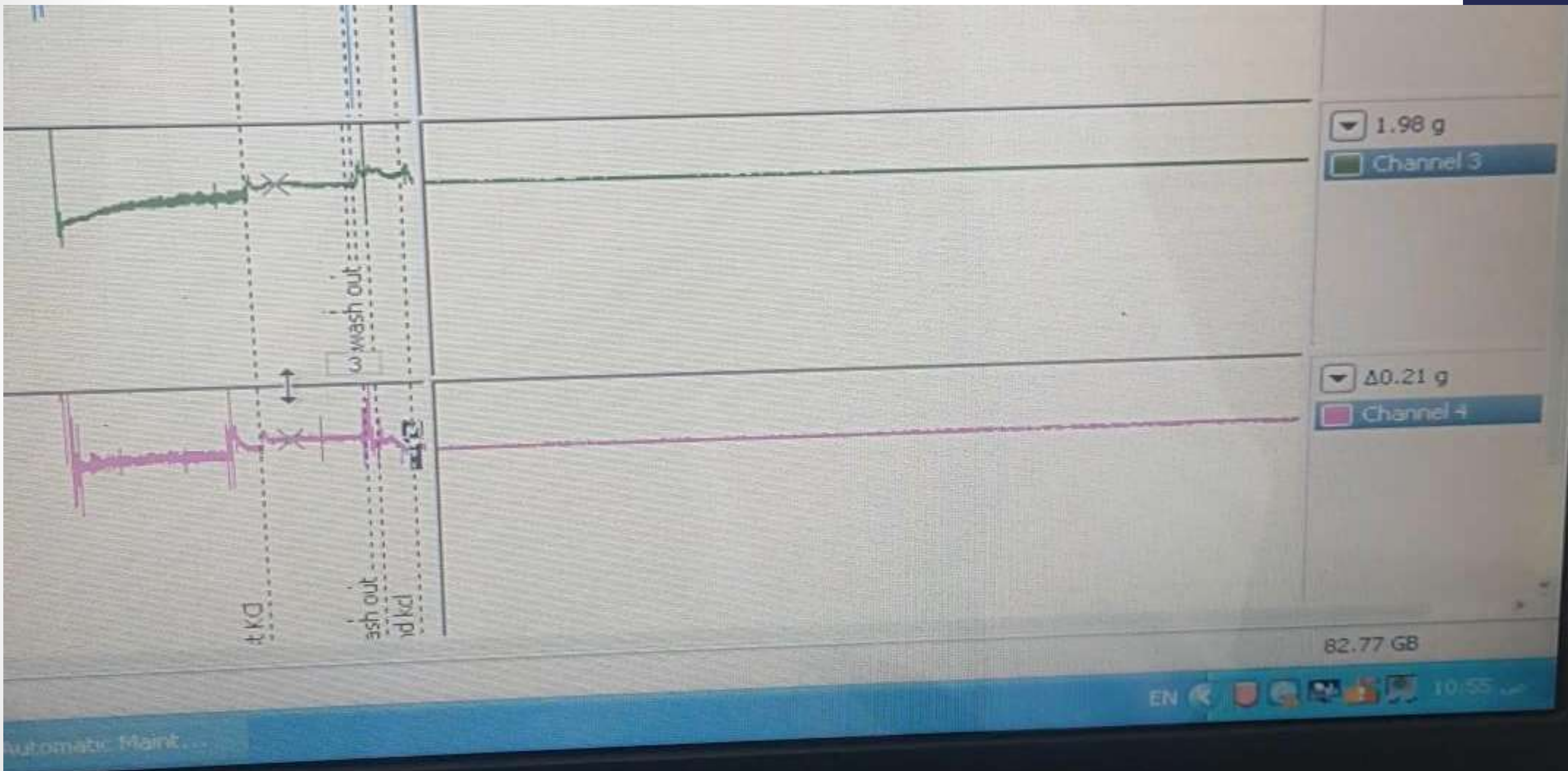
Aim of the experiment

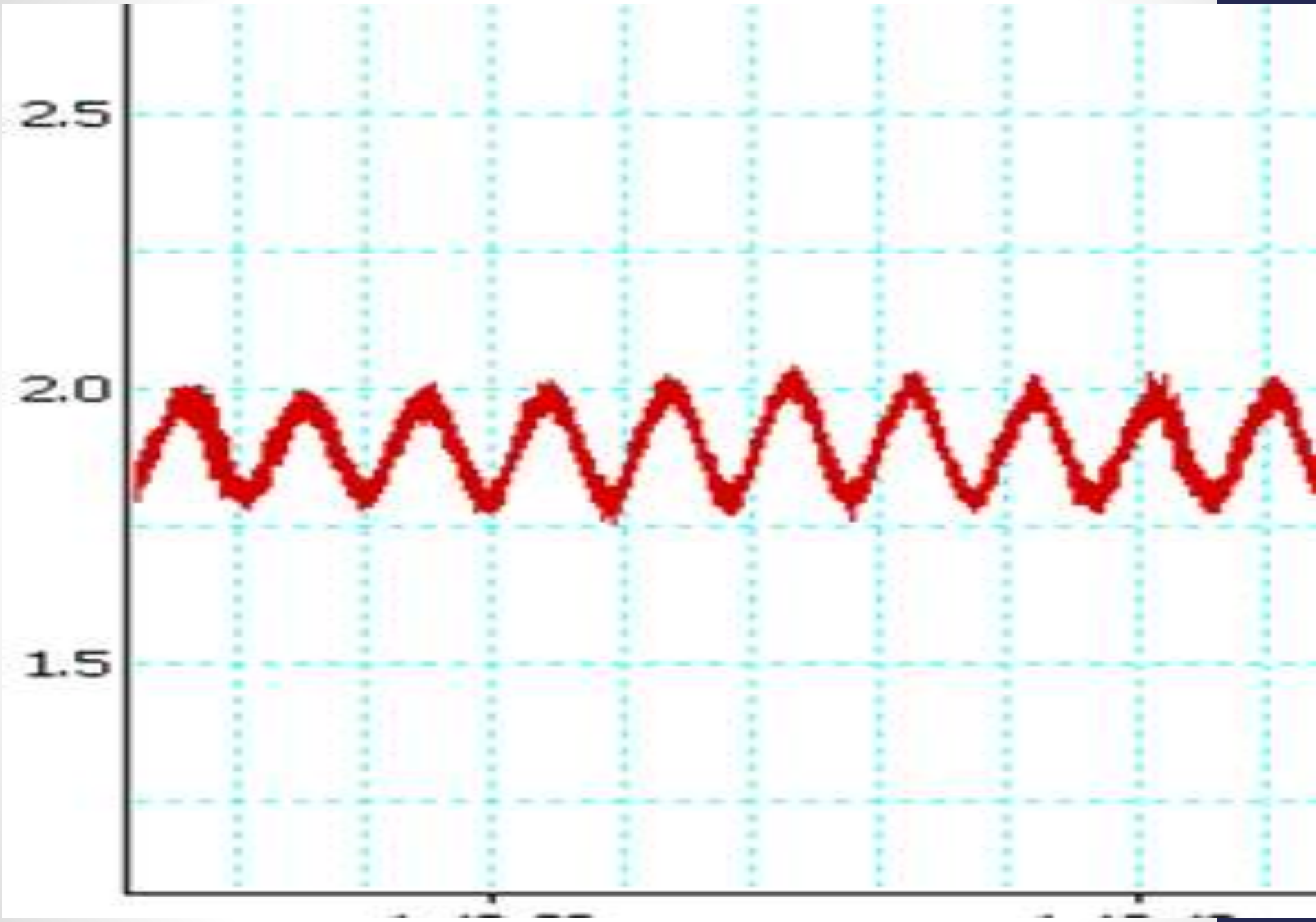
- GI motility is essential for life and is a highly regulated and coordinated process.
- This experiment investigates the contractions in the small intestine by :

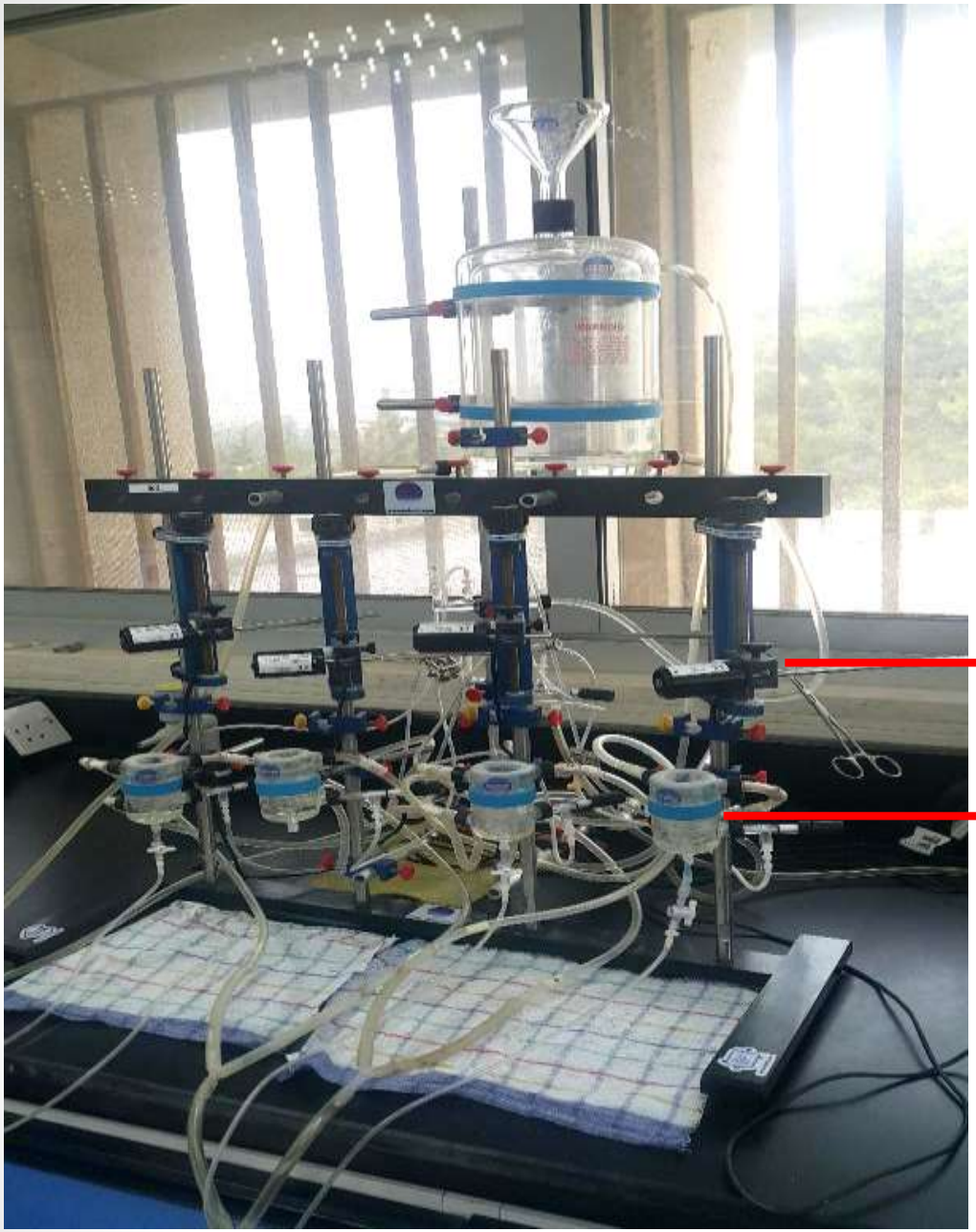
1. Observing the occurrence of spontaneous rhythmical contractions
2. The modification of these contractions by acetylcholine and atropine.

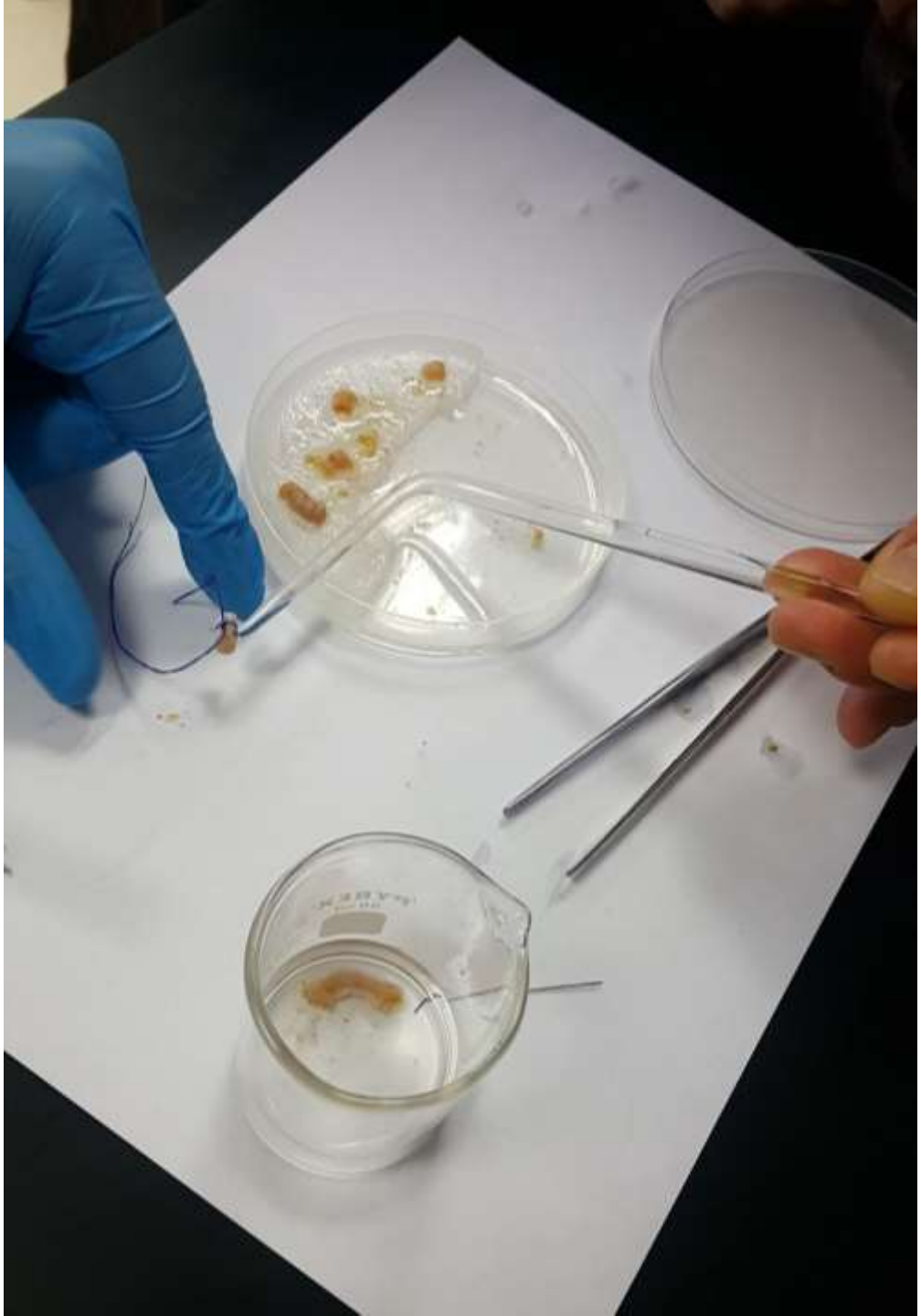


Arrangement of the organ bath, tissue, and pressure transducer.


1.98 g
Channel 3
Δ0.21 g
Channel 4
wash out
82.77 GB
EN
Automatic Maint...


2.5
2.0
1.5


Tension transducer
Organ bath

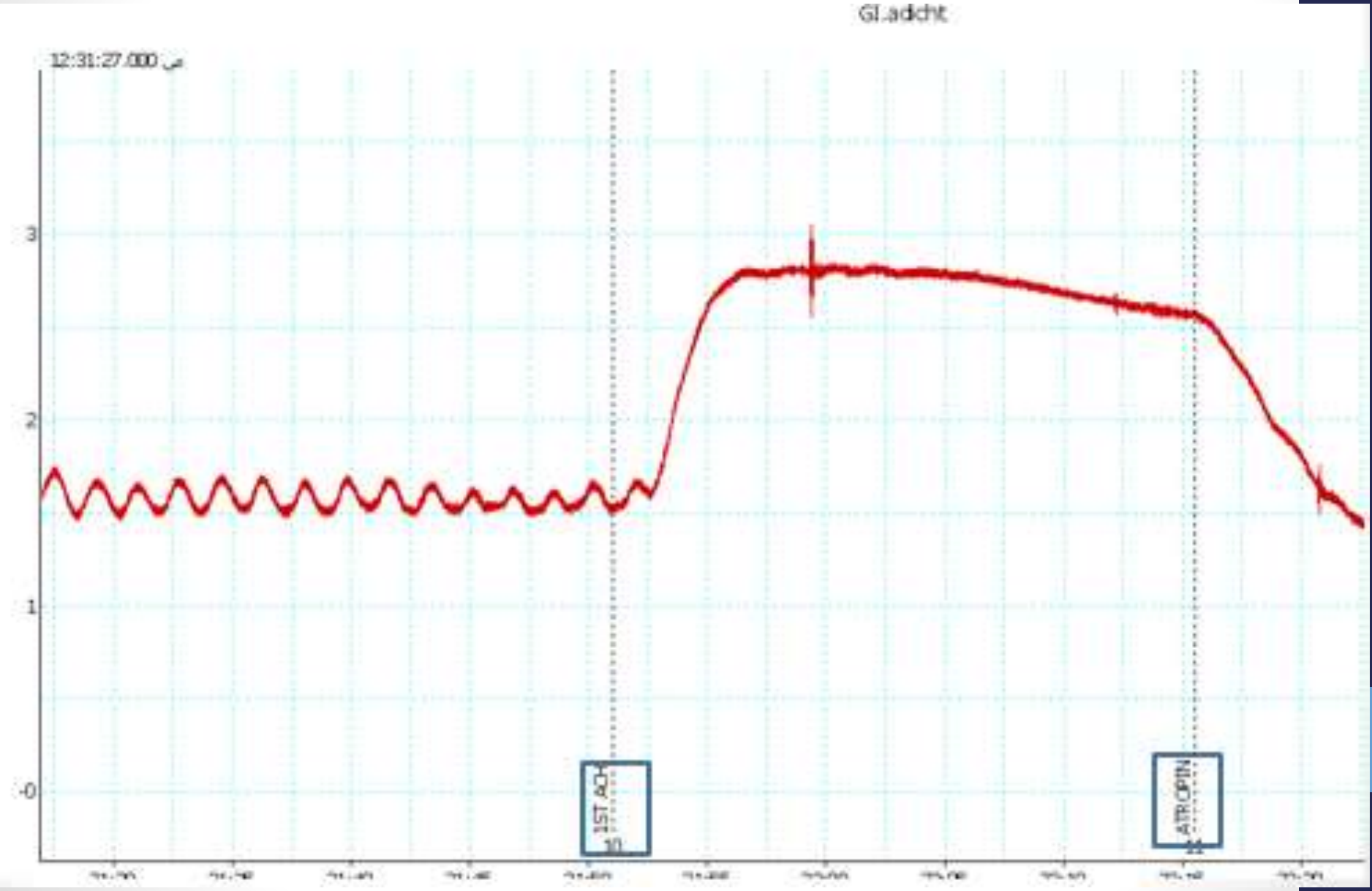


Method

- In our experiment we use the small intestine (SI) of the rat.
- Small pieces (2-3cm) of the SI are hanged vertically by a thread to a glass hook in an organ bath.
- The organ bath contains warm (37^{o}C) oxygenated buffer. This is essential to maintain the viability of the tissue.
- The SI is connected by a thread to a tension transducer
- The tension transducer converts the mechanical signal generated by the contraction of the small intestine to an electric signal and conveys it to a special software
- The software is capable of displaying a simple graph of tension versus time.

- After hanging the tissue it is allowed to rest for 15-20 minutes to allow the muscle to recover normal function after being handled.
- Waves of contraction through the strip should be clearly visible once normal function has been restored.
- At this point we start recording the tension created by the small intestinal segment.
- Then Acetylcholine is added to the organ bath.
- Finally Atropine is added to the organ bath.

Results



Discussion

- Phasic (Rhythmical) contractions: periodic contractions and relaxations occur in esophagus, antrum of stomach, and small intestine

- Smooth muscle cells contract rhythmically in the absence of neuronal or hormonal stimulation.
- Slow waves set the maximum frequency at which contraction can occur at a particular site.

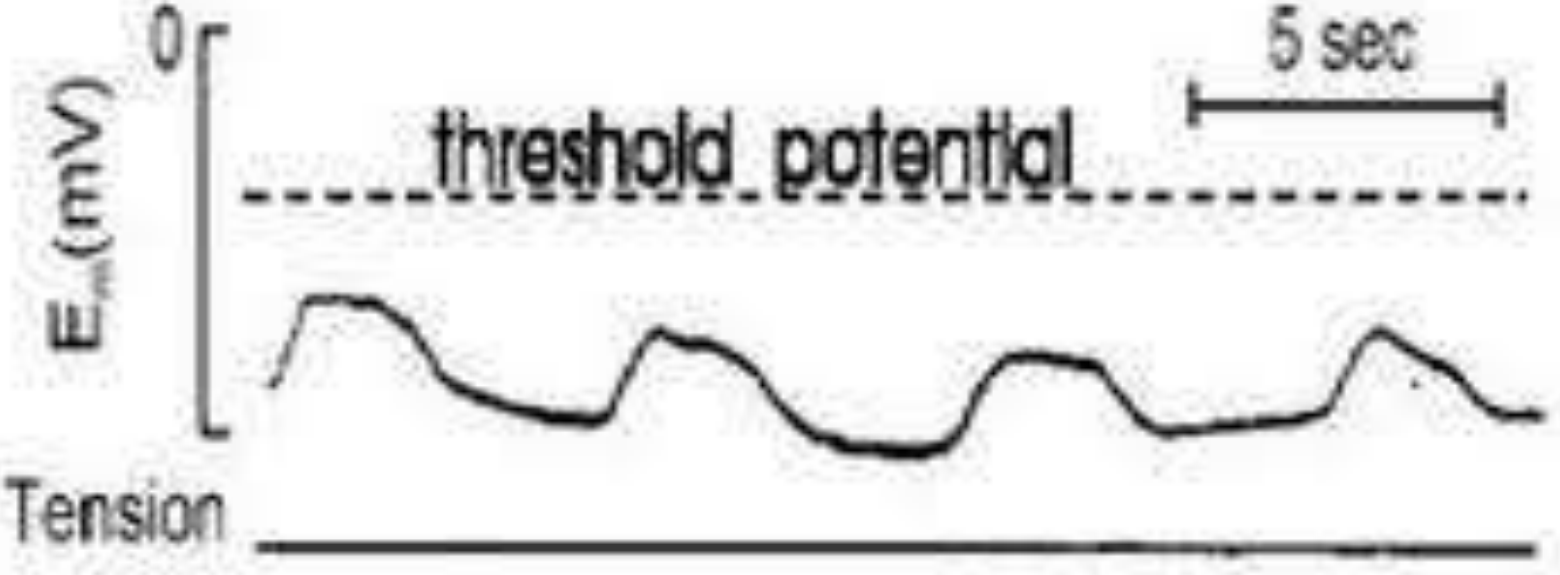
- Slow waves are periodic oscillations of the cell membrane potential consisting of a rapid upstroke and a plateau phase followed by repolarization.
  - Not true action potentials and are always there whether contractions occur or not .

- The interstitial cells of Cajal (ICC) generate the slow waves

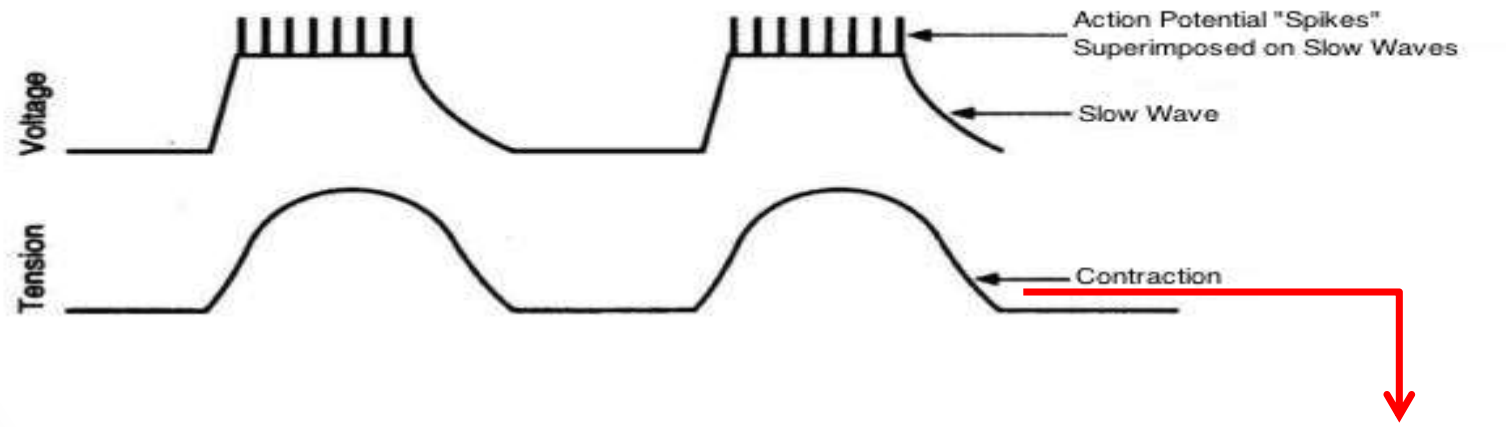
- Slow waves occur at different frequencies at various points along the gastrointestinal (GI) tract , and these frequencies can range from a few to 50 waves/min depending on the species.
- In humans the rate varies according to the location
  - Stomach: 3 slow waves per minute, ileum: 8-9 slow waves per minute, duodenum: 12 slow waves per minute

- For a contraction to occur, a spike potential must be generated by smooth muscle cells, seen as transient membrane depolarization superimposed on the plateau phase (high excitability phase) of the slow wave.
- Can be elicited by Acetylcholine or stretch

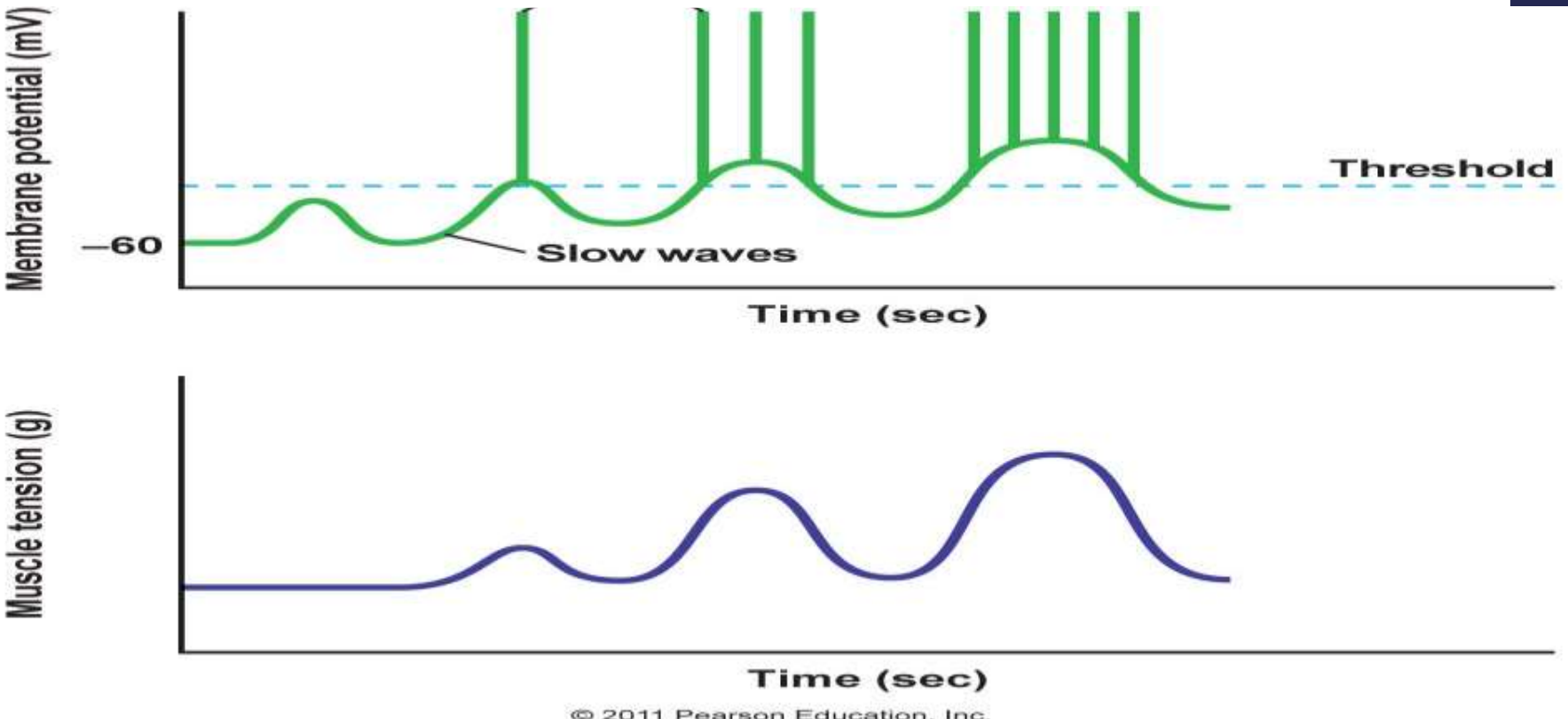
Slow waves without action potentials and contraction



- Remember that in our experiment we measured the actual contraction of the small intestine NOT the slow waves



- Acetylcholine promotes increased contractile force
  - The increase in contractile force is due to an increase in the number spikes not in the frequency of slow waves.



- Ach is the major excitatory neurotransmitter in the SI
- Secreted by enteric neurons and parasympathetic neurons
- Its effect on intestinal smooth muscle cells is mediated through the muscarinic receptors
- Inhibition of the contractile effect of ACh is mediated by adding atropine; a competitive antagonist of Ach at the muscarinic receptor.
- Norepinephrine has a mild inhibitory effect on the **rat's** SI contraction. (this is why we didn't use it in our experiment)