Increase preferential activation of large fiber

Introduktion

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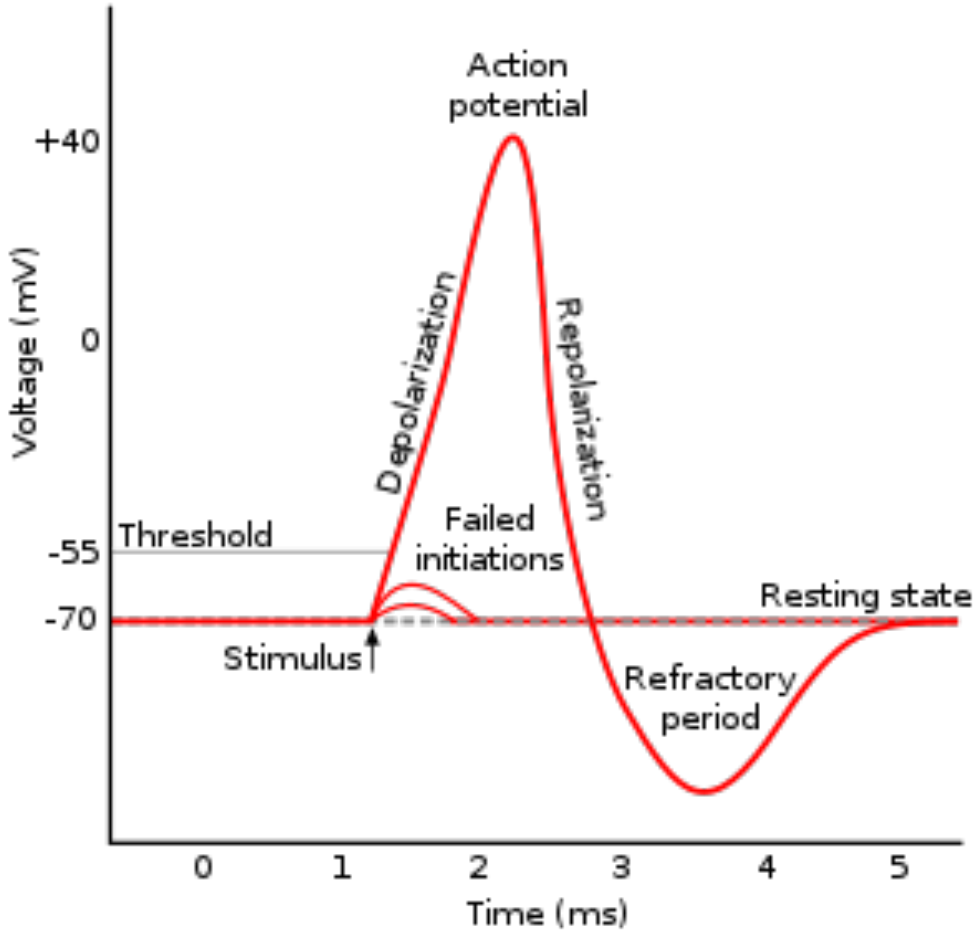
Agenda

- Welcome
- Background
  - Neurophysiology
  - Excitability
  - Method
- Project
  - Description
  - Meetings
  - Project plan

Action potential



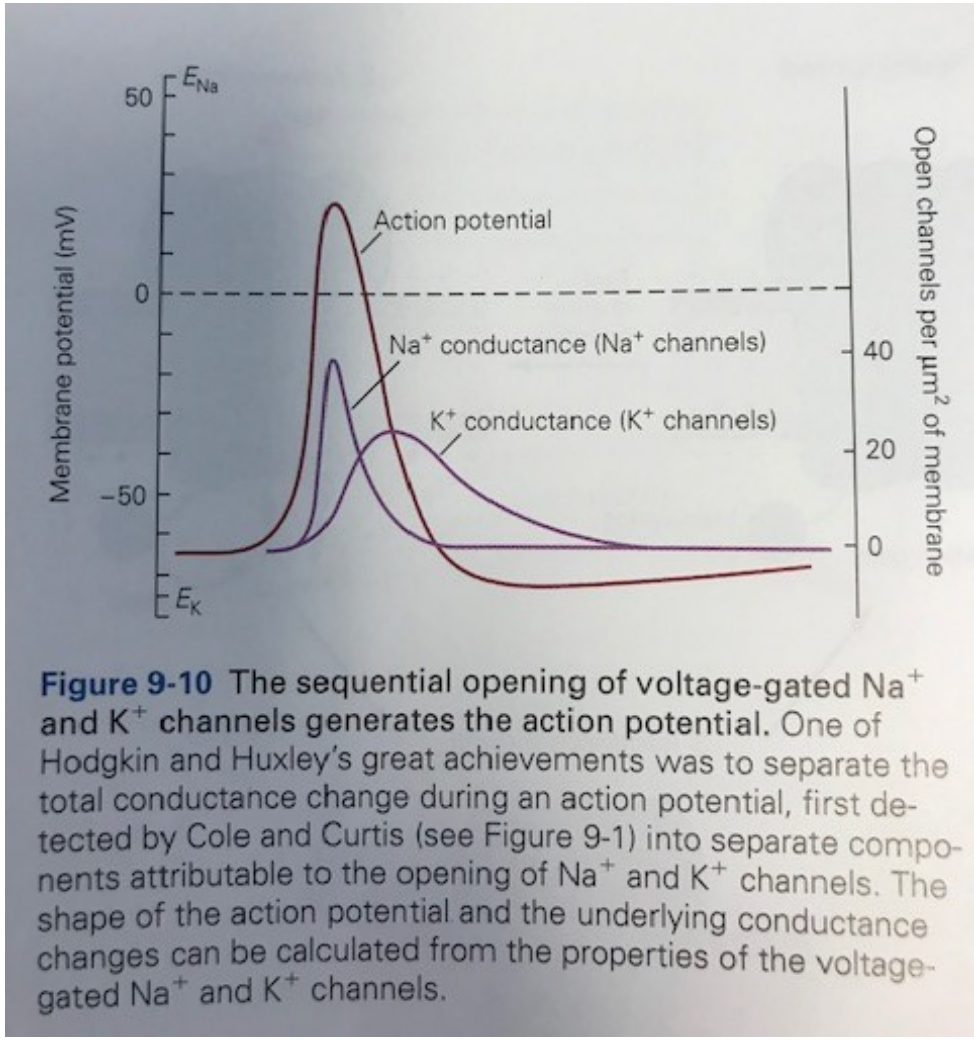
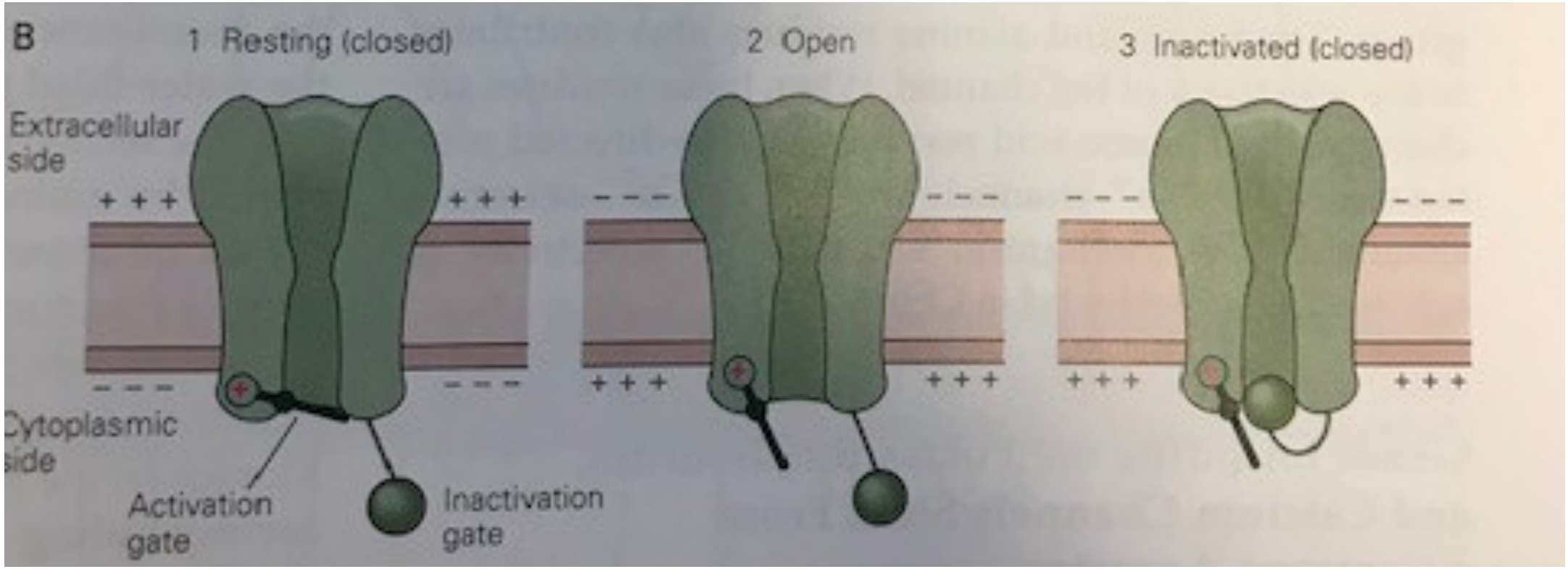


Figure 9-10 The sequential opening of voltage-gated Na^+ and K^+ channels generates the action potential. One of Hodgkin and Huxley's great achievements was to separate the total conductance change during an action potential, first detected by Cole and Curtis (see Figure 9-1) into separate components attributable to the opening of Na^+ and K^+ channels. The shape of the action potential and the underlying conductance changes can be calculated from the properties of the voltage-gated Na^+ and K^+ channels.

Voltage-gated ion channels



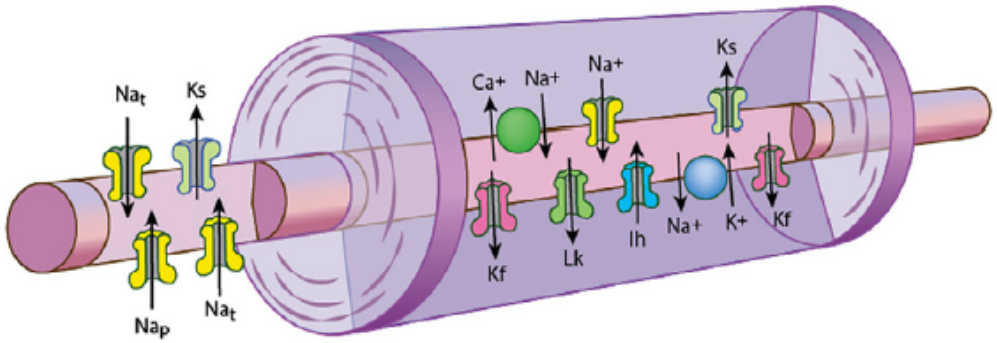
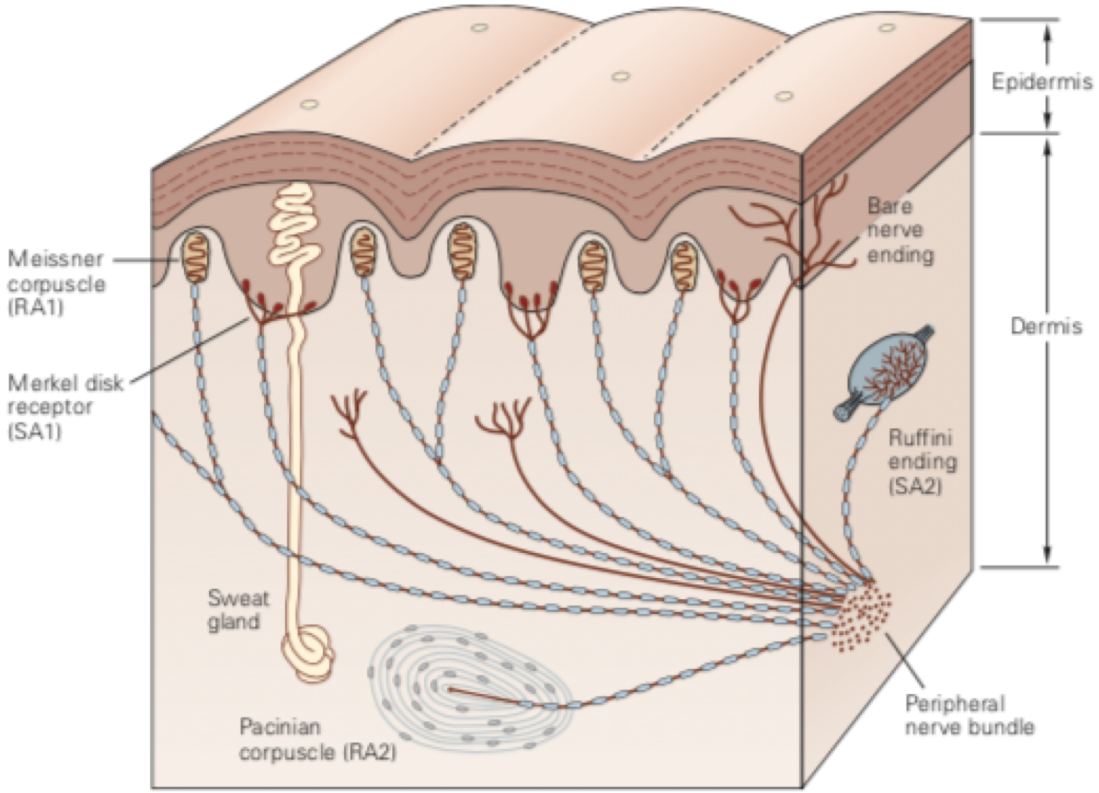
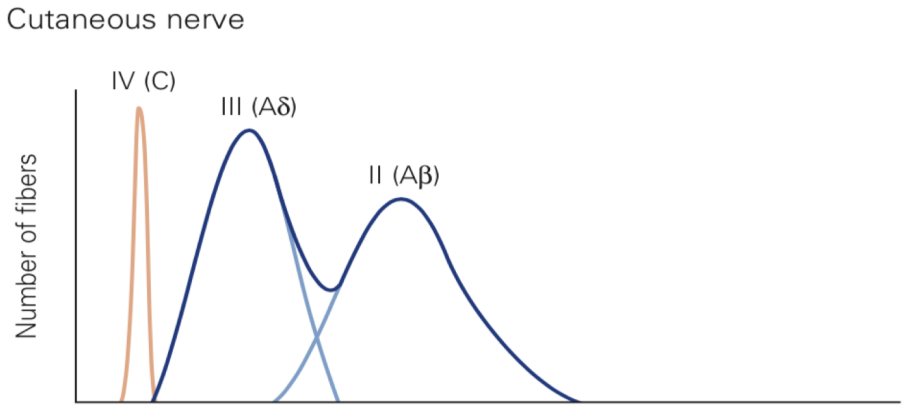


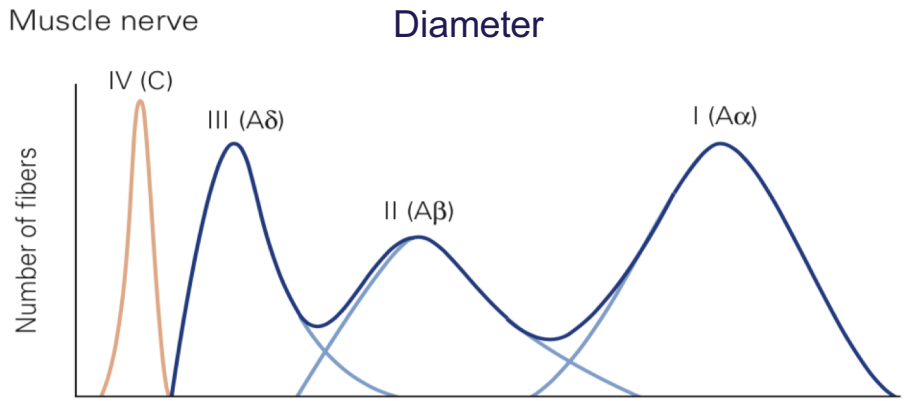
Table 1
Key ion channel subtypes and their neurophysiological roles.

Key ion channel subtypes	Neurophysiological role	Axonal localization	References
Transient Na^+ channels Na_t	Action potential generation; represent majority of Na^+ current	High density at nodes of Ranvier	Ritchie and Rogart (1977), Schwarz et al. (1995), Caldwell et al. (2000)
Persistent Na^+ channels Na_p	Demonstrate incomplete inactivation, modulation of excitability	May reflect differential gating of Na_t channel population	Bostock and Rothwell (1997), Baker and Bostock (1997), Krishnan et al. (2009)
Slow K^+ channels K_s	Outward rectification, limitation of ectopic firing, Reduction of excitability following impulse trains	Highest density at nodes of Ranvier	Baker et al. (1987), Schwarz et al. (1995), Devaux et al. (2004)
Fast K^+ channels K_f	Dampen excitability after action potential generation to prevent re-excitation	High density in juxtaparanode	Chiu and Ritchie (1984), Wang et al. (1993), Rasband et al. (1998)
Hyperpolarization activated cation conductance I_h	Stabilizing membrane potential and excitability; inward rectification	Predominantly expressed at internode	Baker et al. (1987), Pape (1996), Krishnan et al. (2009)
Na^+/K^+ pump	Maintenance of low intracellular Na^+ concentration and membrane potential	Unclear localisation (nodal, paranodal and/or internodal)	Morita et al. (1993), Alberti et al. (2007), Krishnan et al. (2009),
Na^+/Ca^{2+} exchanger	Removal of excess Ca^{2+}; reverse operation can lead to axonal injury and cell death	Axonal membrane; Internode and nodal regions	Steffensen et al. (1997), Persson et al. (2010)

Different type of fibers







Axon diameter (μm)	1	5	12	20
Conduction velocity (m/s)	1	30	72	120

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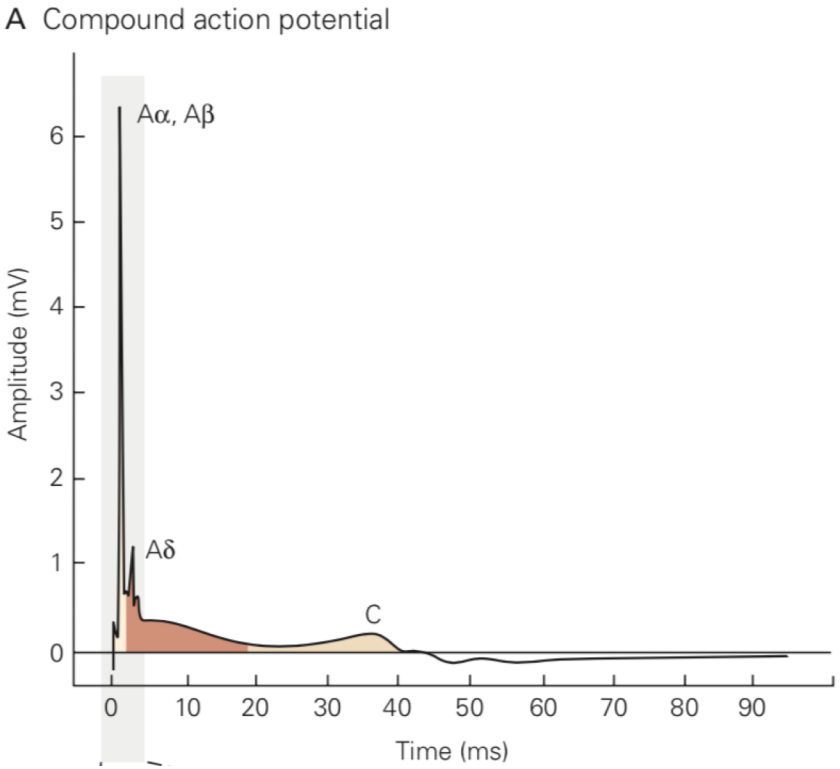
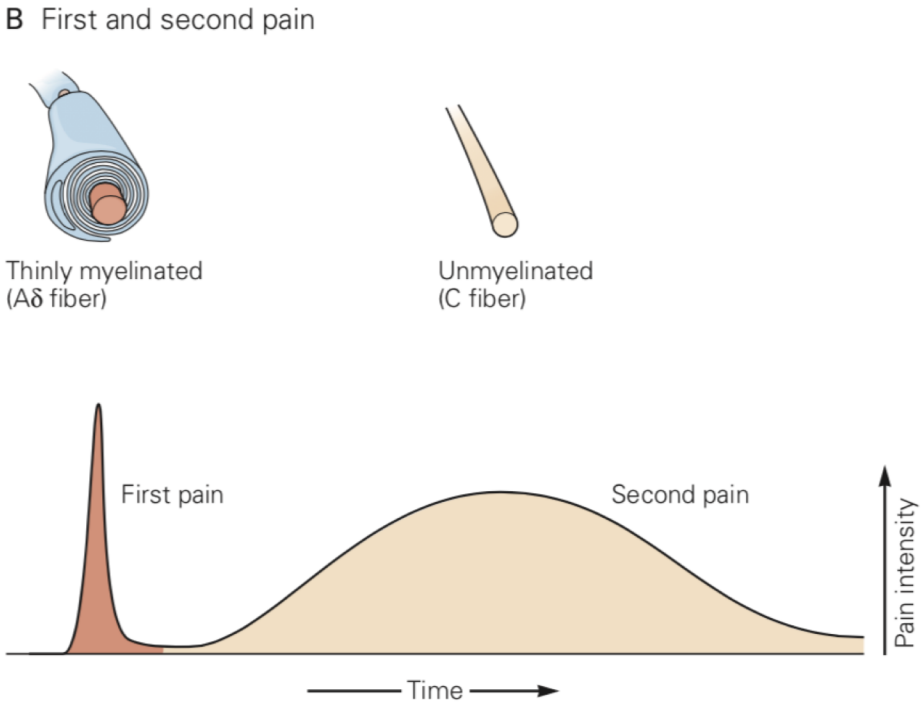
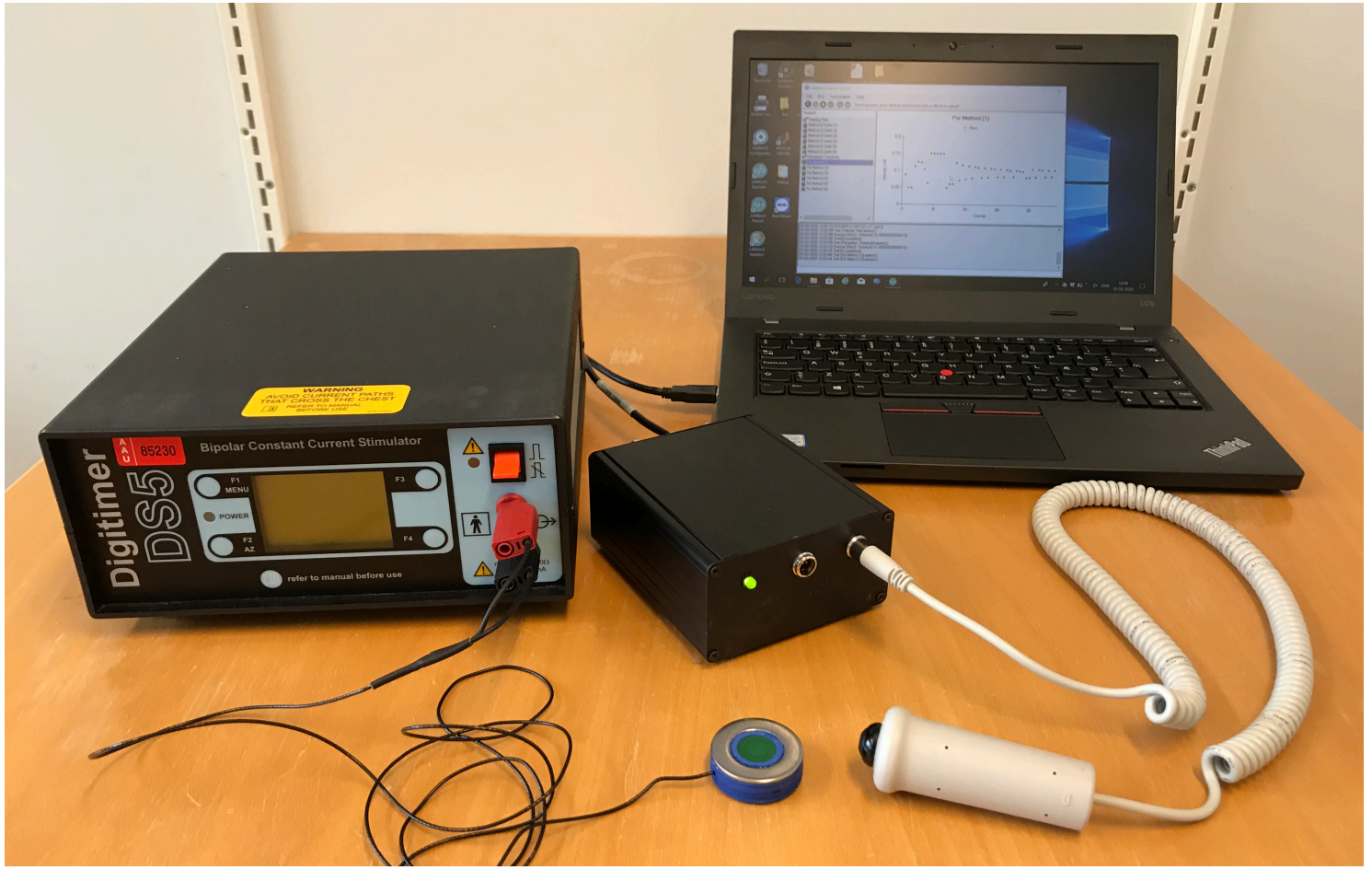
The velocity of nerve fibers





Excitability of cutaneous nerve fibers



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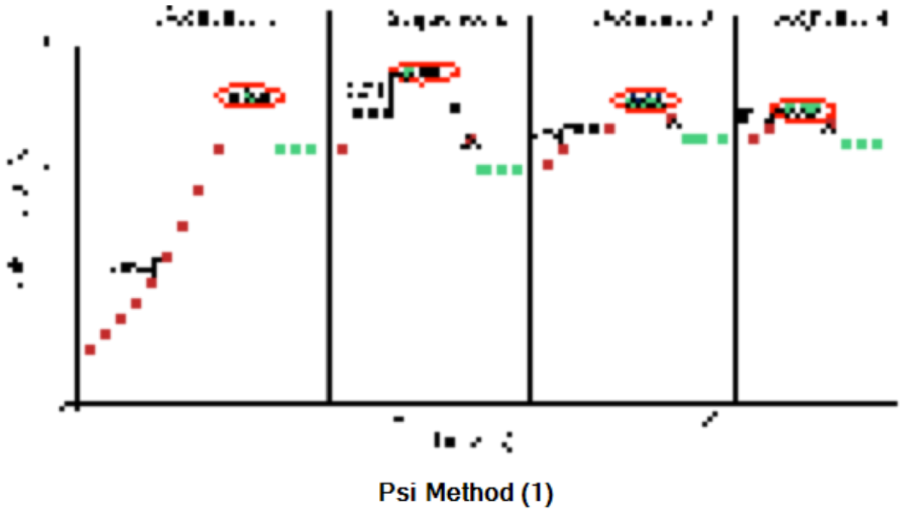
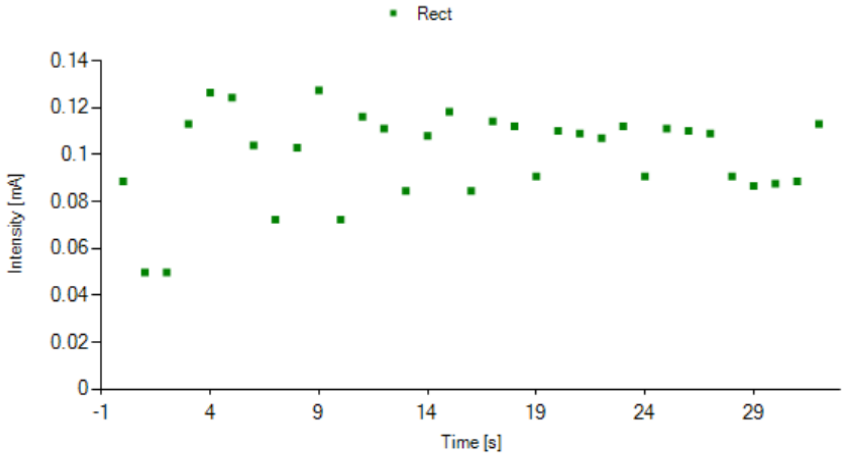
Estimation of perception thresholds

Up/down method



PSI method



Hejlskov Poulsen et al. (In revision)
Brøckner, Jensen et al. (unpublished)

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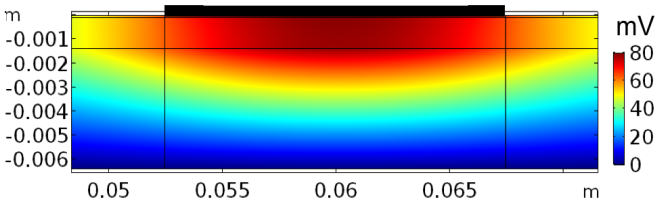
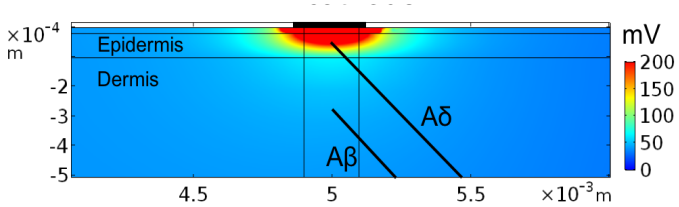
The Electrical Field Generated by the Electrodes

Patch electrode



Pin electrode

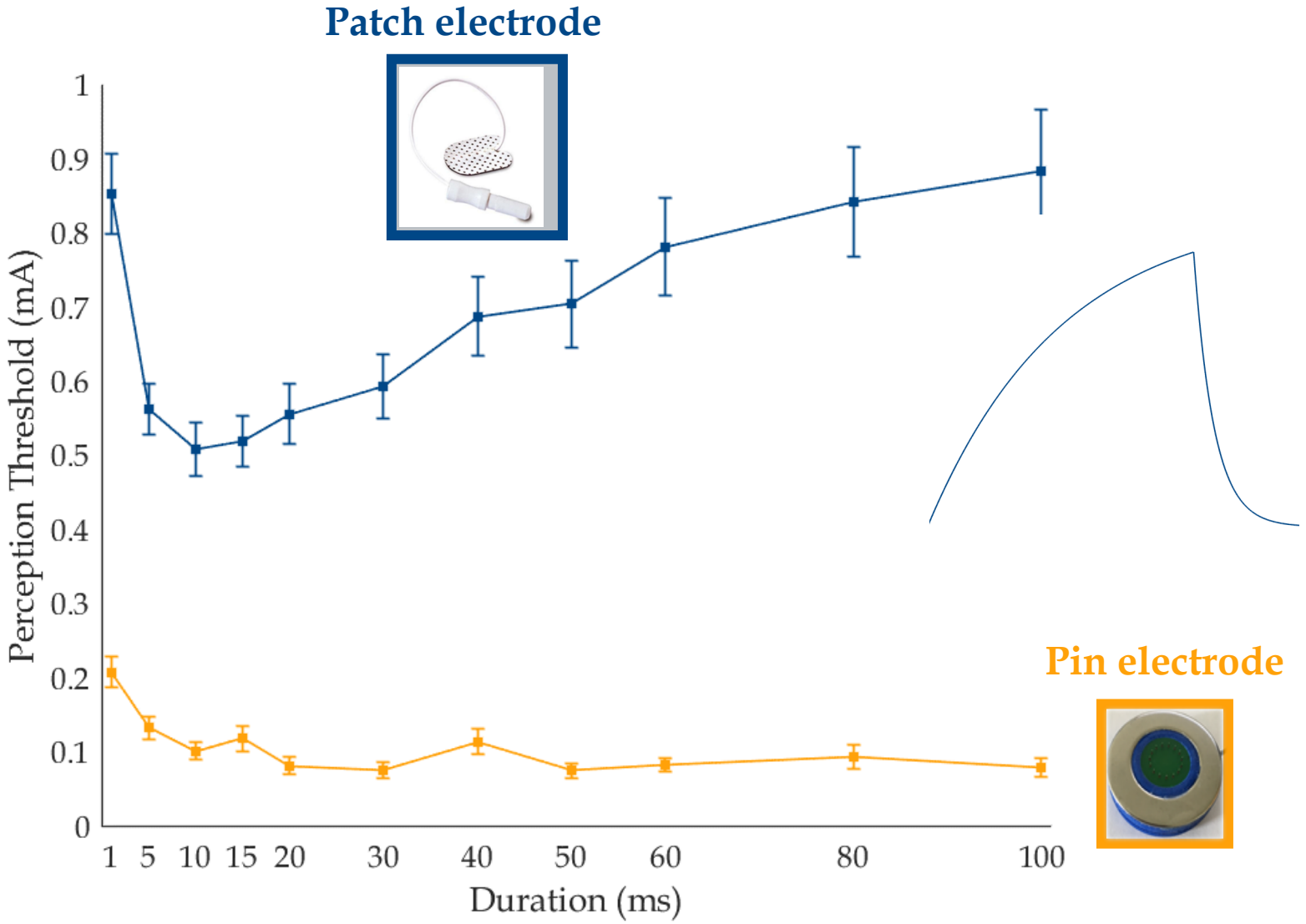


- The pin electrode generated a substantially higher electrical field in epidermis (0.18 V) compared to the patch electrode (0.08 V).

- Supports preferential activation of small fibers by Pin electrodes since small fibers terminate in epidermis.

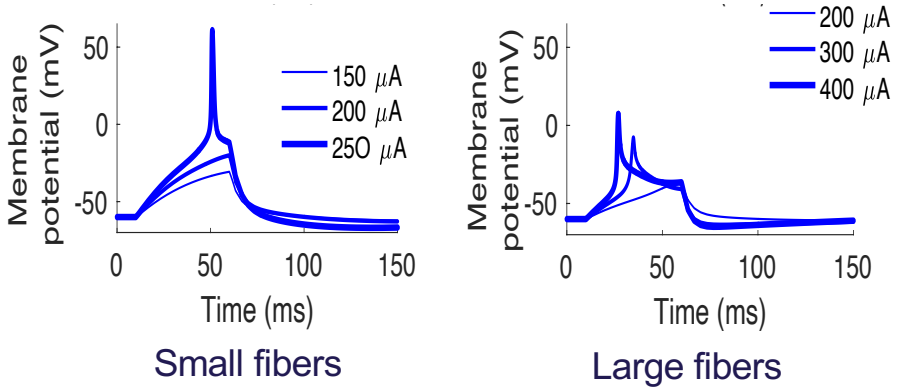
Increase preferential activation of large fibers

Accommodations



Hugosdottir et al. (2019) J. Neurophysiol. DOI:10.1152/jn.00390.2019

Why Different Accommodations in Small and Large Fibers?



Slowly increasing membrane potential

⬇

Inactivation of sodium channels[1]

⬇

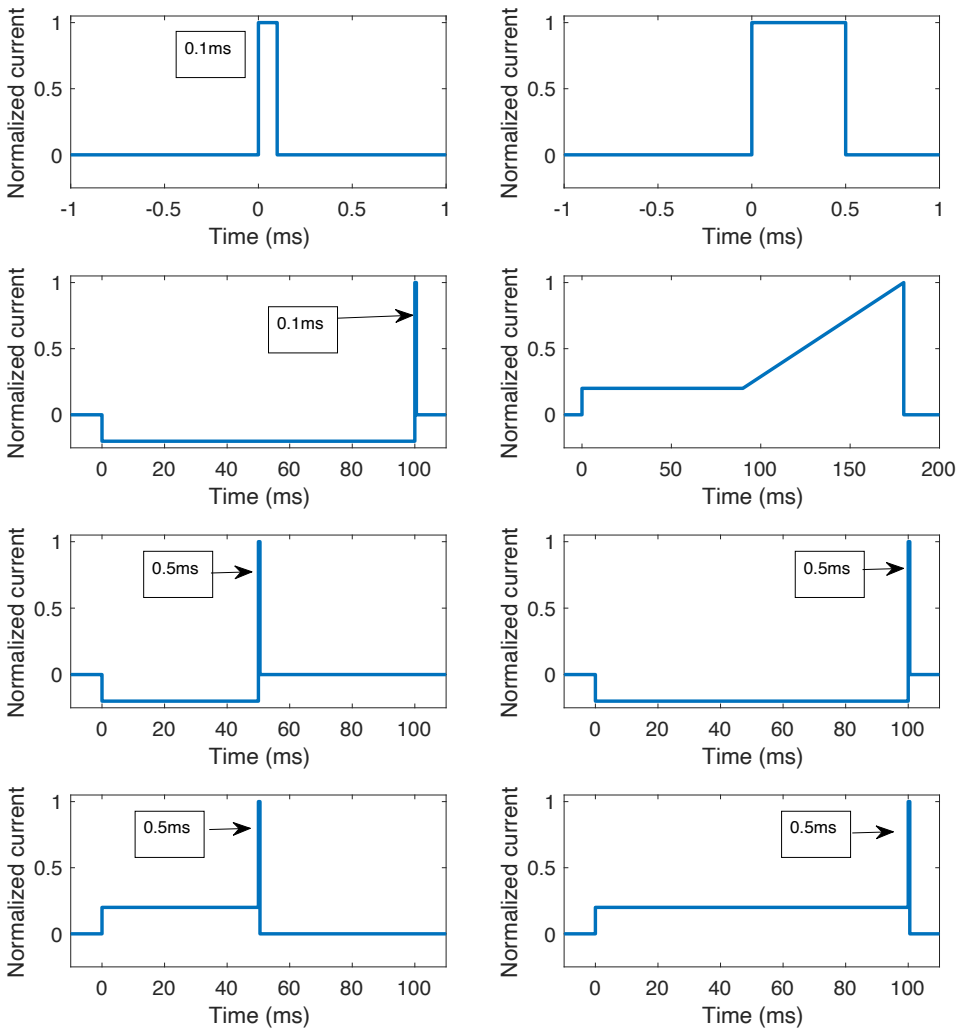
The inactivation of sodium channels is different between small and large fibers[2]

⬇

Different accommodations

1. Bostock H., Cikurel K., Burke D., 1998, Threshold tracking techniques in the study of human peripheral nerve, Muscle & Nerve, p. 137–158, 1998.

2. Blair N.T. and Bean B. P., 2002, Roles of tetrodotoxin (TTX)-sensitive Na+ current, TTX-resistant Na+ current, and Ca2+ current in the action potentials of nociceptive sensory neurons., Journal of Neuroscience., 22:10277-10290



Perception threshold

Pain threshold

And ….

Samarbejde

- Laboratoriet
  - Hvis man er i boble sammen, må man gerne være flere med mundbind i lab end der står på skiltet.
  - Lab + udstyr afsprittes før og efter brug
  - Der er run på !
- Mødefrekvens + feedback
  - Ugentligt møde. I sender dagsorden 2 dage inden.
- Bosat i Lock-down kommune?

Modul 3.4
Projekt

Husk at få en aftale i stand med projektvejleder:

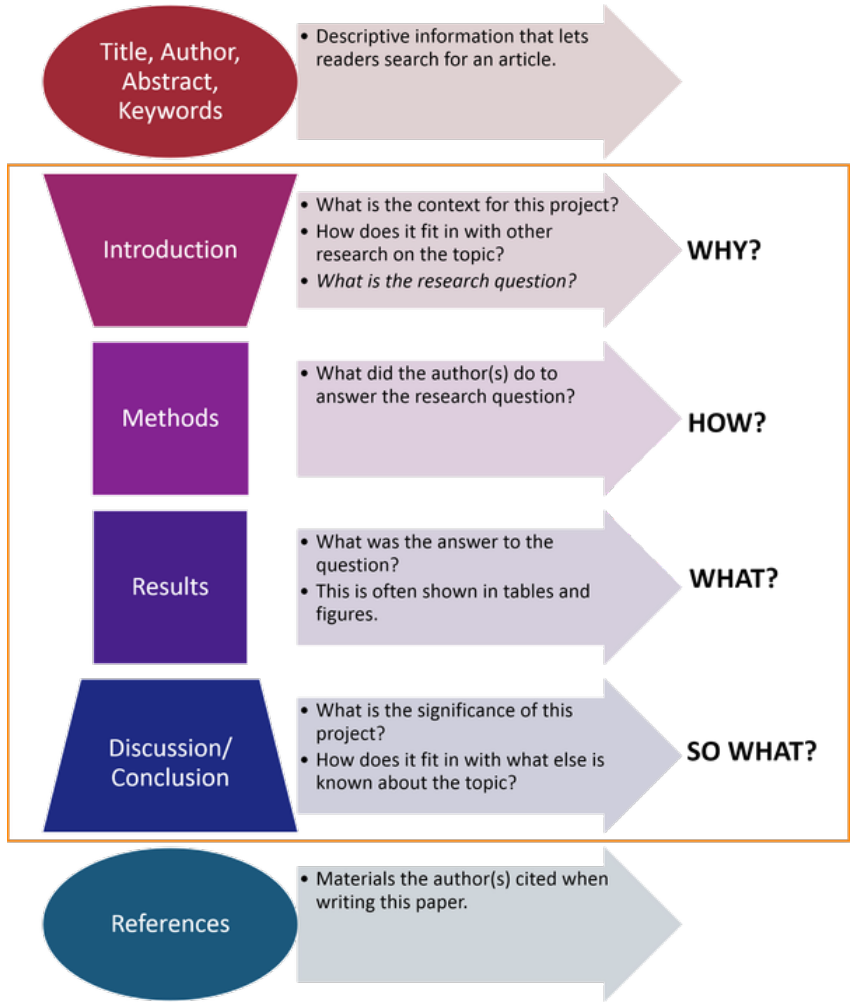
- Aftal mødefrekvens og kommunikationsform – mails, tlf, efter behov, en gang om ugen osv
  - Et vejldermøde om ugen. Dagsorden + materiale to dage før
- Klargør forventninger om tilstedeværelse i laboratoriet – vil vejleder være til stede altid eller evt. kun ved gennemgang af nye metoder – vil alle gruppemedlemmer dukke op eller sendes repræsentanter
  - Jeg er med i starten, men I skal prøve at være alene i lab, når det hele kører.
- Lav en anslået tidsplan over forsøg i samarbejde med vejleder – husk at tage hensyn til anden undervisning og vejleders andre aktiviteter
  - I laver første udkast inden næste møde.
- Fastslå vejleders holdning til regler for gennemlæsning af projektopgave og responstid
  - Jeg når kun at læse igennem en gang, men det er jo jeres projekt. Formuleringen af fx hypotesen er vigtig, så den skal vi arbejde en del med.
- Bliv enig med vejleder om hvilke referencer der er acceptable – her menes opslagsværker, lærerbøger, Wiki, artikler, impact factor osv.
  - Jeg har ikke stærke holdninger. Peer reviewed artikler er bedst.
- Bliv enig med vejleder om projektopgavens form, omfang osv – **Aalborg model**, artikelform, **25-50 sider**, hvad skal i Appendix etc.
- **Det er vejleder der har det sidste ord i hvordan jeres projektrapport udformes**

Modul 3.4
Projekt

- **Projekt rapport aflevering:** 18. December (elektronisk)

- **Projektopgaven bør være på mellem 25-50 sider og opstilles ifølge IMRAD strukturen:**
  - Abstract/Resumé
  - Introduktion
  - Metode
  - Resultater
  - Diskussion/Konklusion
  - Referenceliste

  - Se eksempler på tidligere projekter indleveret på 3. semester på aub.aau.dk under projektbiblioteket



Modul 3.4
Projekt

Jan Stavnshøj
Ingeniørassistent

Institut for Medicin og Sundhedsteknologi
Fredrik Bajers Vej 7
Lokale: D1-110
9220 Aalborg Ø, DK

Sekretær: 9940 8827
jks@hst.aau.dk

Yderligere kontaktinformation

Økonomi:

- Jan Stavnshøj på maskinværkstedet, kommer til at håndtere midler til projekt
- Hver gruppe har 500 kr. til rådighed
- Det er Jan Stavnshøj, der foretager alle indkøb relateret til studieprojektmidler.
- Når en gruppe ønsker at foretage et indkøb for studieprojektmidler, henvender gruppen/vejleder sig til Jan, som så registrerer gruppen og dennes indkøb/forbrug.
- For at være beretiget til midlerne er det fortsat et krav, at vejleder er ansat/aflønnet af HST.

Modul 3.4
Projekt

- Skulle der opstå samarbejdsvanskeligheder mellem gruppemedlemmer eller vejleder/gruppe, så start med at afholde møde med projektvejlederen for at finde en løsning

- Hvis problemet ikke kan løses uden yderligere tiltag så kontaktes semesterkoordinator Jacek Lichota

- Retningslinjer for evt. opsplitning af projektgrupper: https://www.hst.aau.dk/uddannelser/Regler+og+formularer/Opsplitning+af+grupper/

Projektplan - Kan dem fungere?

- Project period: 10/11 – 18/12
- Week 46: Intro meeting 12/11 online + literature
- Week 47: Formulating a hypothesis, Introduction to the lab
- Week 48: Write introduction, pilot tests
- Week 49: Write methods, collect data
- Week 50: Analyze data, write results and discussion
- Week 51: finalize report, and deliver report Dec 18th