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Nieuwe methoden voor nieuwe en bestaande opleidingen

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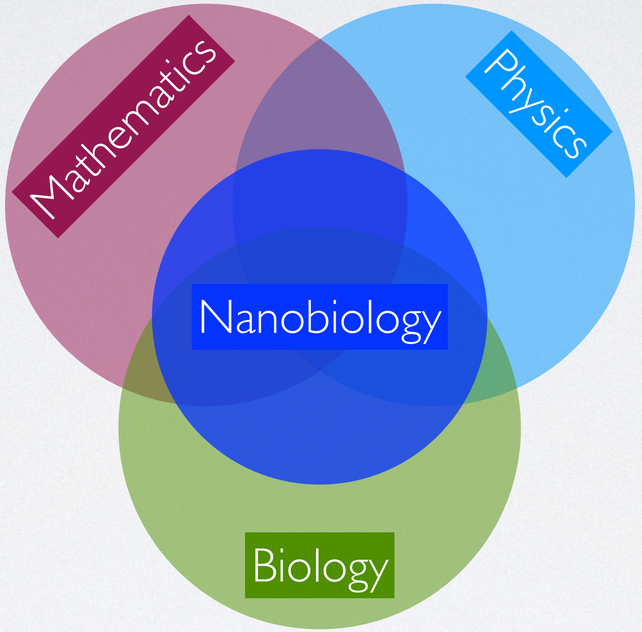

Using the language of maths
and the principles of physics
to understand the complexity of biology.

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NANOBIOLOGY SWOT

	Helpful	Harmful
Internal	S combineert drie vakgebieden	W taalbarrière
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Open Leermaterialen voor een Multidisciplinaire Opleiding

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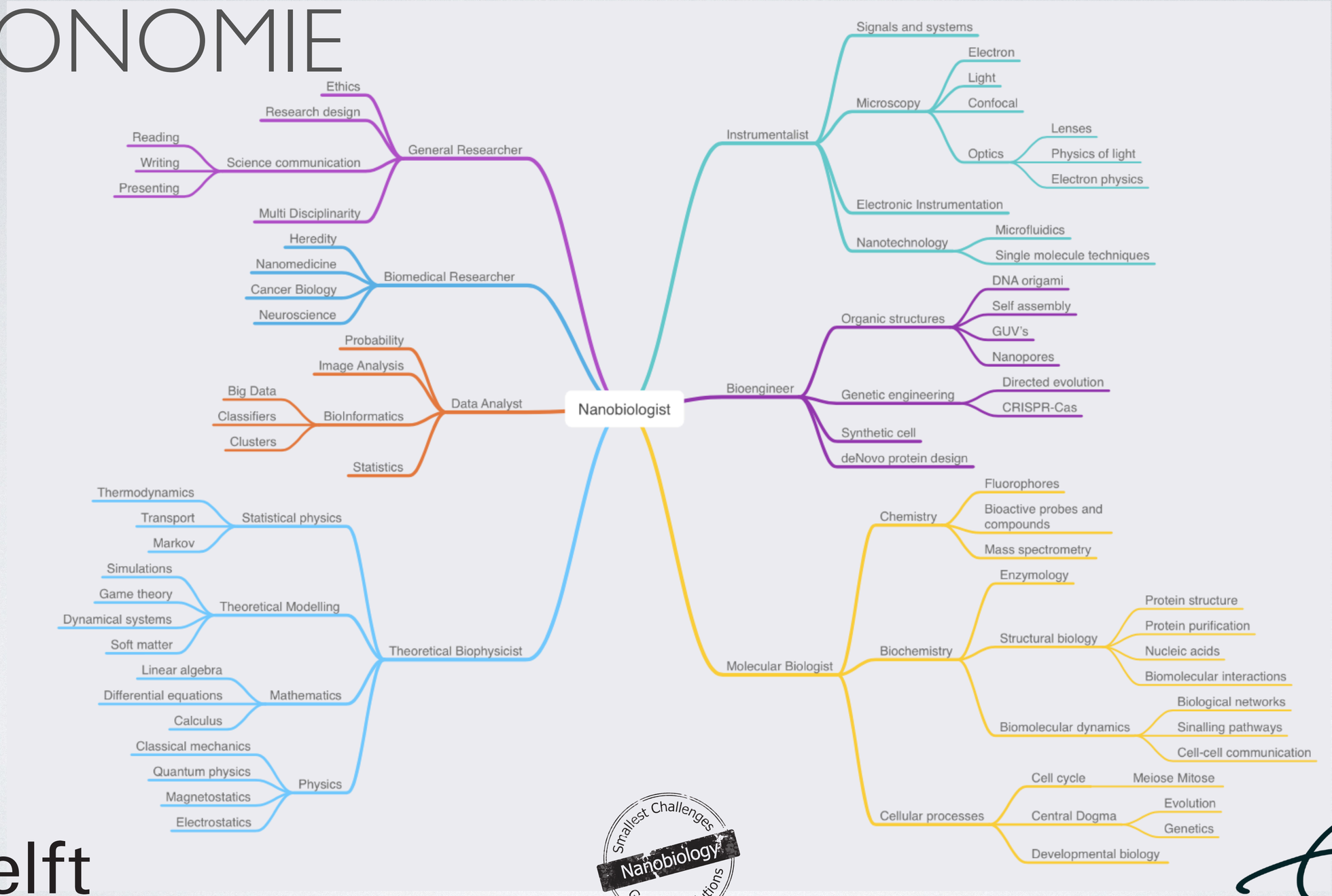

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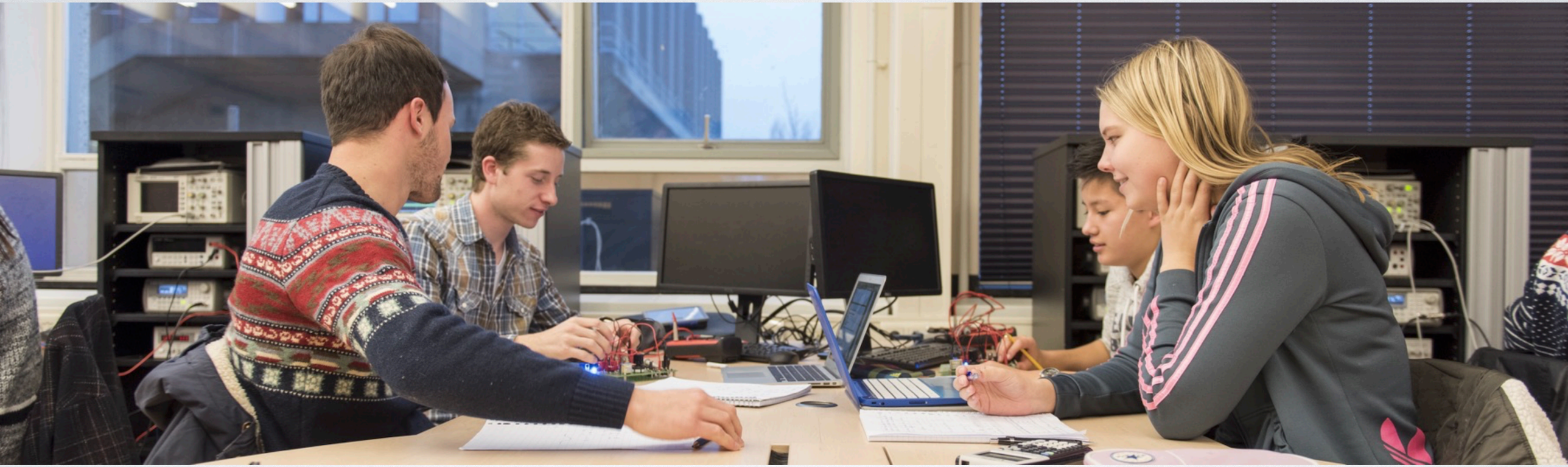

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natuurkunde → biologie

voorbeelden → voorbeelden

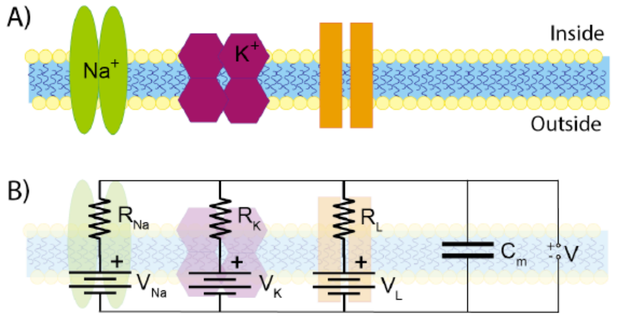

Figure 4 A) Schematic representation of the cell membrane.
B) the suiting RC circuit of the cell membrane.
The resistor is taken from: "Resistor" by Studio Refine is licensed under CC BY 3.0.
The battery is taken from: "Two cell battery" by Studio Refine is licensed under CC BY 3.0.

a) **(6p)** What are the inward (upward) currents (I_{Na}, I_K, I_L) through each channel, and the total inward (upward) current through the membrane in **Figure 4A** and **Figure 4B**? Express your answer in terms of the membrane potential V (defined to be positive when the potential is highest on the inside (upper)), the emfs of each channel/gate, and the resistances of each channel/gate.

b) **(2p)** Write down the differential equation describing how the voltage $V(t)$ changes over the membrane. Give your answer in terms of the resistances, emfs, and the capacitance shown in **Figure 4 A) Schematic representation of the cell membrane. B) the suiting RC circuit of the cell membrane.**

c) **(3p)** Show that you can rewrite the equation you derived for the voltage as an equation for the total current $I(t) = I_{Na}(t) + I_K(t) + I_L(t)$.

$$\frac{dI(t)}{dt} = -\frac{1}{C_m}\left(\frac{1}{R_{Na}} + \frac{1}{R_K} + \frac{1}{R_L}\right) I(t) \quad (1)$$

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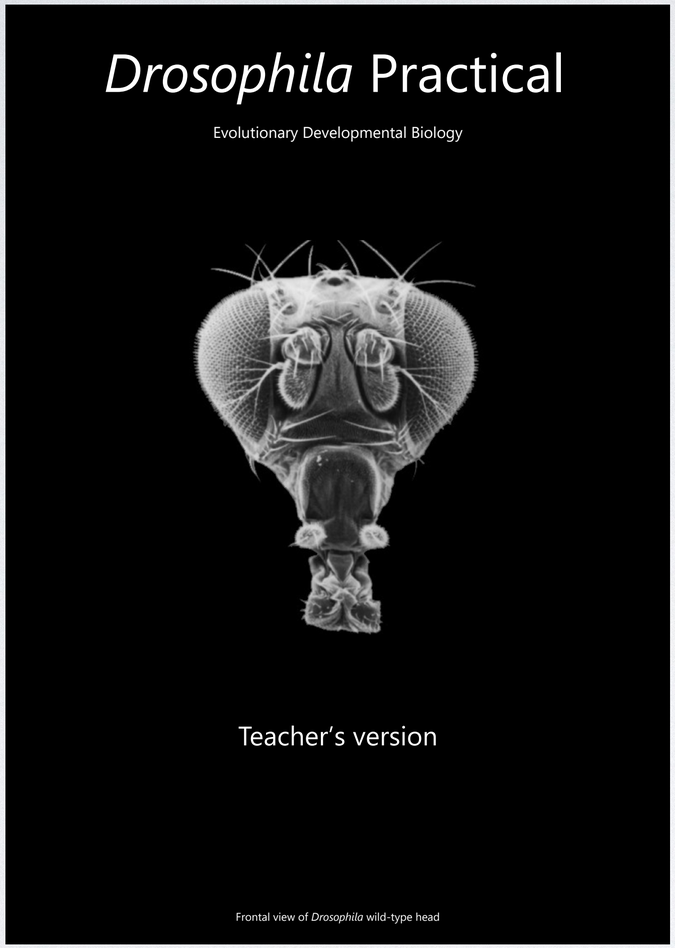

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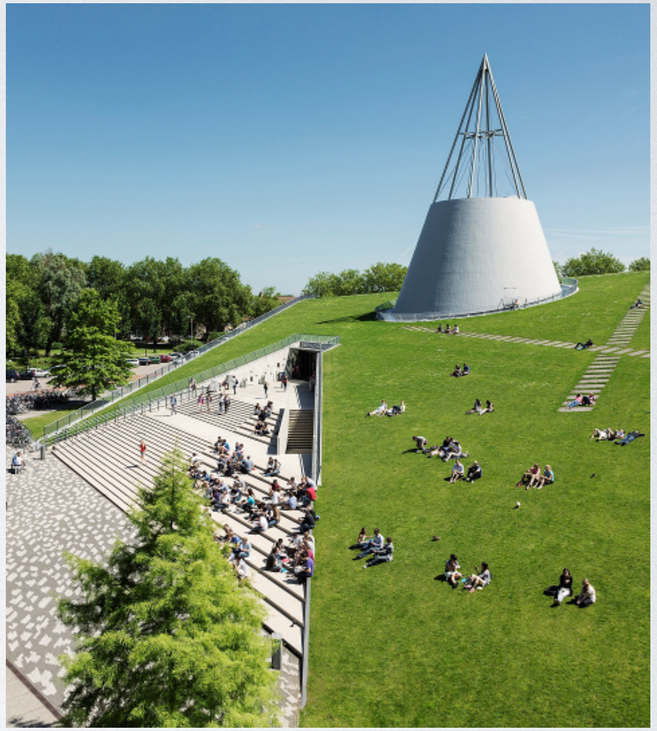
  - Uit een ontwerpprogramma
- Bibliotheek



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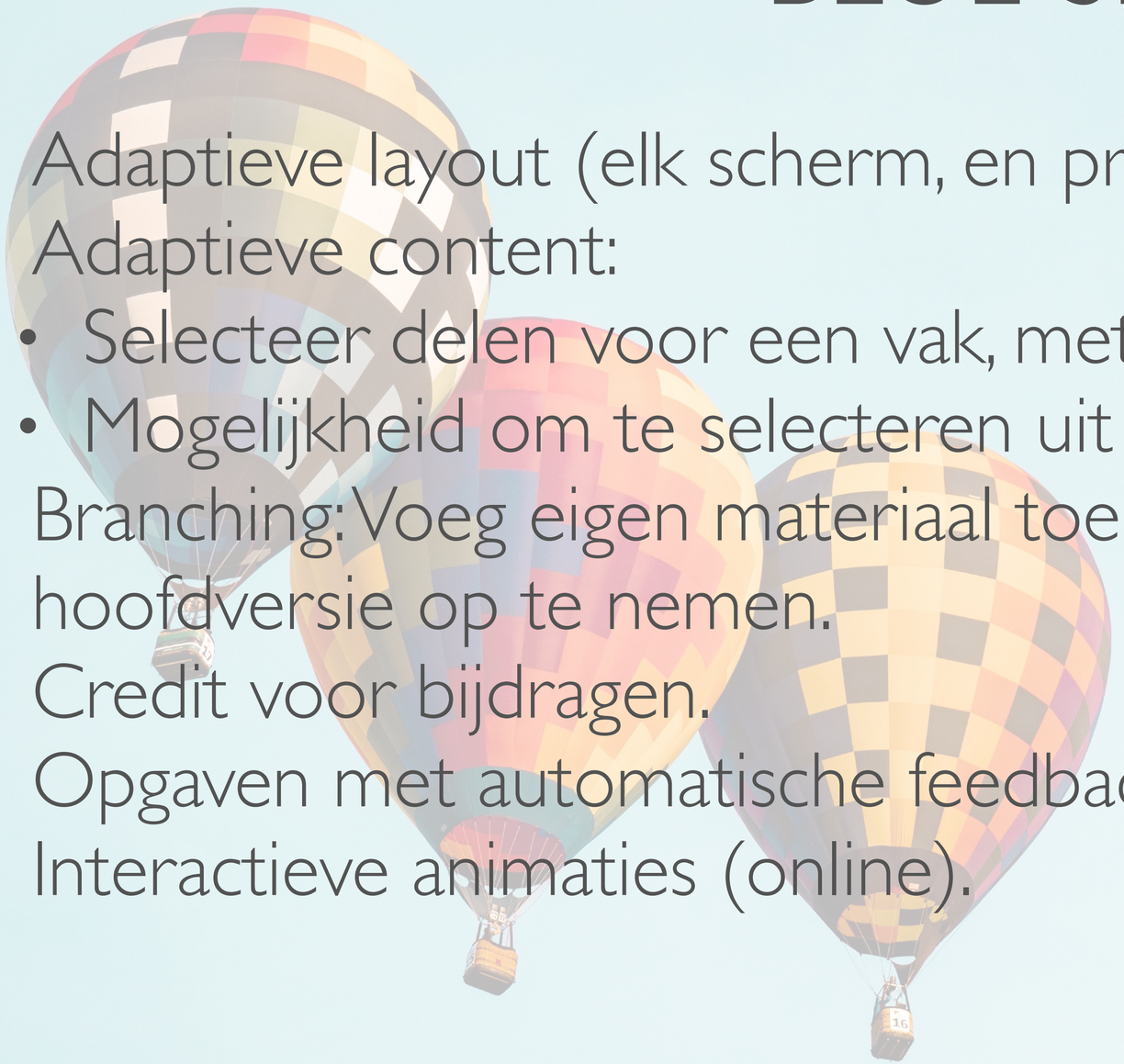

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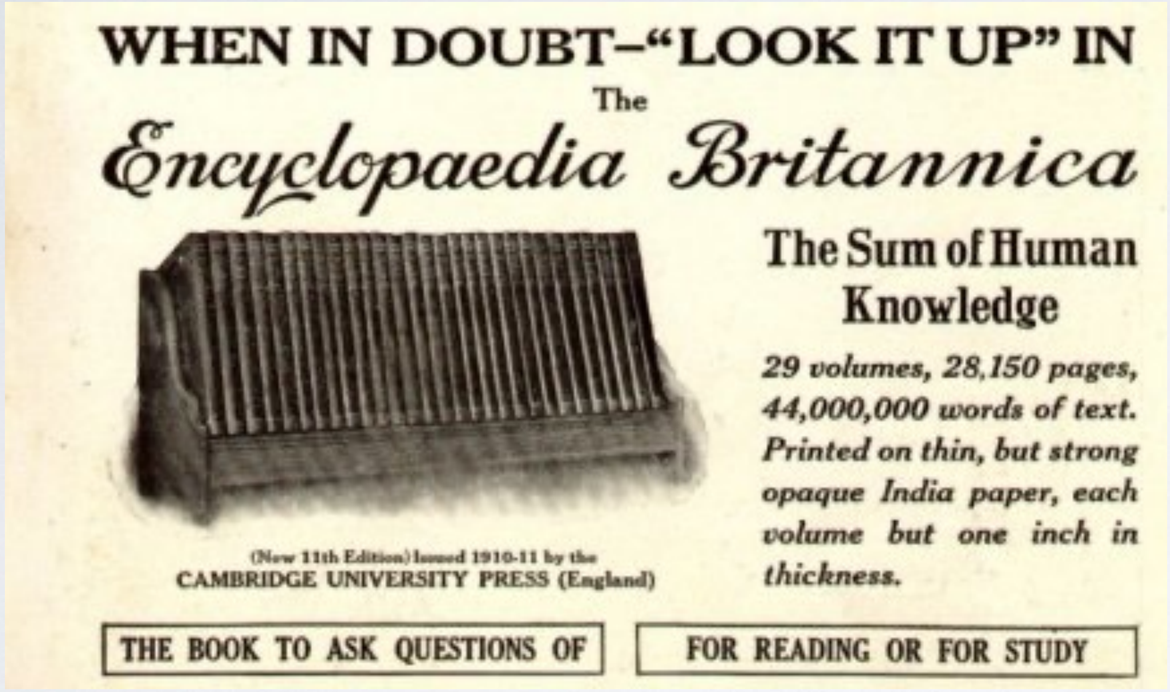
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3. Energy

3.1. Work

How much work do you need to do to move a box? The answer depends on two things: how heavy the box is, and how far you have to move it. Multiply the two, and you've got a good measure of how much work will be required. Of course, work can be done in other contexts as well - pulling a spring from equilibrium, or cycling against the wind. In each case, there's a *force* and a *displacement*. To be fair, we will only count the part of the force that is in the direction of the displacement (when cycling, you don't do work due to the fact that there's a gravitational force pulling you down, since you don't move vertically; you do work because there's a drag force due to your moving through the air). We define *work* as the product of the component of the force in the direction of the displacement, times the displacement itself. We calculate this component by projecting the force vector on the displacement vector, using the dot product (see Section 15.1.1 for an introduction to vector math):

$$W = \mathbf{F} \cdot \mathbf{x}. \tag{3.1}$$

Note that work is a scalar quantity - it has a magnitude but no direction. Work is measured in Joules (J), with one Joule being equal to one Newton times one meter.

Of course the force acting on our object need not be constant everywhere. Take for example the extension of a spring: the further you pull, the larger the force gets, as given by Hooke's law (2.7). To calculate the work done when extending the spring, we chop up the path (here a straight line) into many small pieces. For each piece, we approximate the force by the average value on that piece, then multiply with the length of the piece and sum. In the limit that we have infinitely many pieces, this approximation becomes exact, and the sum becomes an integral: for one dimension, we thus have:

$$W = \int_{x_1}^{x_2} F(x)\mathrm{d}x. \tag{3.2}$$

Likewise, the path along which we move need not be a straight line. If the path consists of multiple straight segments, on each of which the force is constant, we can calculate the total work by adding the work done on the different segments. Taking the limit to infinitely many infinitesimally small segments $\mathbf{dr}$, on each of which the force is given by the value $\mathbf{F}(\mathbf{r})$, the sum again becomes an integral:

$$W = \int_{\mathbf{r}_1}^{\mathbf{r}_2} \mathbf{F}(\mathbf{r}) \cdot \mathrm{d}\mathbf{r}. \tag{3.3}$$

Equation (3.3) is the most general version of the definition of work; it simplifies to (3.2) for movement along a straight line, and to (3.1) if both the path is straight and the force constant[1].

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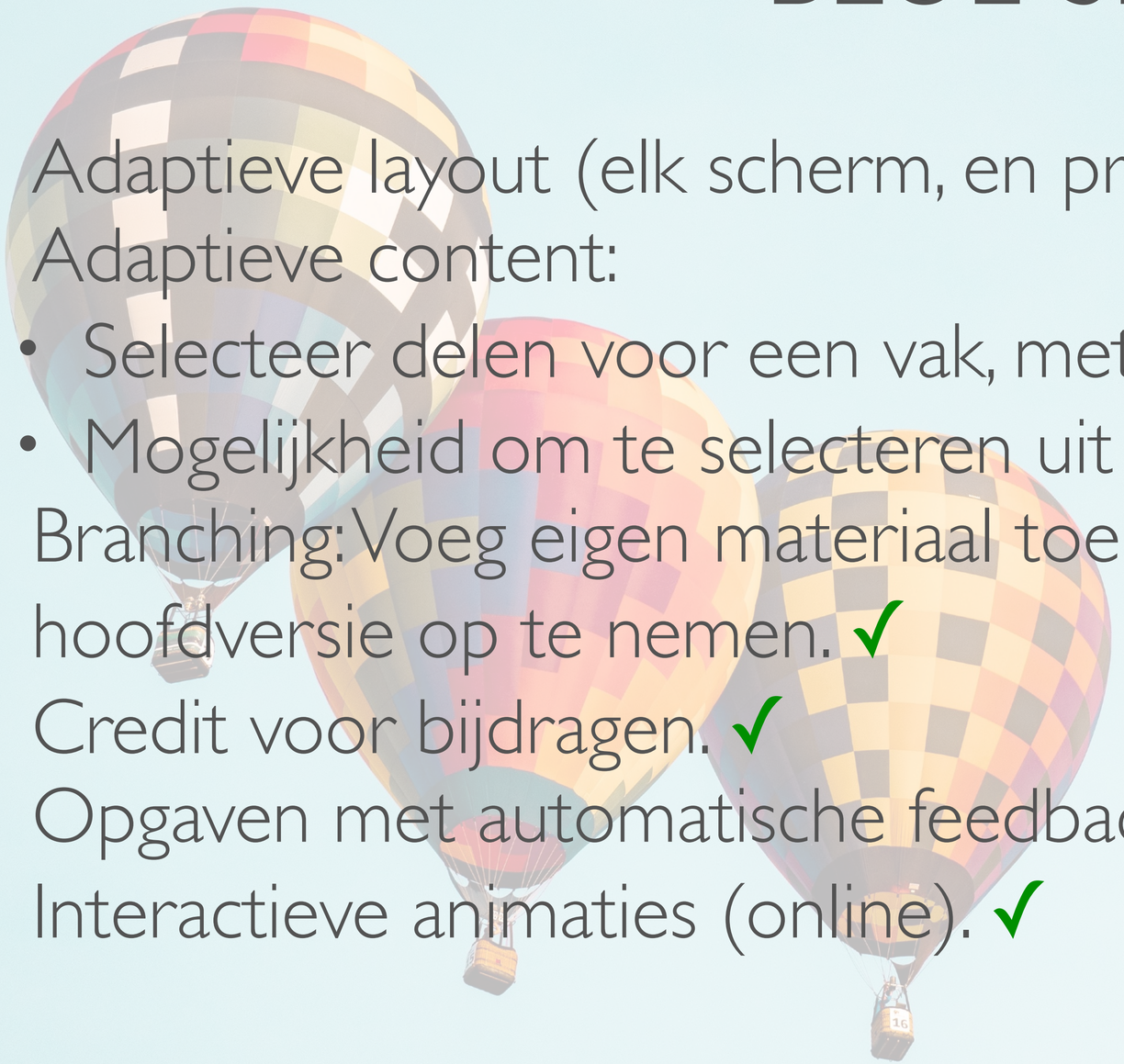

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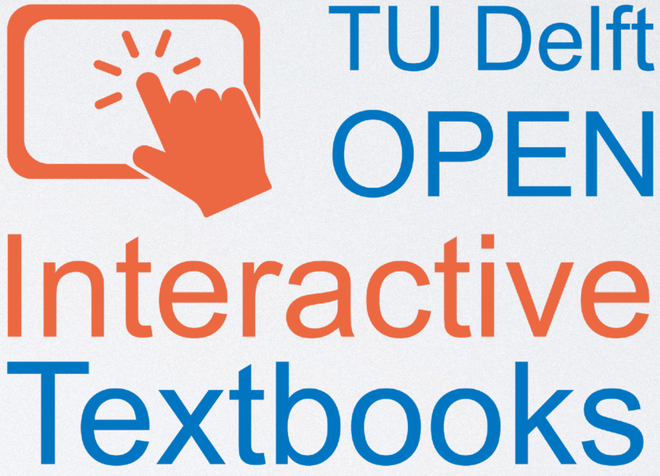

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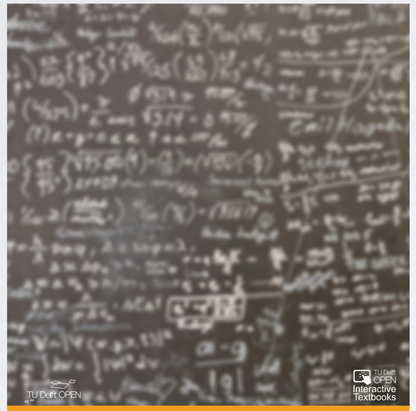

Mathematics for Quantum Physics

Peter Bruin

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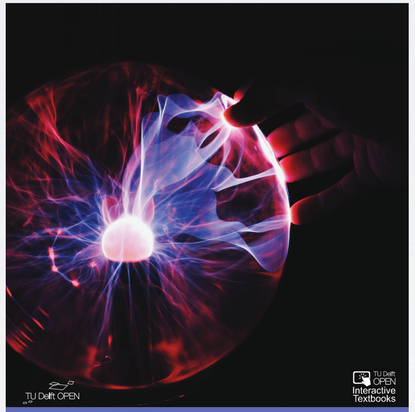

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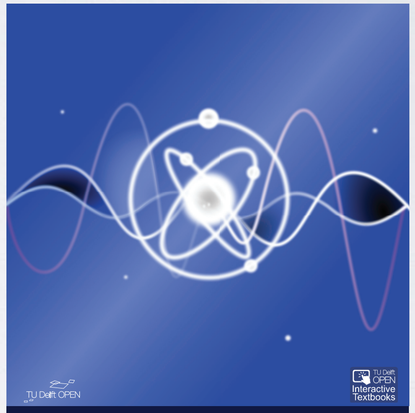
Introduction to particle and continuum mechanics

Timon Idema

9 november



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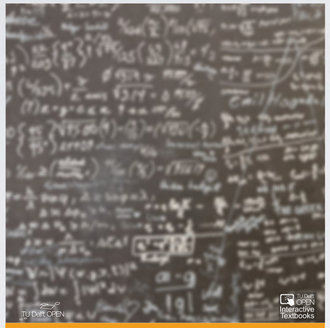

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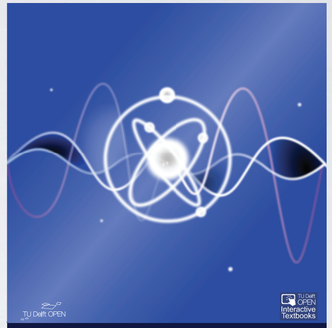

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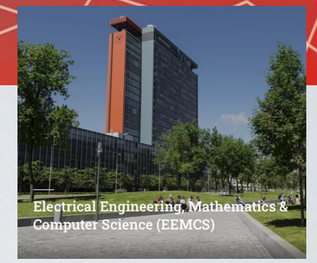

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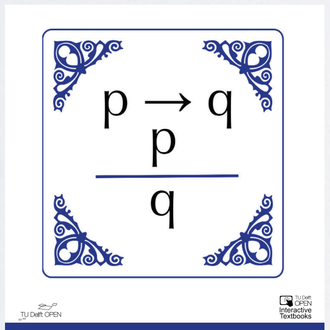

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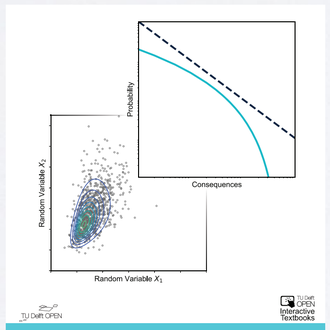

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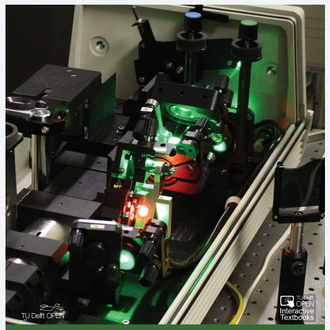

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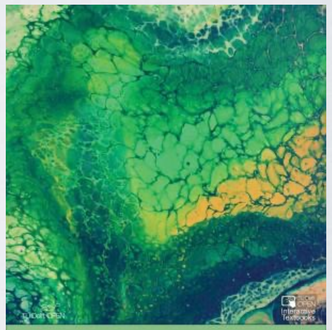

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Ik vind het fijn dat al het lesmateriaal, dus tekst, code, videos en opdrachten op een plek zijn geordend en dat je hiermee op verschillende manieren de lesstof kunt verwerken. Een combinatie van deze verschillende componenten is dan denk ik ook mijn "preferred learning material", met de meeste voorkeur voor videos. --- Nanobiology & Computer Science student

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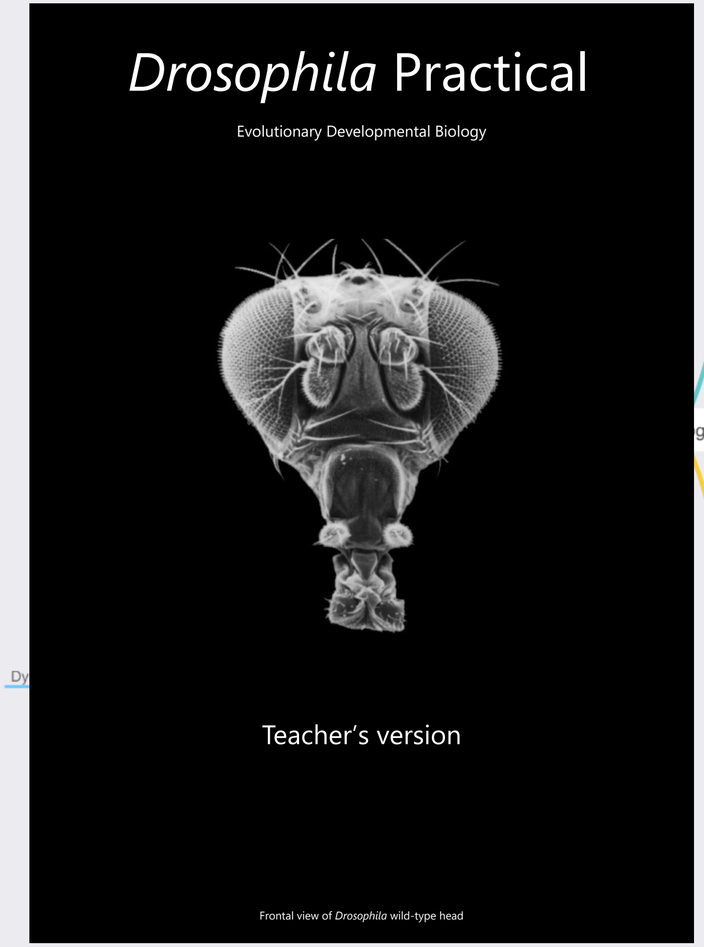

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