Zur Funktion von Bildern und Visualisierungen im Physikunterricht

München, 15.10.2020

Bilder

- **90 % der Informationen laufen über die Augen**

- **Augen 10 000 000 Bit/Sek - Nase 20 Bit/Sek**

- **Allerdings nur 16 Bit/Sek erreichen das Bewusstsein**

(Holzinger, 2000)

Techniken gefordert
– auch im Umgang mit Lehr-Lern-Medien

Visualisierungen im Physikunterricht

1. **Visual Literacy**
2. **Visualisierungen (3 +1 Arten)**
3. **Didaktische Funktionen**
4. **Anforderungen für effektives Lernen**

Visual literacy

"die erlernte Fähigkeit,

visuelle Botschaften zutreffend zu interpretieren

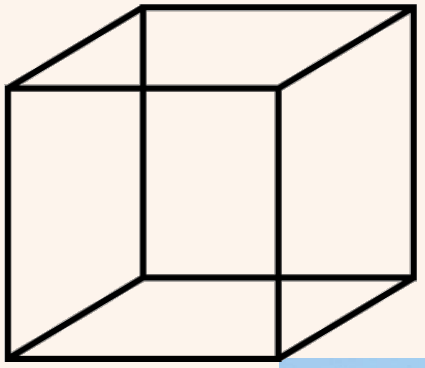
und solche Botschaften selbst herstellen zu können"

Pettersson, R. (1994). Visual Literacy und Infologie.
In B. Weidenmann (Hrsg.), Wissenserwerb mit Bildern. S. 215-235. Bern: Verlag Hans Huber.

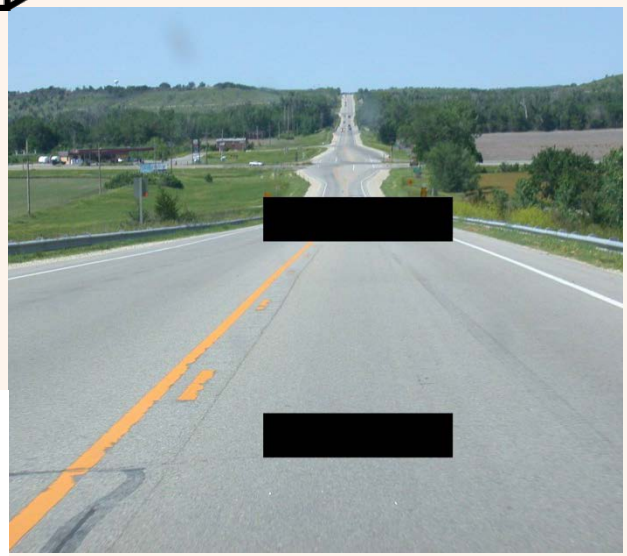
Visual literacy

Visual literacy

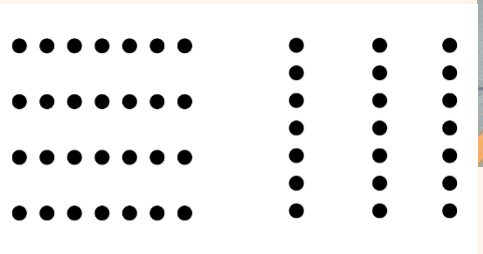
- 1. Trennung von Hintergrund und Figuren



- 2. Wiedererkennen von Mustern



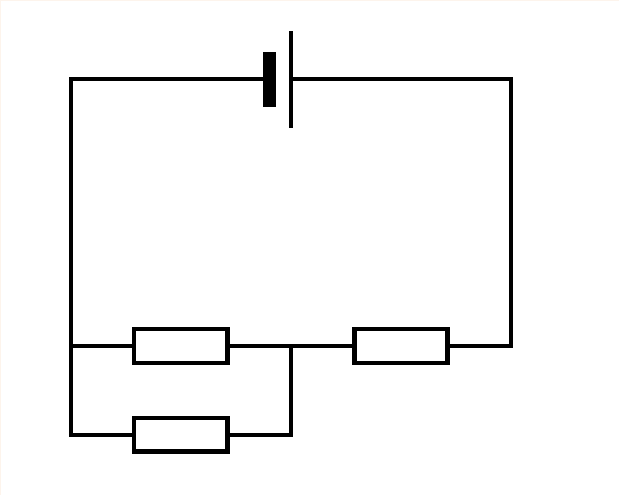
- 3. Perspektive / Größenverhältnisse



- 4. Gruppenrelationen

Visual literacy

- Symbole verstehen



- Daten auslesen

- Interpretieren können

Kompetenzen

Kompetenzbereiche im Fach Physik ***(KMK 2004)***

Fachwissen	Physikalische Phänomene, Begriffe, Prinzipien, Fakten, Gesetzmäßigkeiten kennen und Basiskonzepten zuordnen
Erkenntnisgewinnung	Experimentelle und andere Untersuchungsmethoden sowie Modelle nutzen
Kommunikation	Informationen sach- und fachbezogen erschließen und austauschen
Bewertung	Physikalische Sachverhalte in verschiedenen Kontexten erkennen und bewerten

Arten von Visualisierungen

A) Abbilder oder Abbildungen

B) Analogiebilder

C) Logische Bilder

D) Dynamische Visualisierungen

Techniken - Anforderungen

Arten von Visualisierungen

A) Abbilder oder Abbildungen

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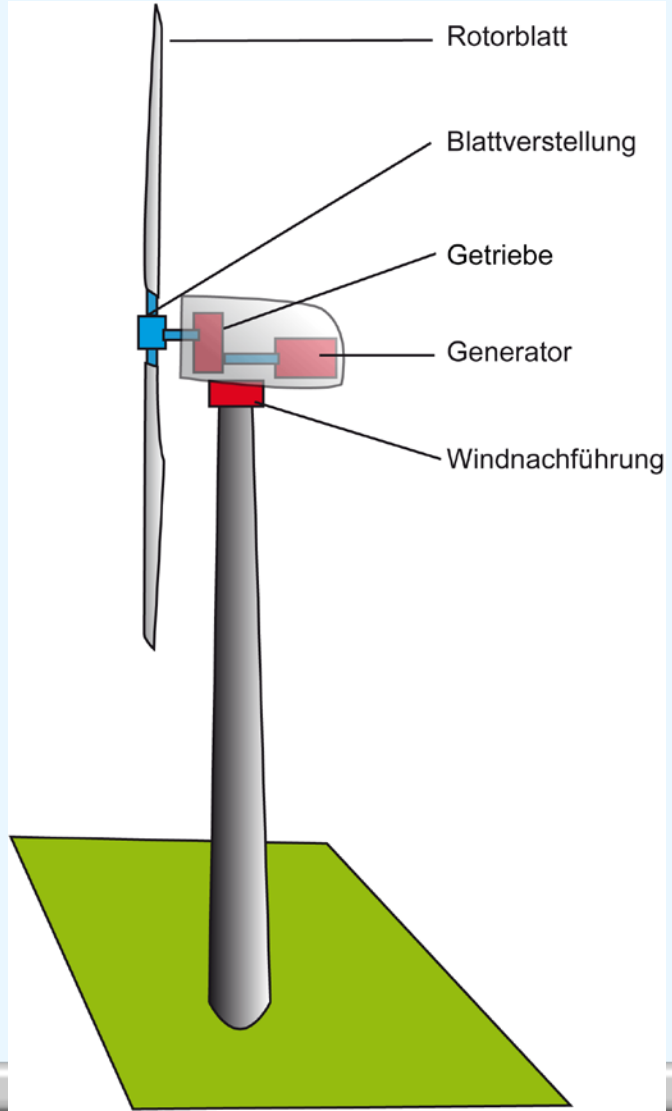

Arten von Visualisierungen

B) Analogiebilder

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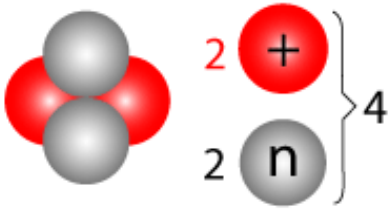
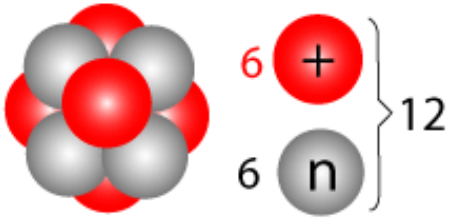


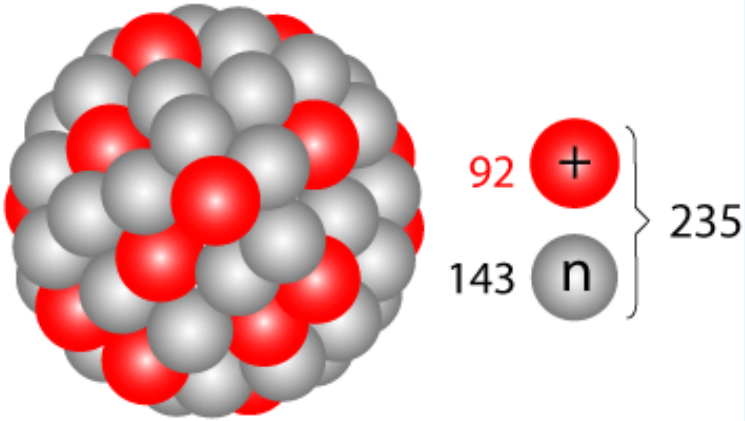
$^{4}_{2}He$

Kern eines Heliumatoms



$^{12}_{6}C$

Kern eines Kohlenstoffatoms

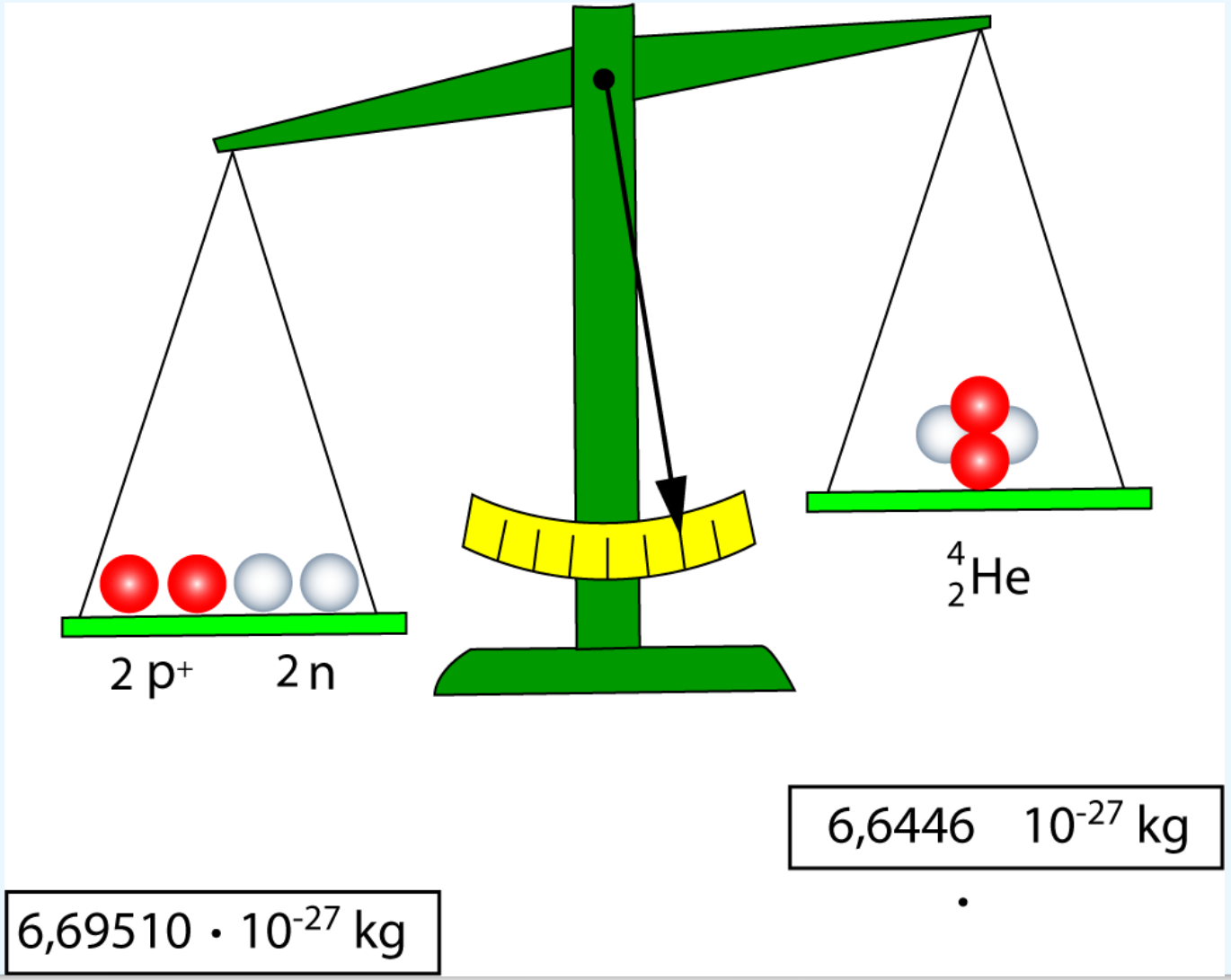


$^{235}_{92}U$

Kern eines Uranatoms

Arten von Visualisierungen

B) Analogiebilder



Arten von Visualisierungen

C) Logische Bilder

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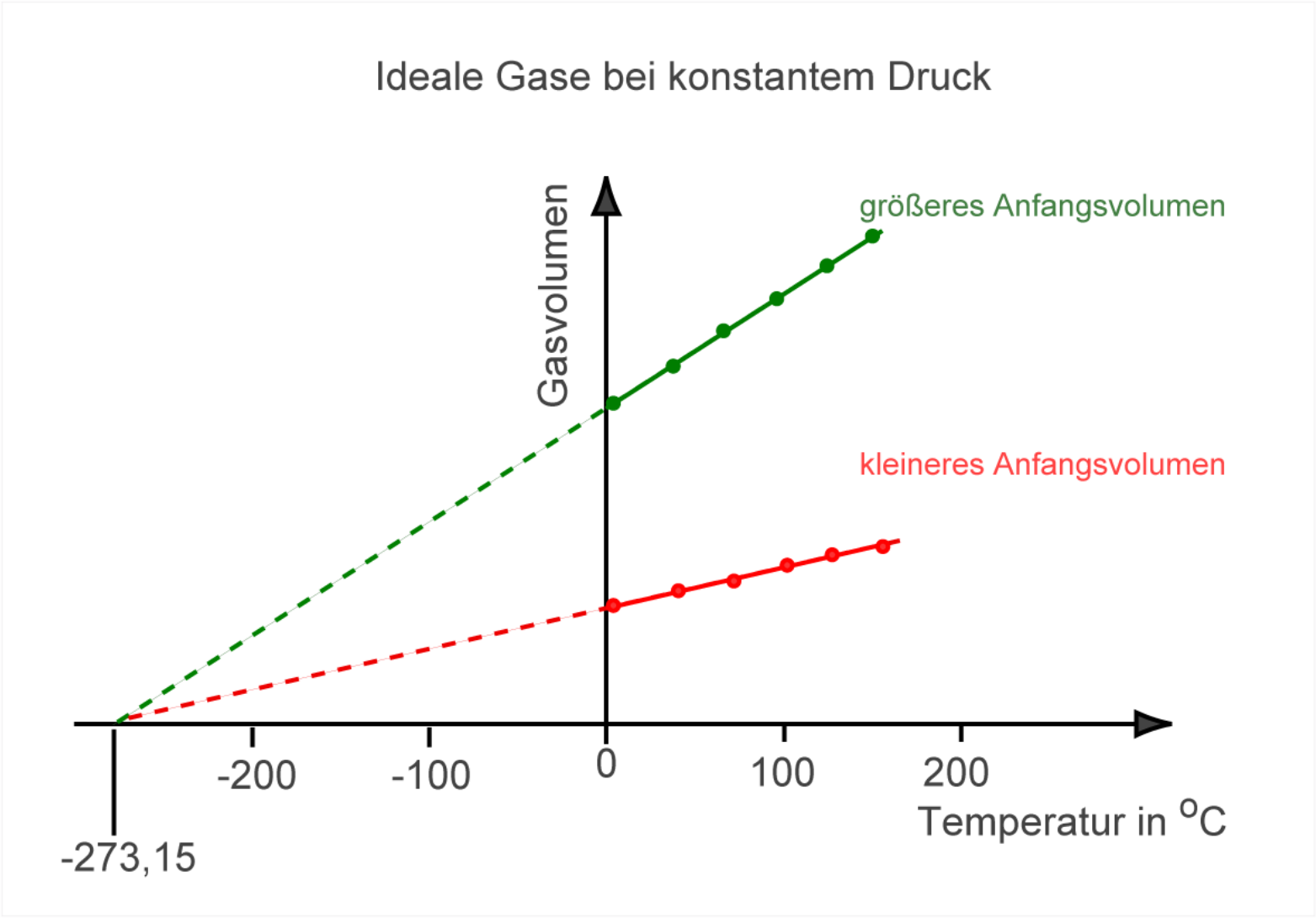

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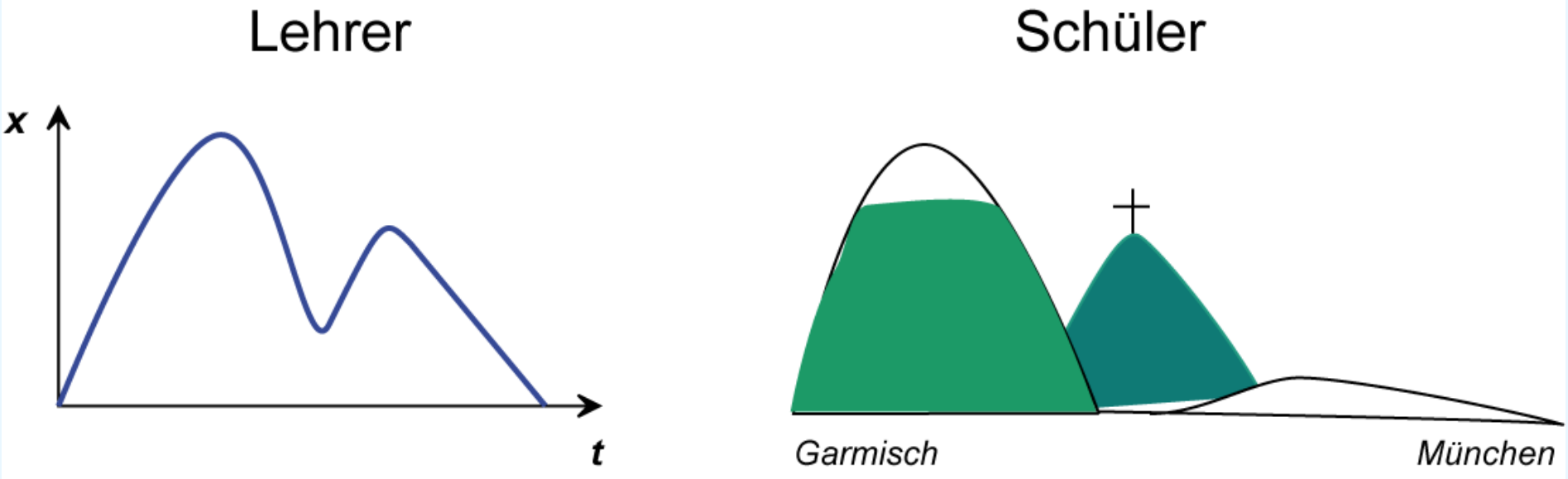
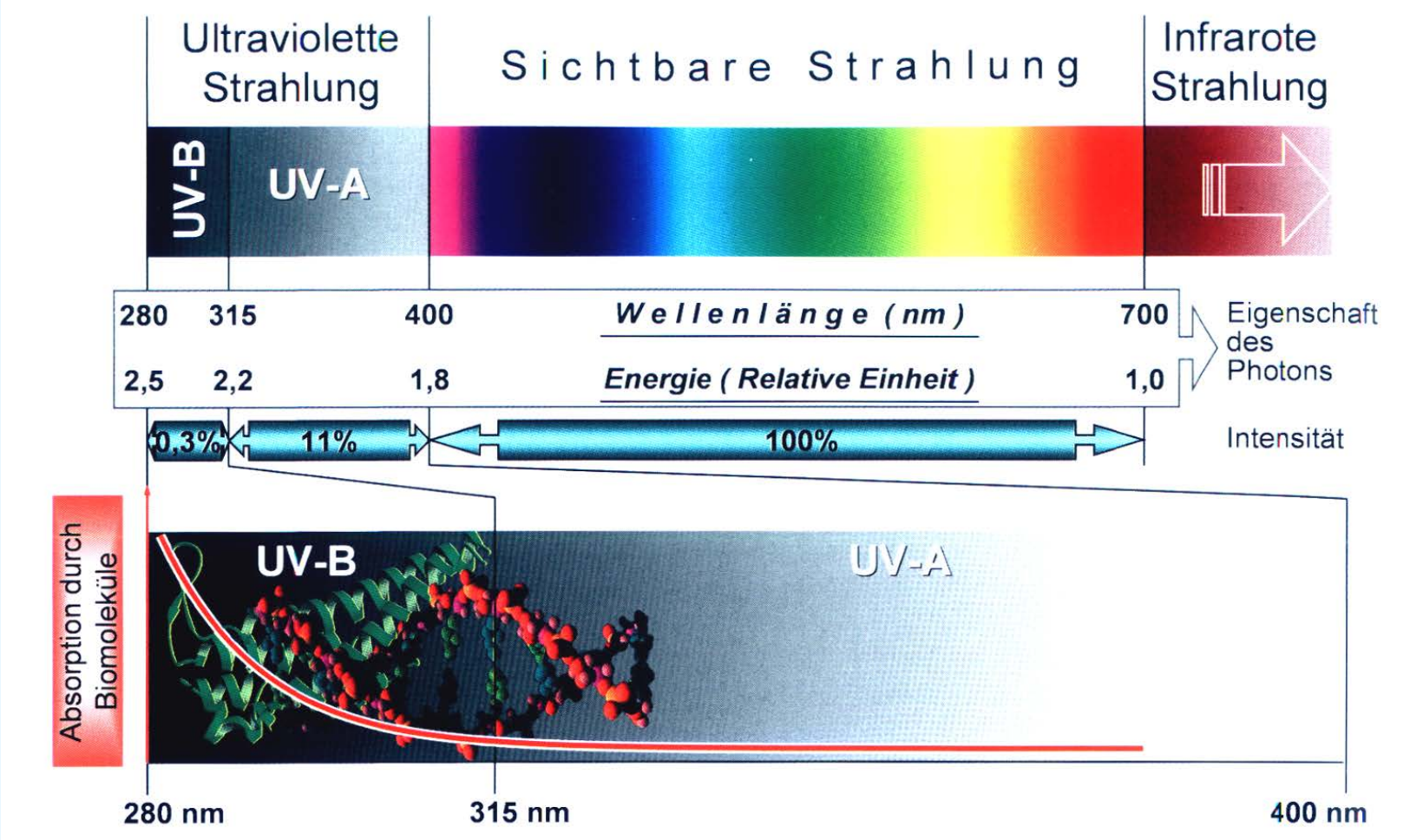


Infografiken

Arten von Visualisierungen

D) Infografiken



Arten von Visualisierungen

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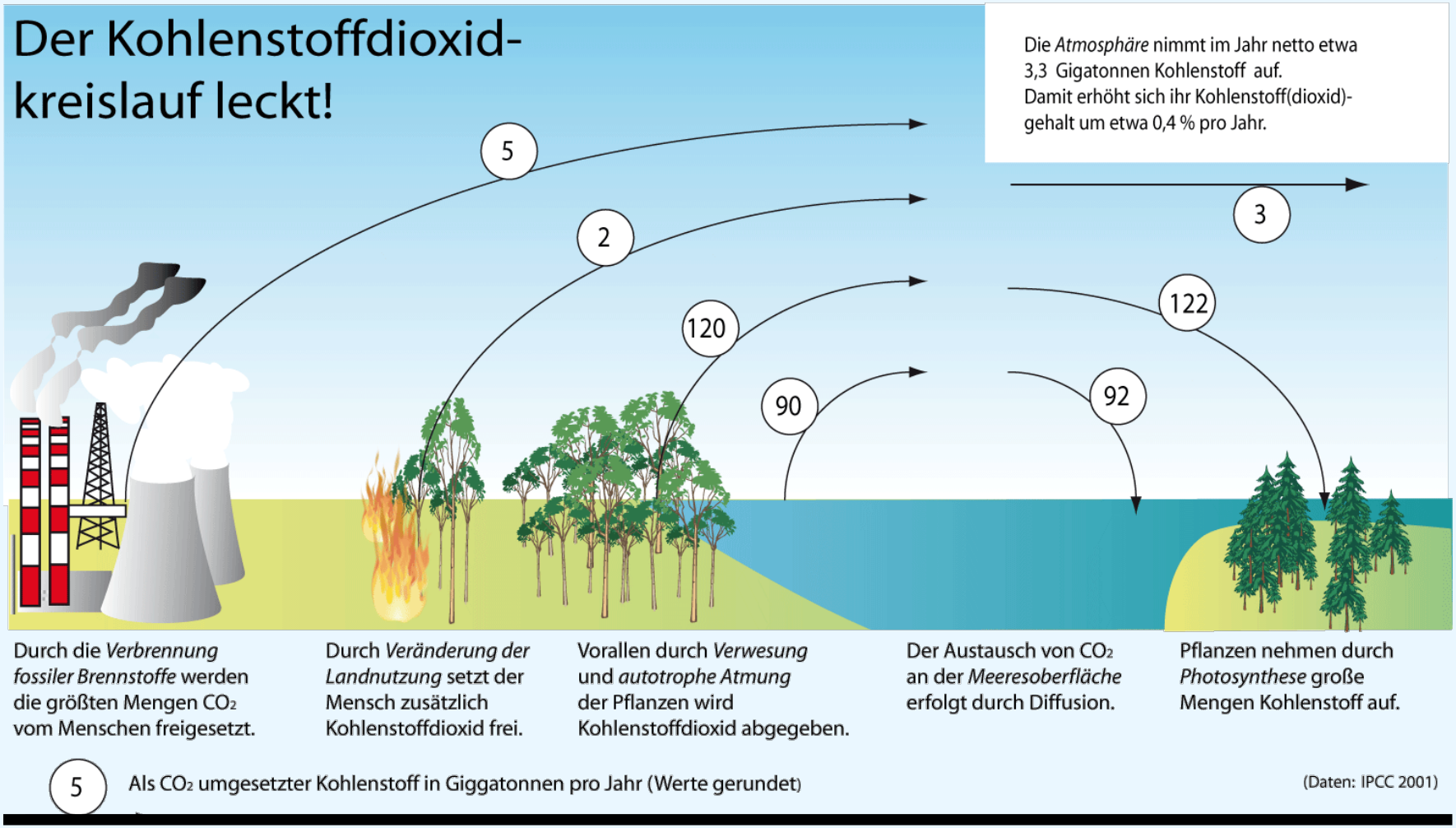
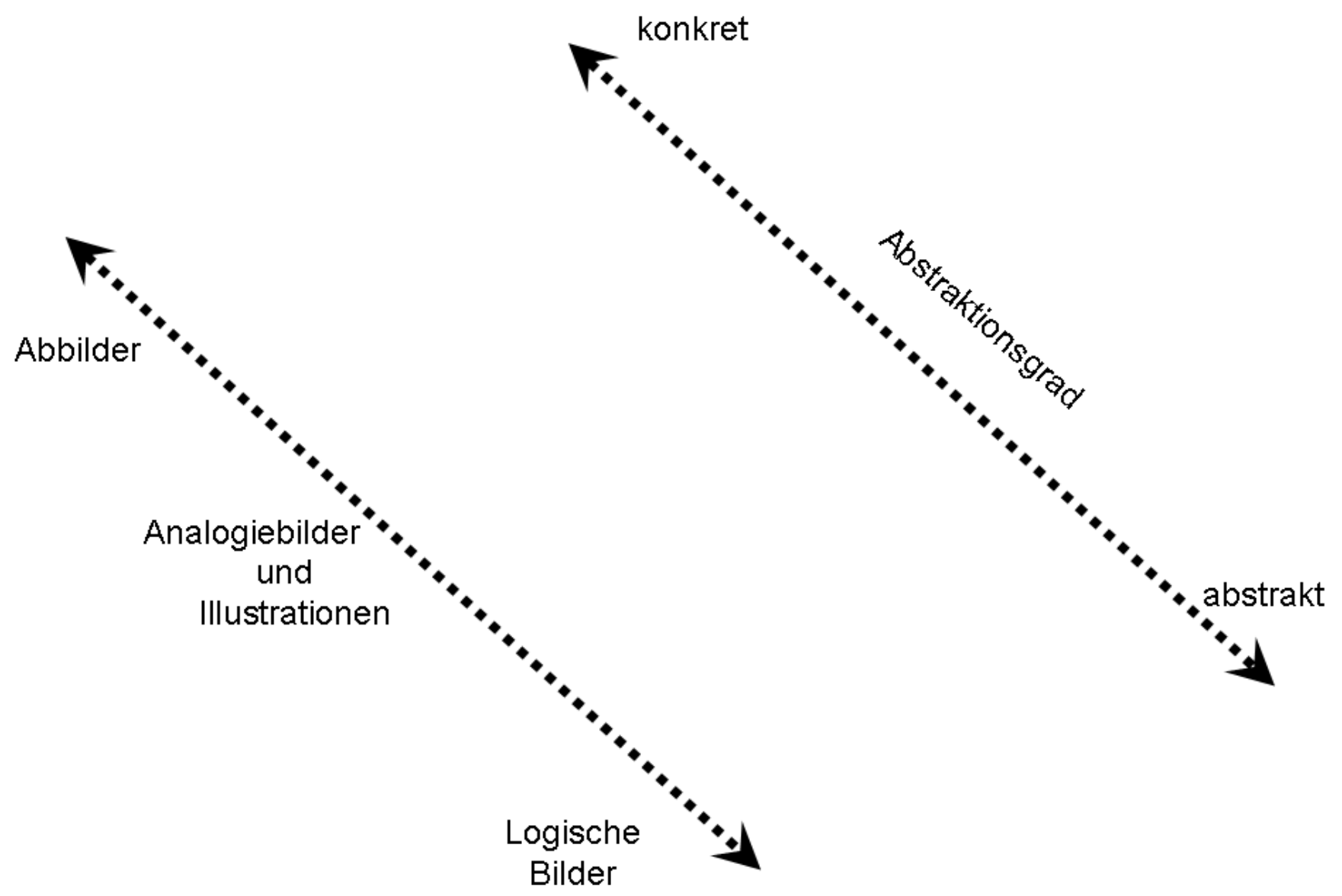


Funktionen aus didaktischer und methodischer Sicht

8 Funktionen



1. Blickfang / Interesse

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2. Kontext / Bezugsrahmen

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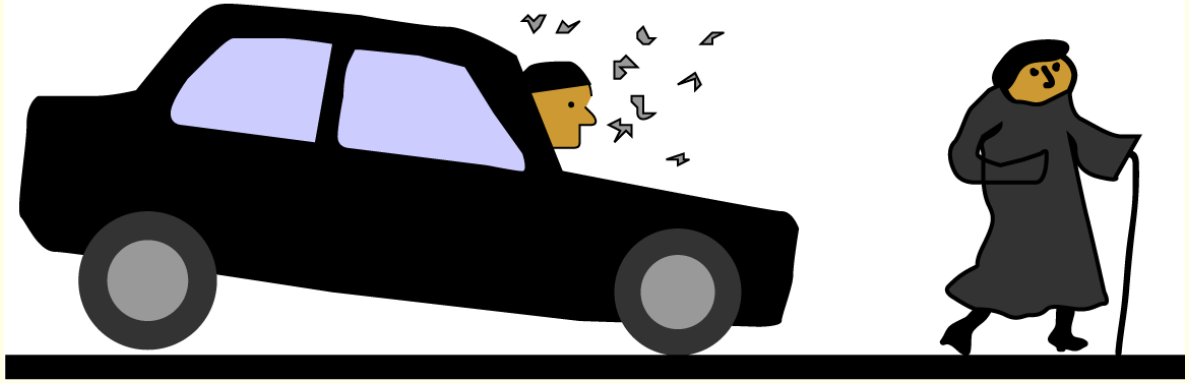

2. Kontext / Bezugsrahmen

3. Zeigefunktion

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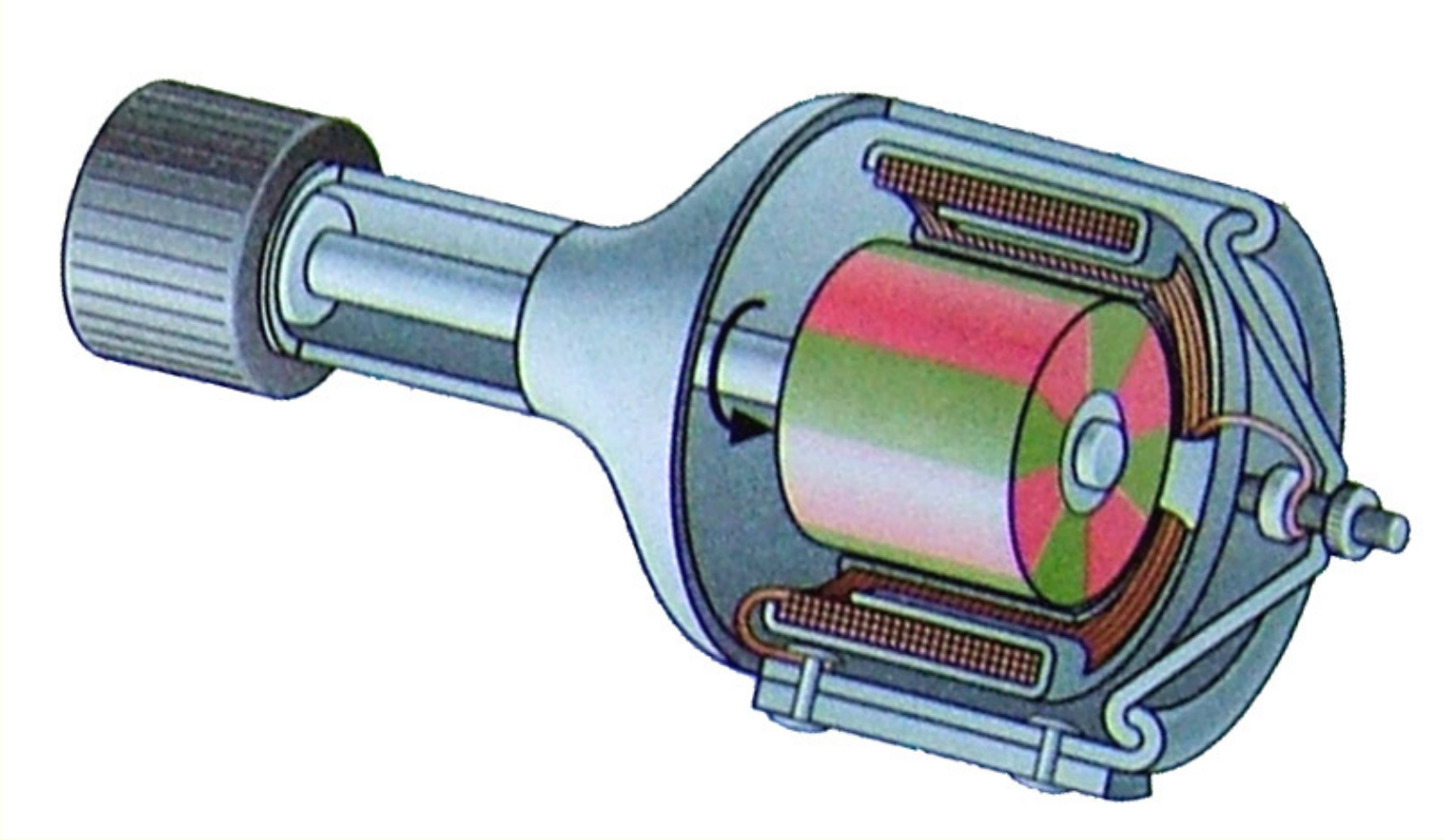

Abb.: Schnittzeichnung zu einem Generator. (Dorn Bader, 2001) Physik.

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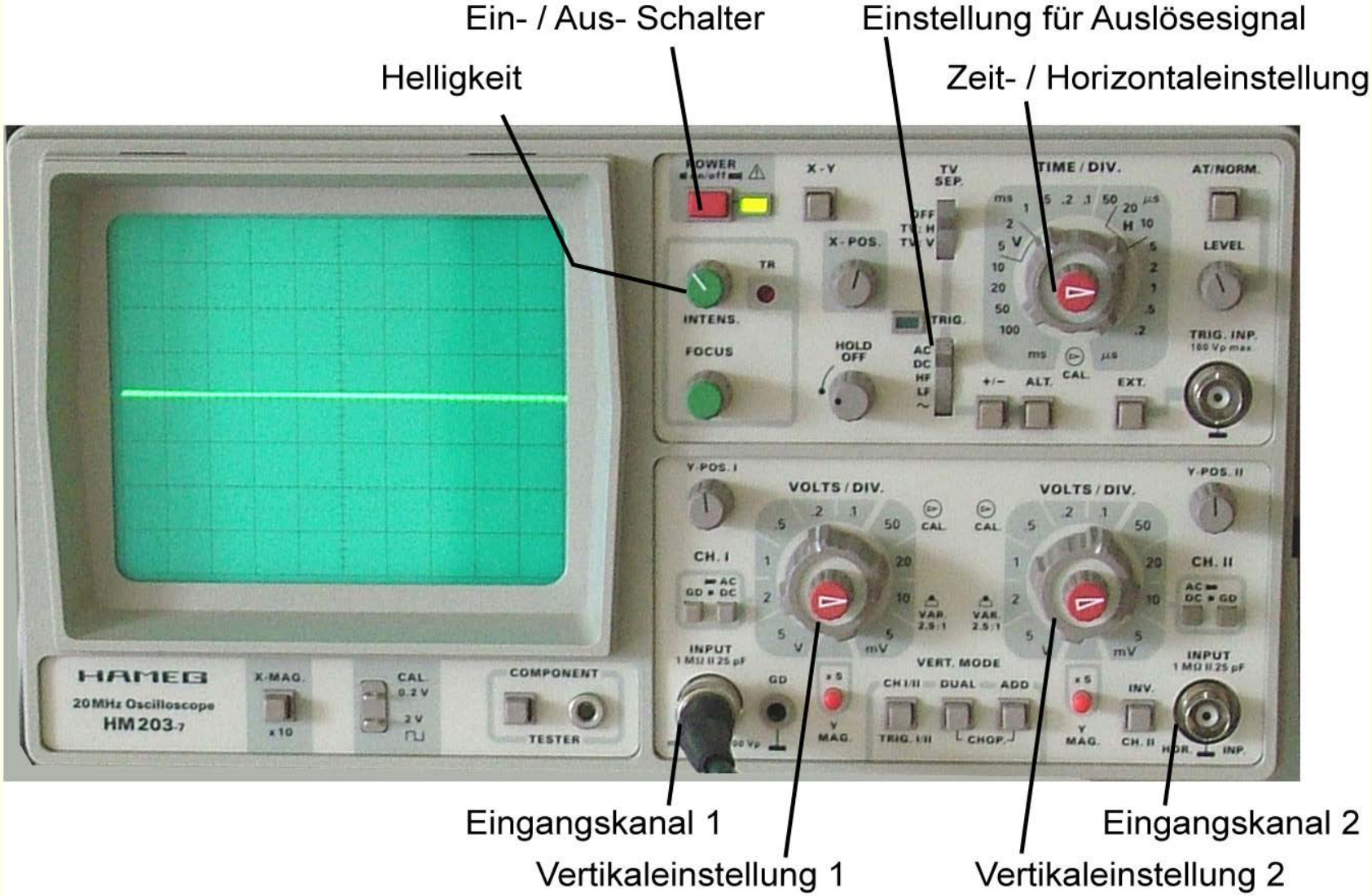

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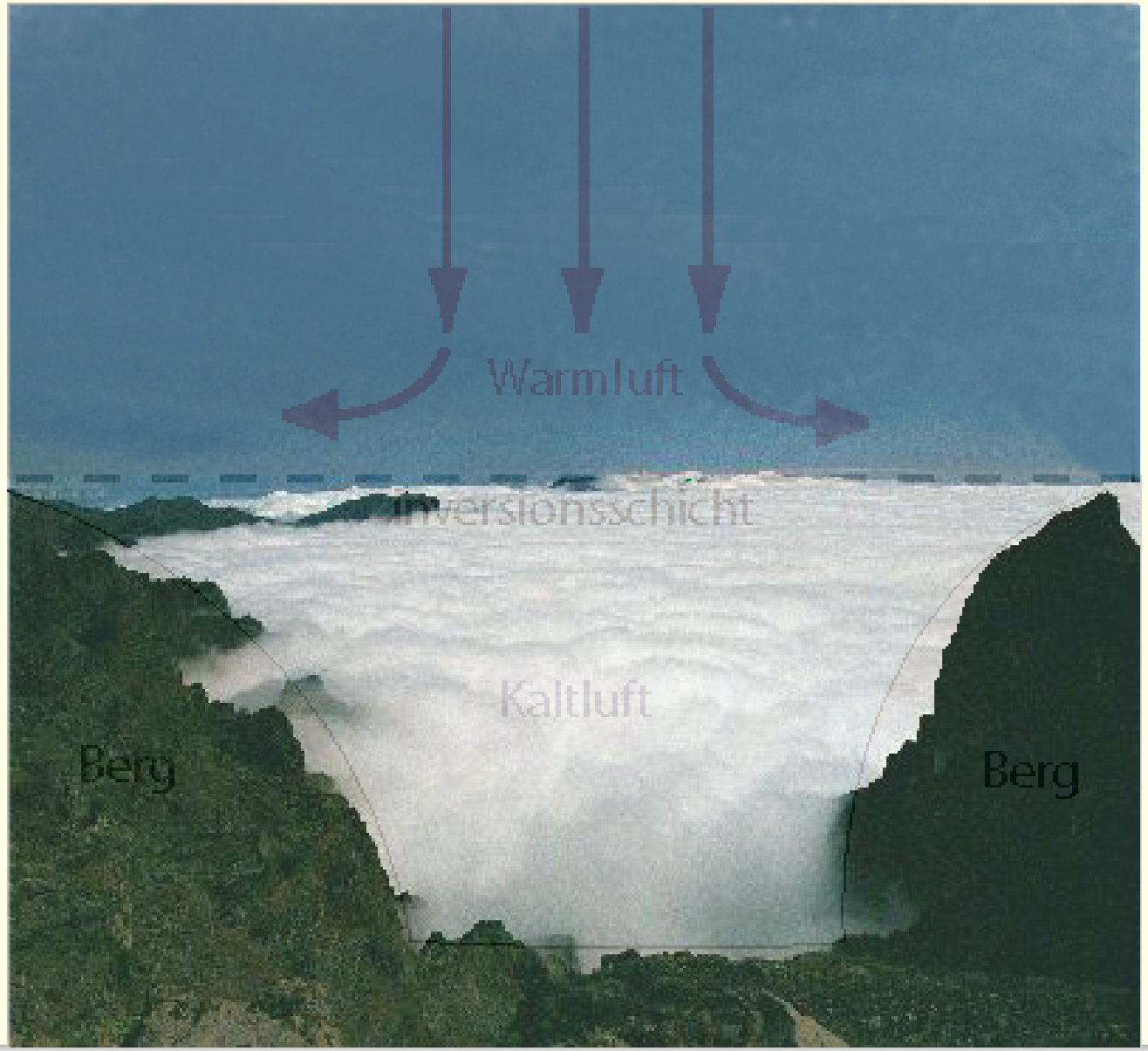

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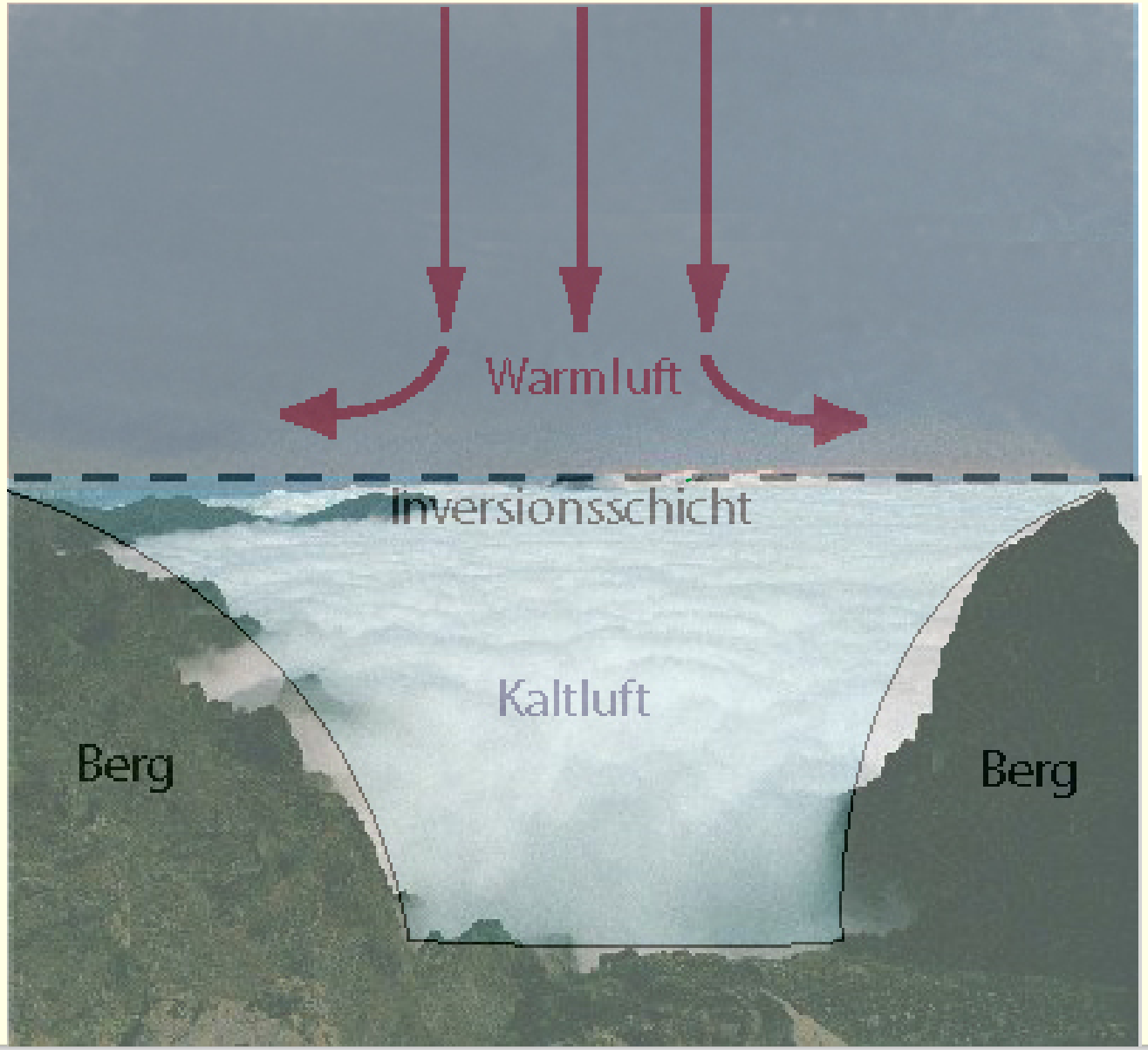

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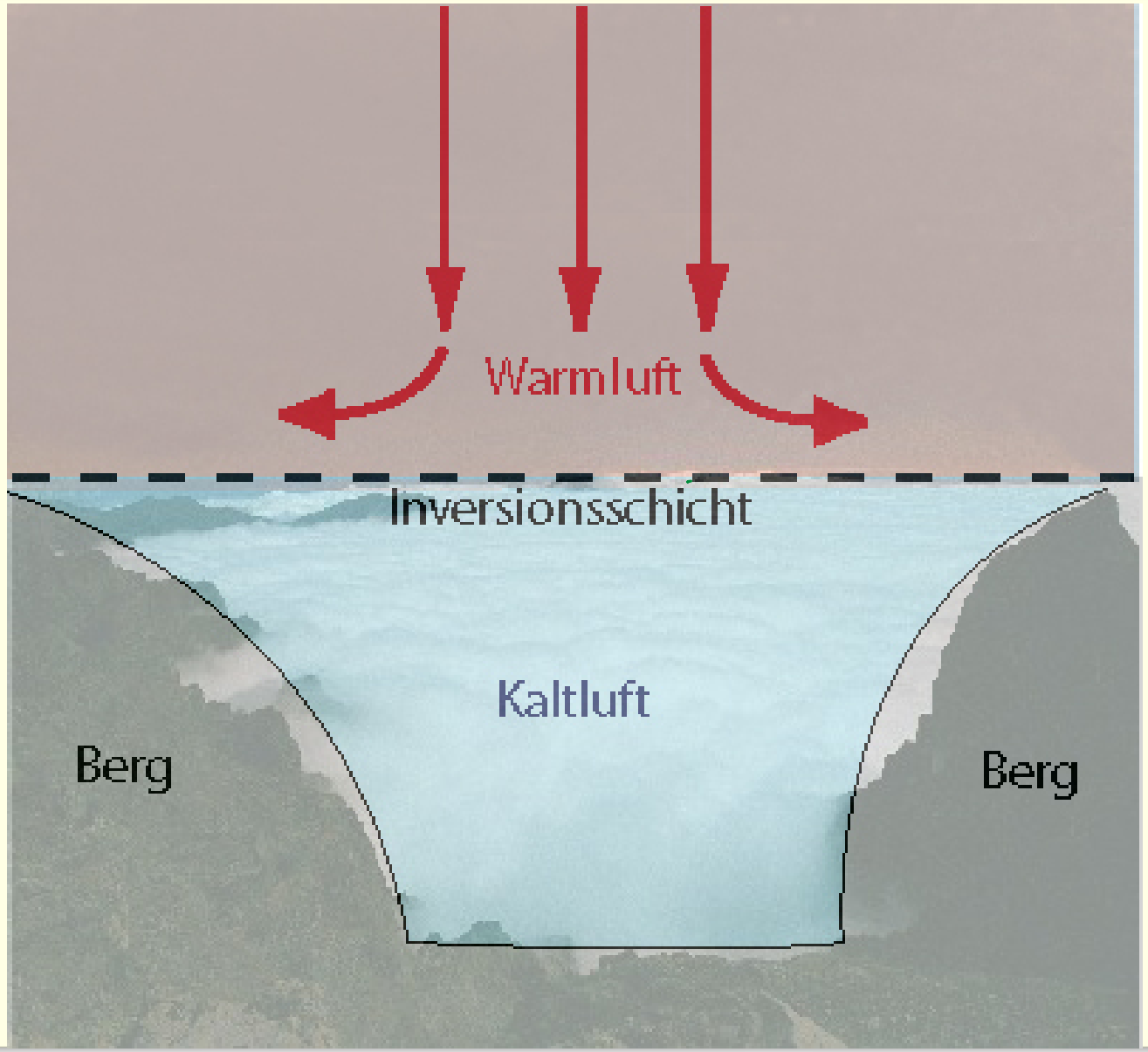

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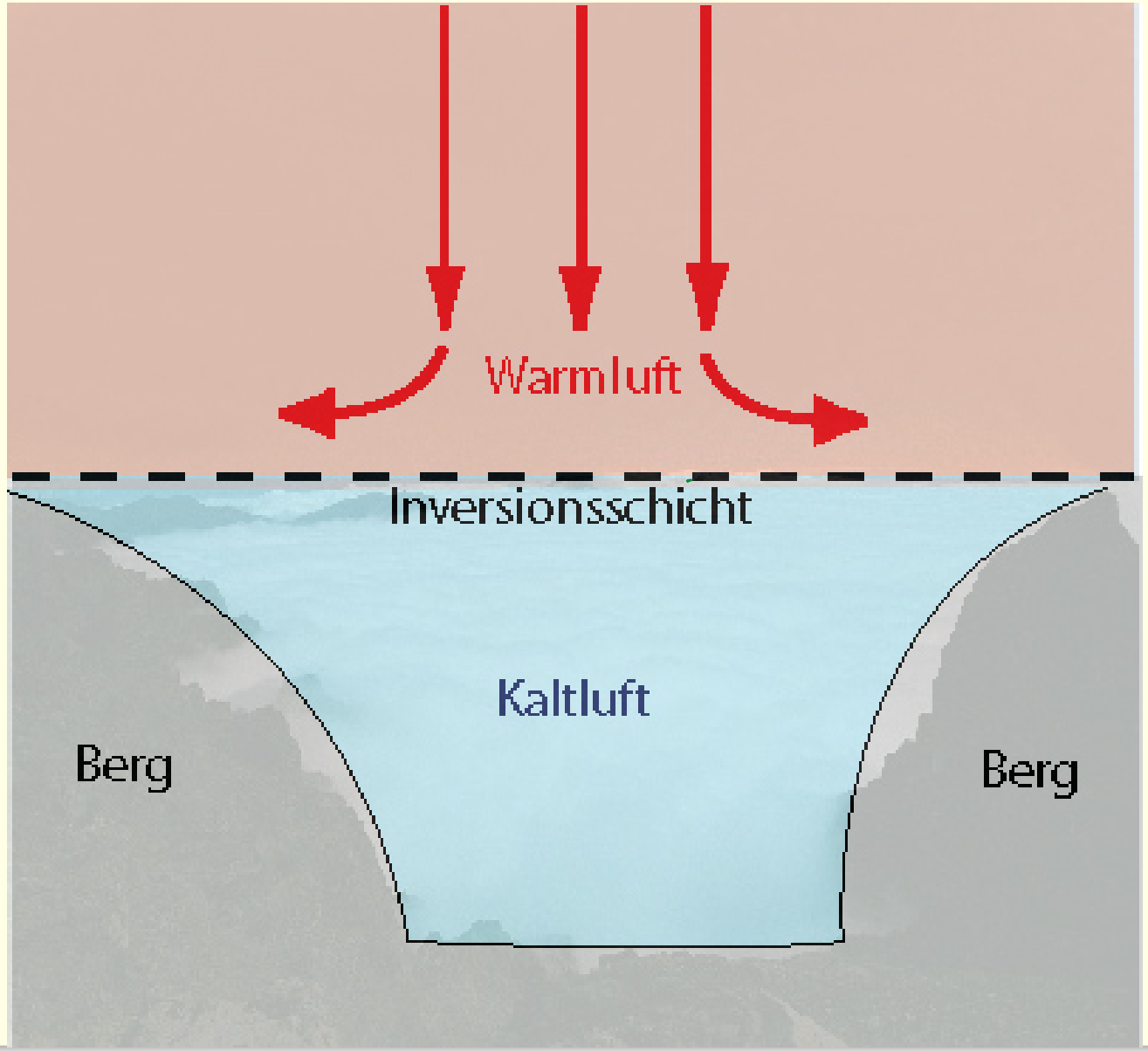

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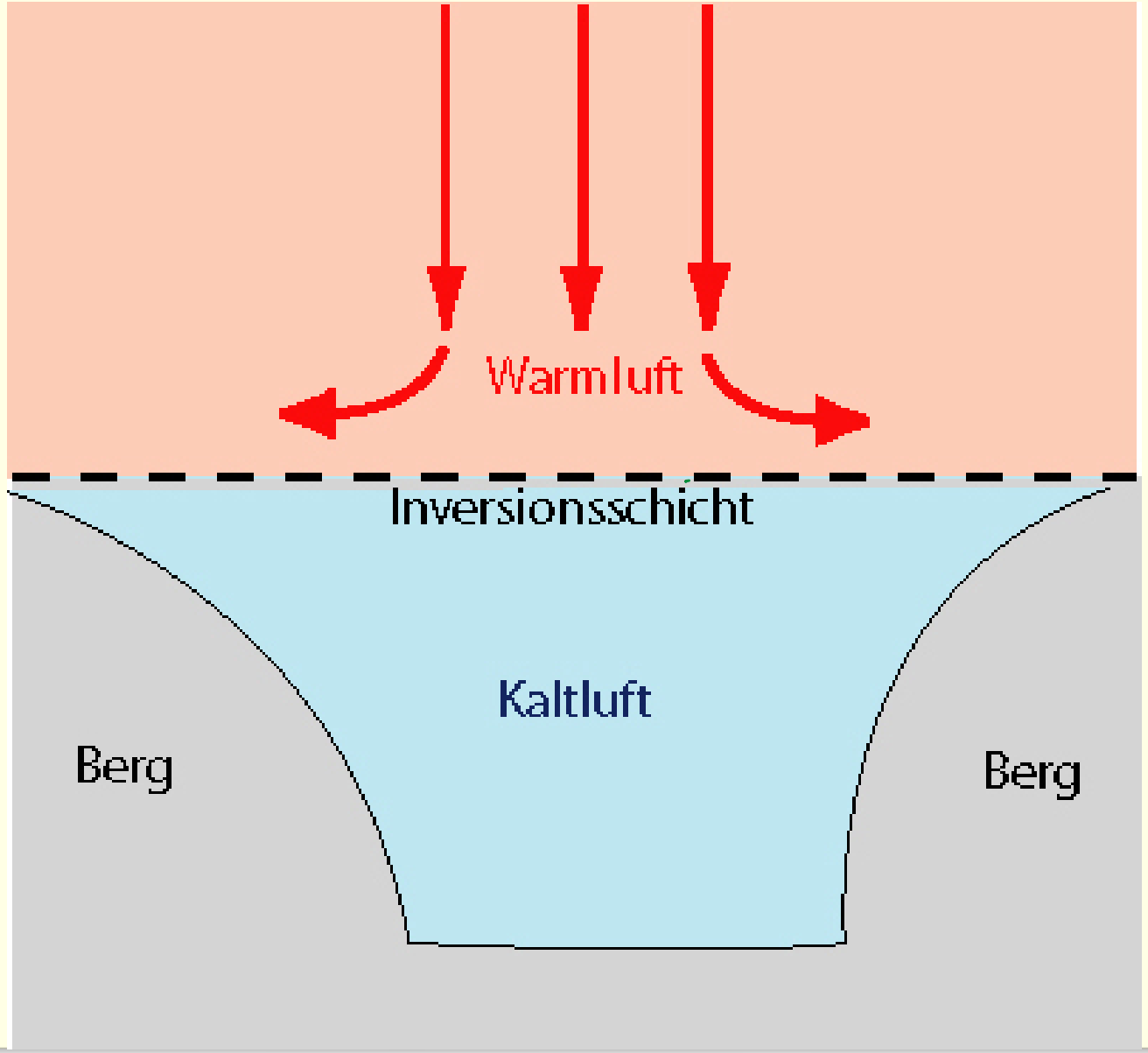

4. Veranschaulichen

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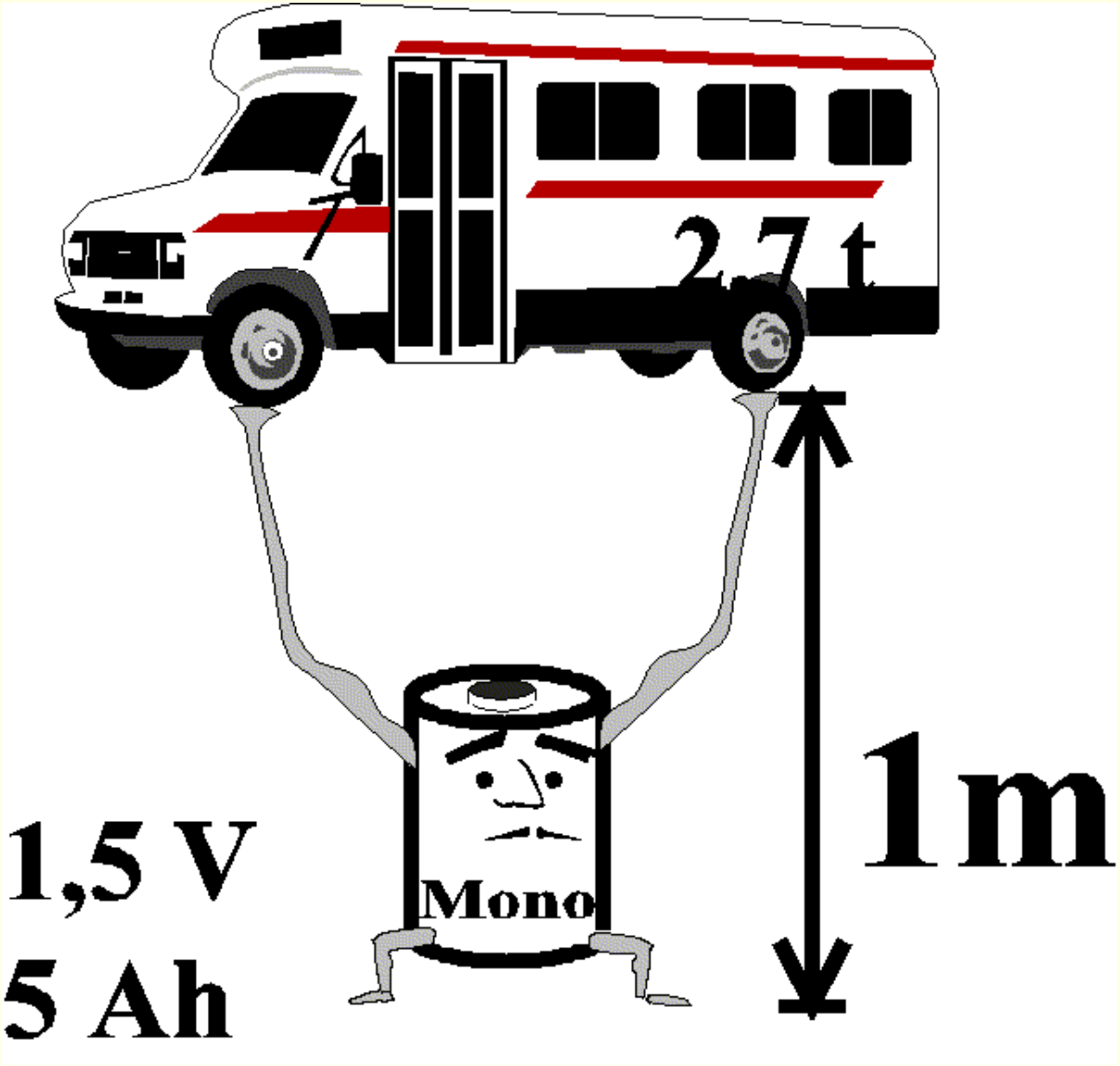

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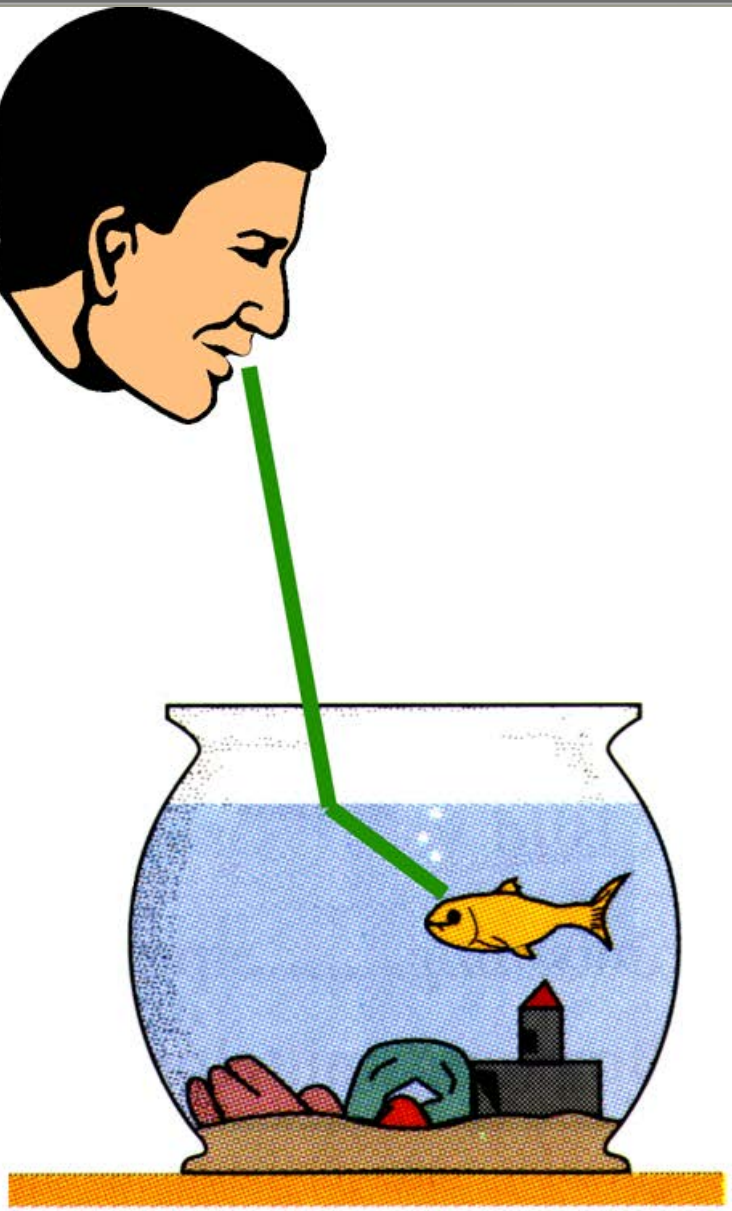

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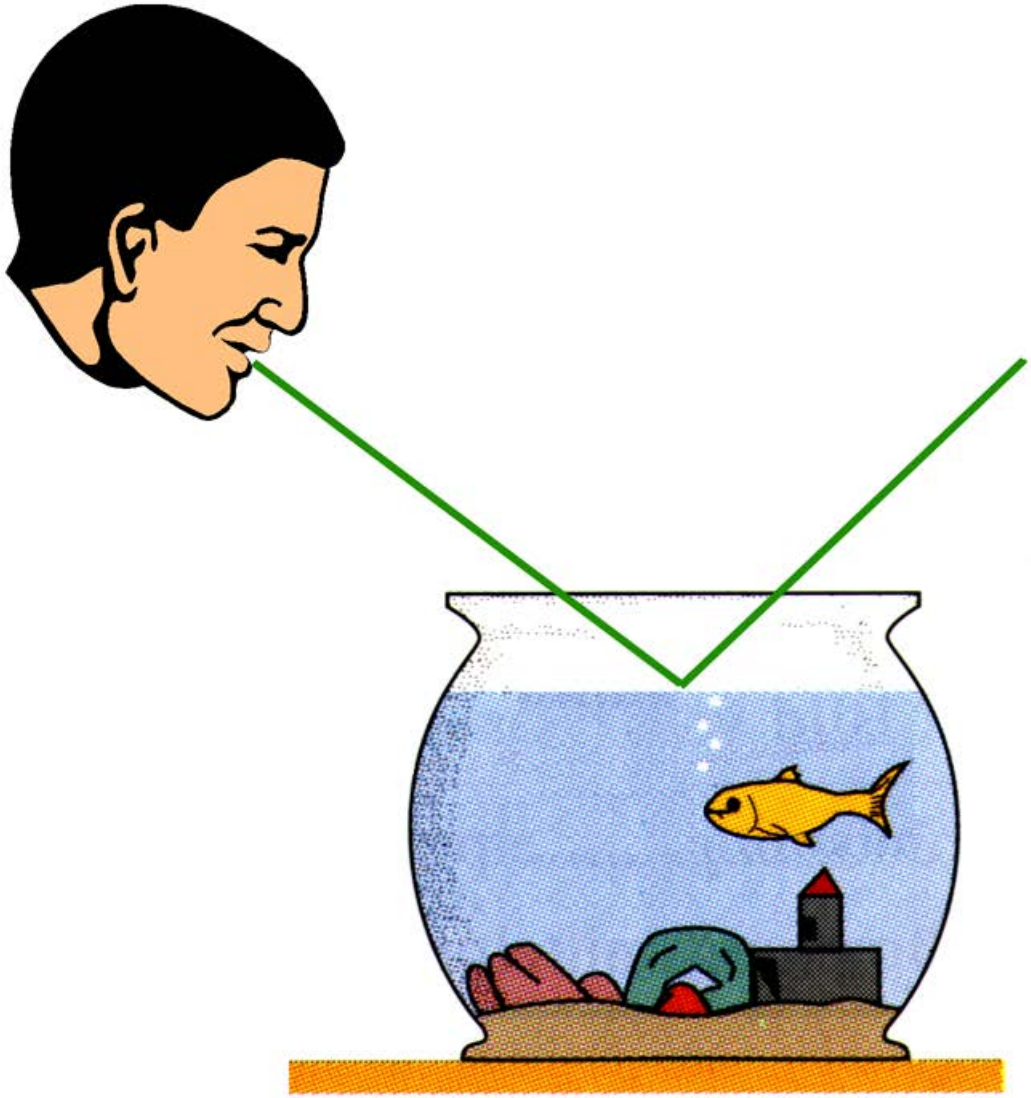

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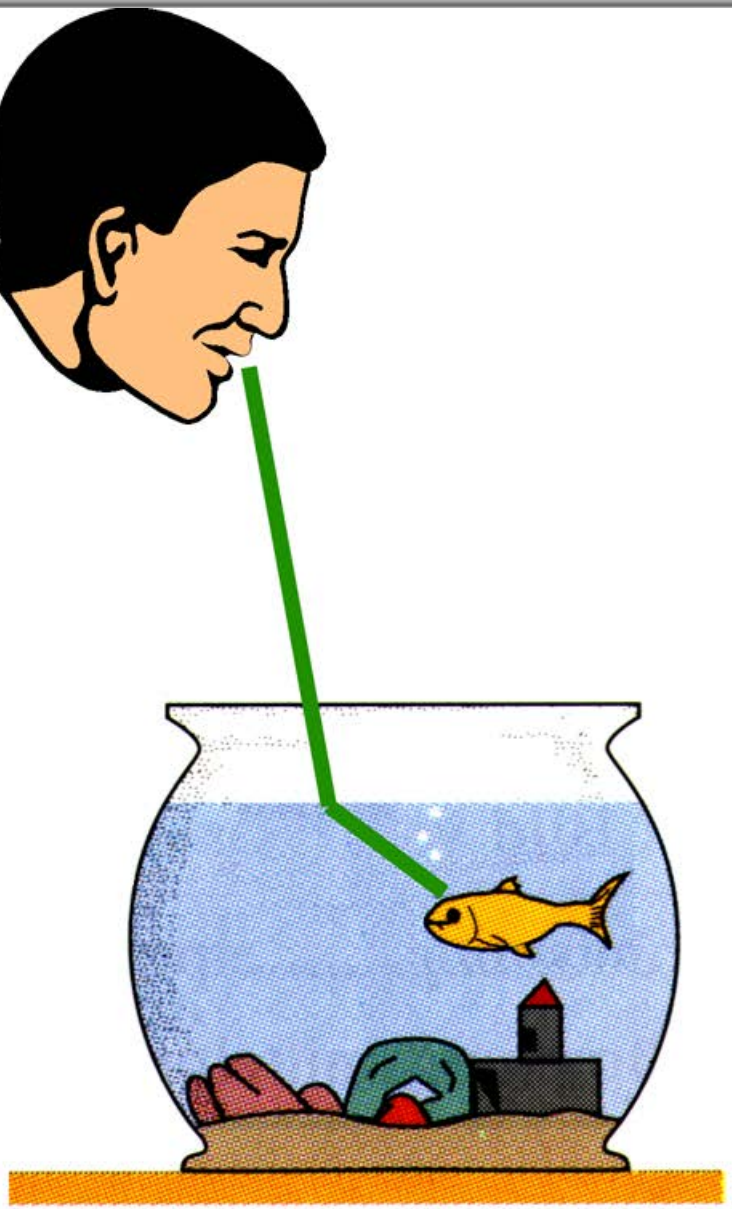

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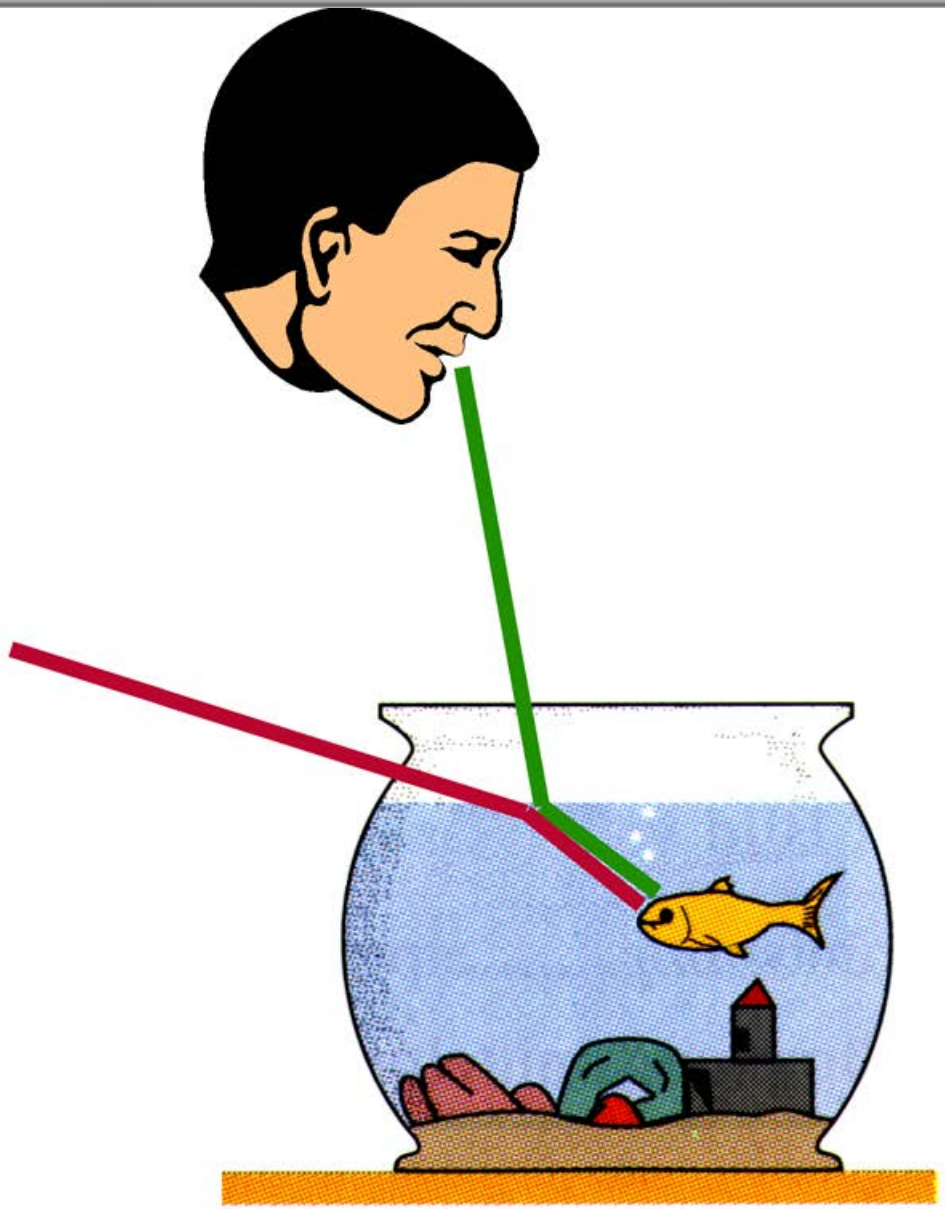

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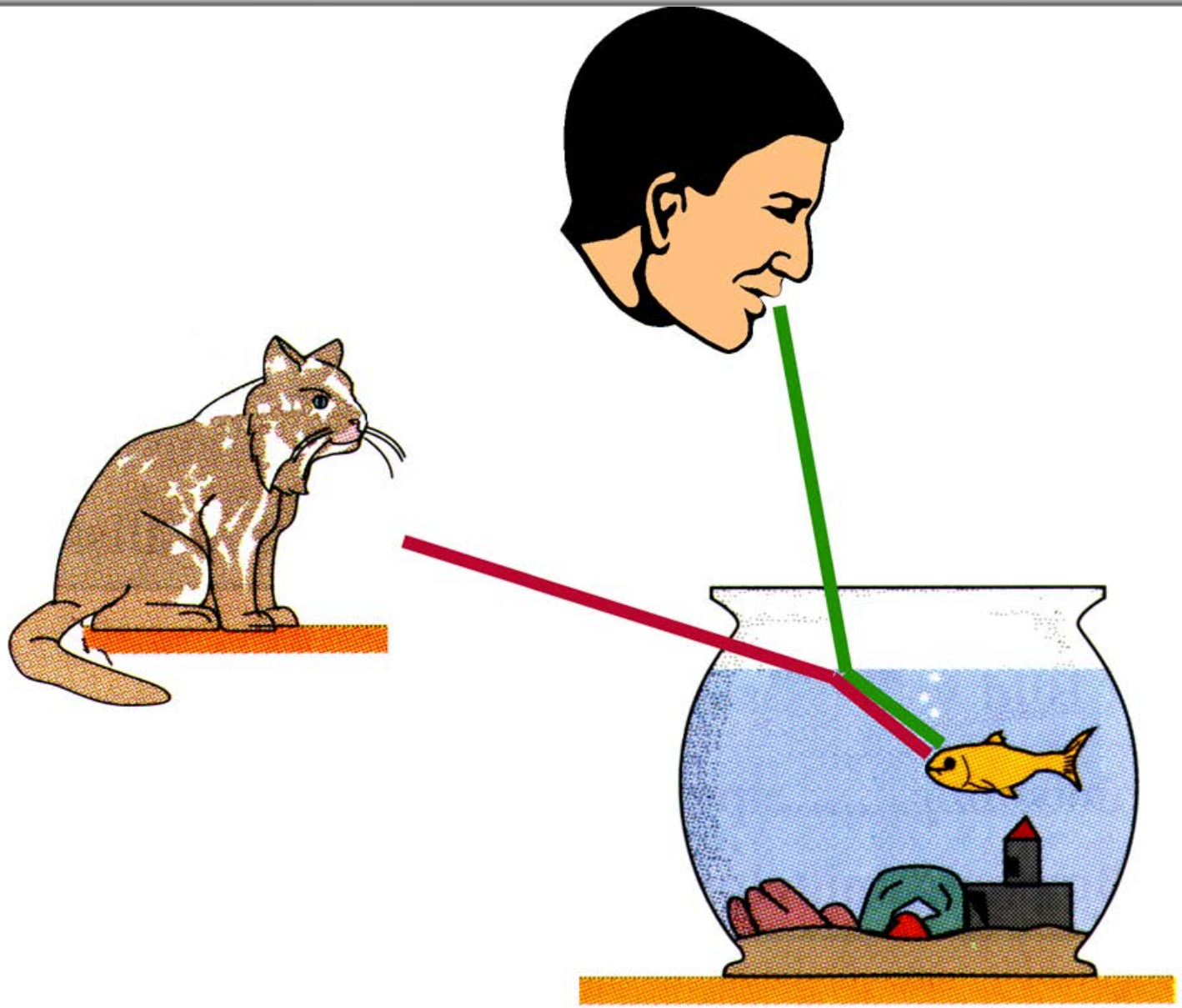

5. Modellvorstellungen unterstützen

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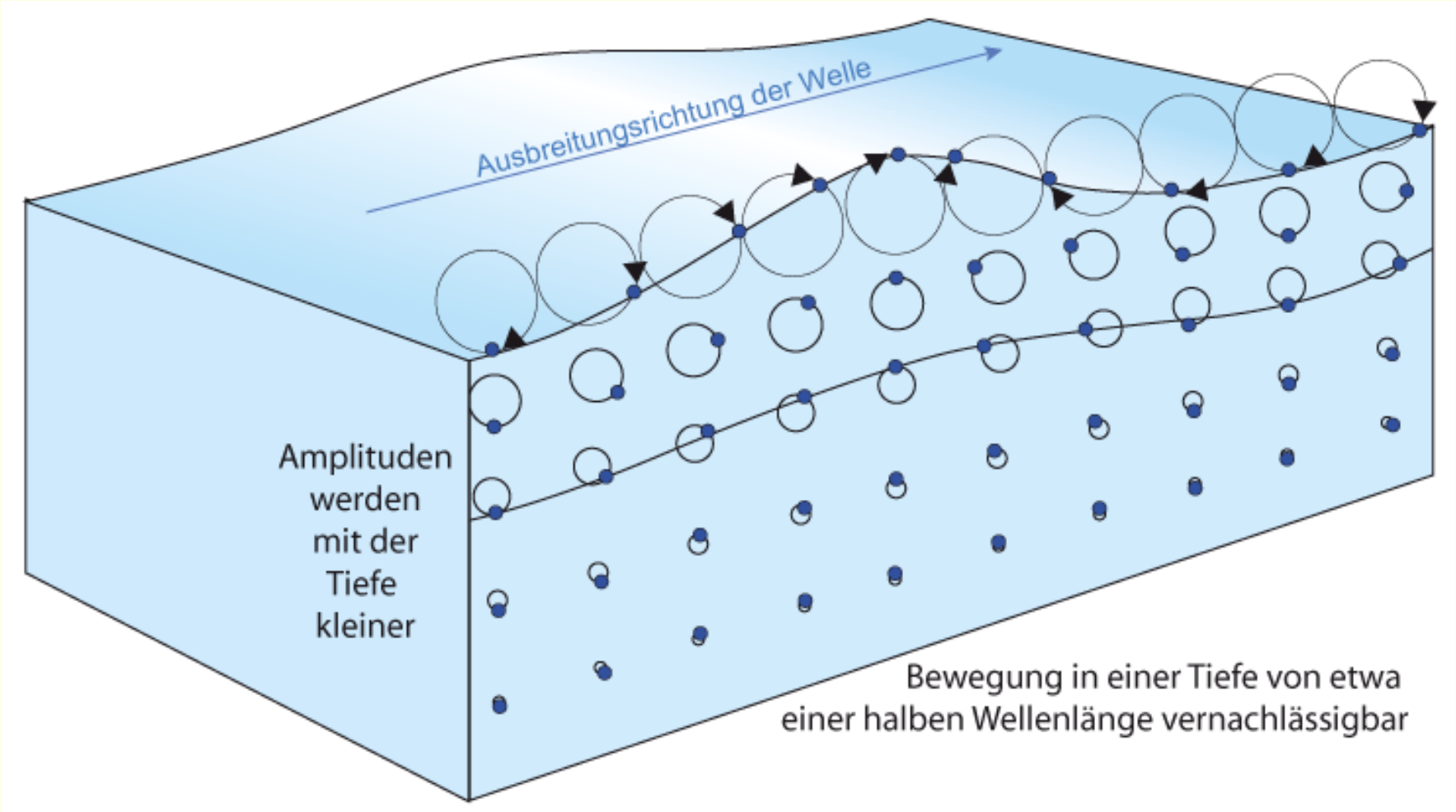

www.didaktik.physik.uni-muenchen.de/multimedia/programme_applets/wellen/kleine_repetitorium/wasserwellen/index.html

6. Repräsentation und Konstruktion

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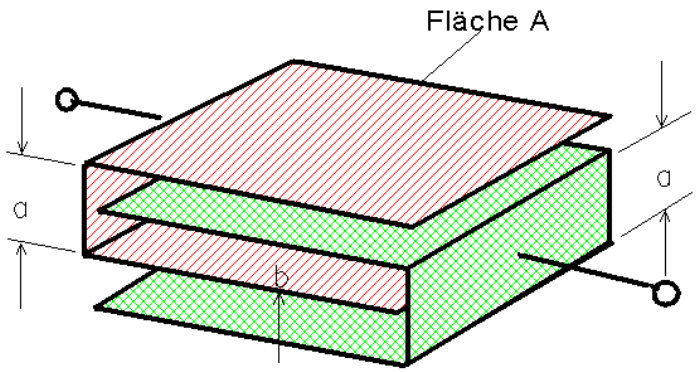

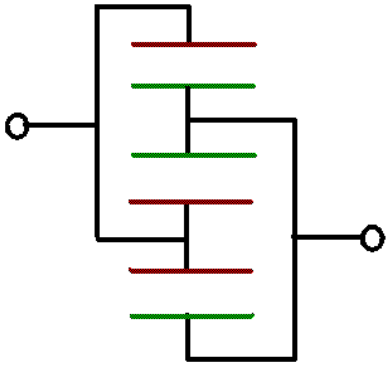

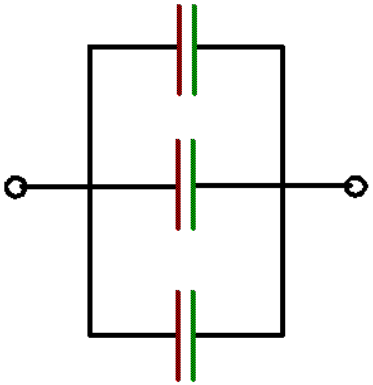

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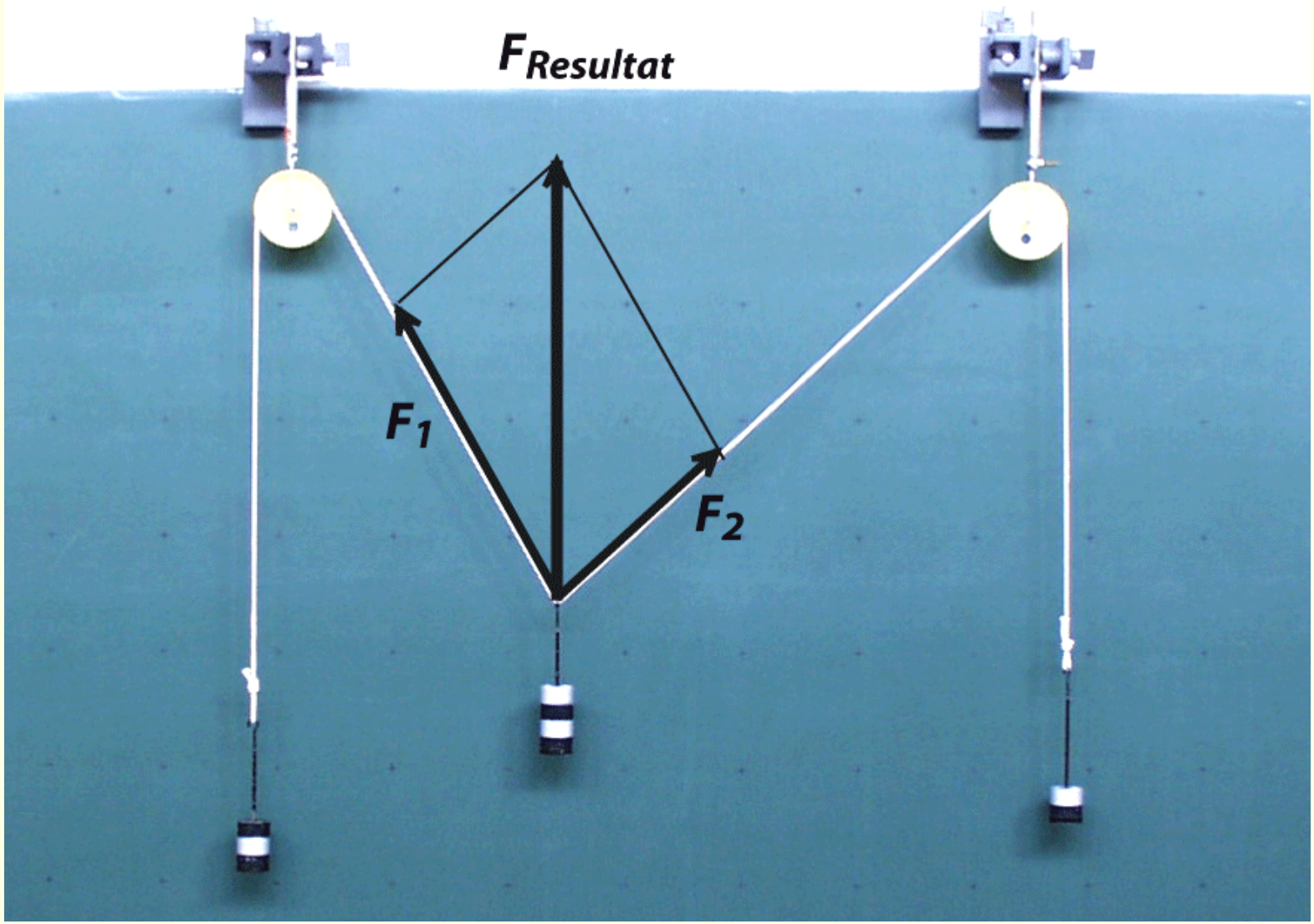

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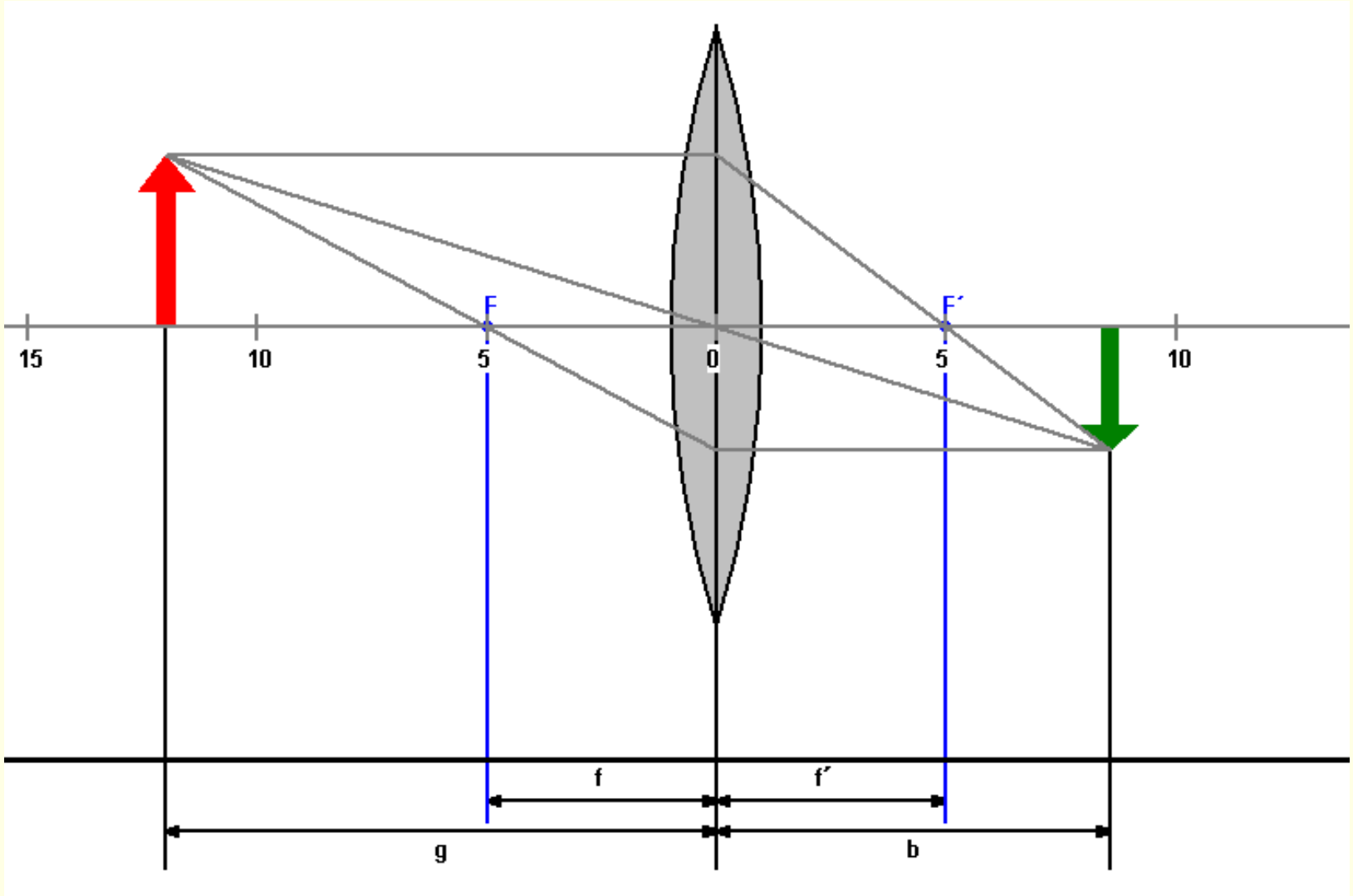

7. Wissen strukturieren

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Konvektion

in Gasen

...

Wärmestrahlung

Luftströmung um Heizkörper

Wärmeleitung

Energietransport

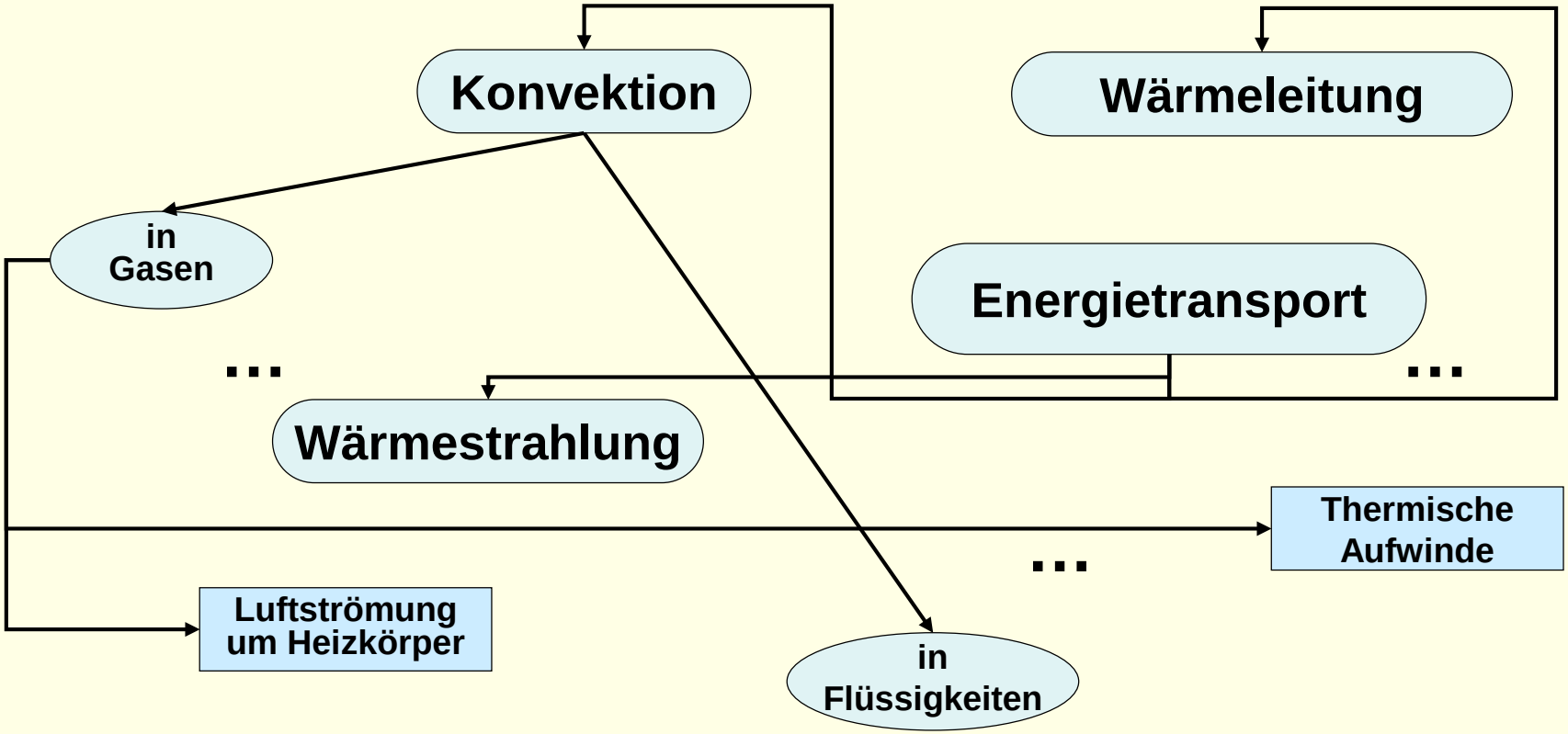
...

Thermische Aufwinde

...

in Flüssigkeiten

7. Wissen strukturieren



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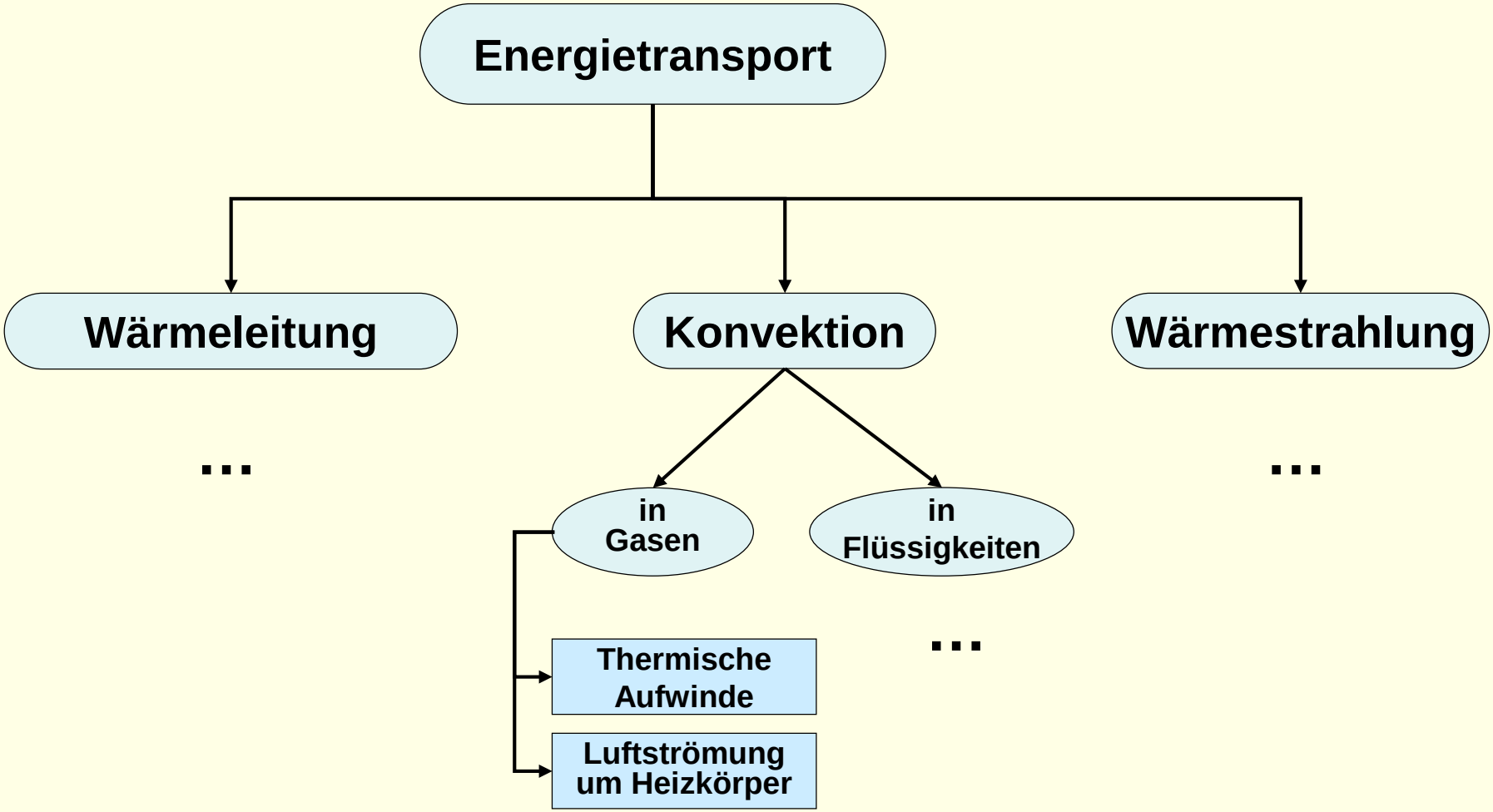
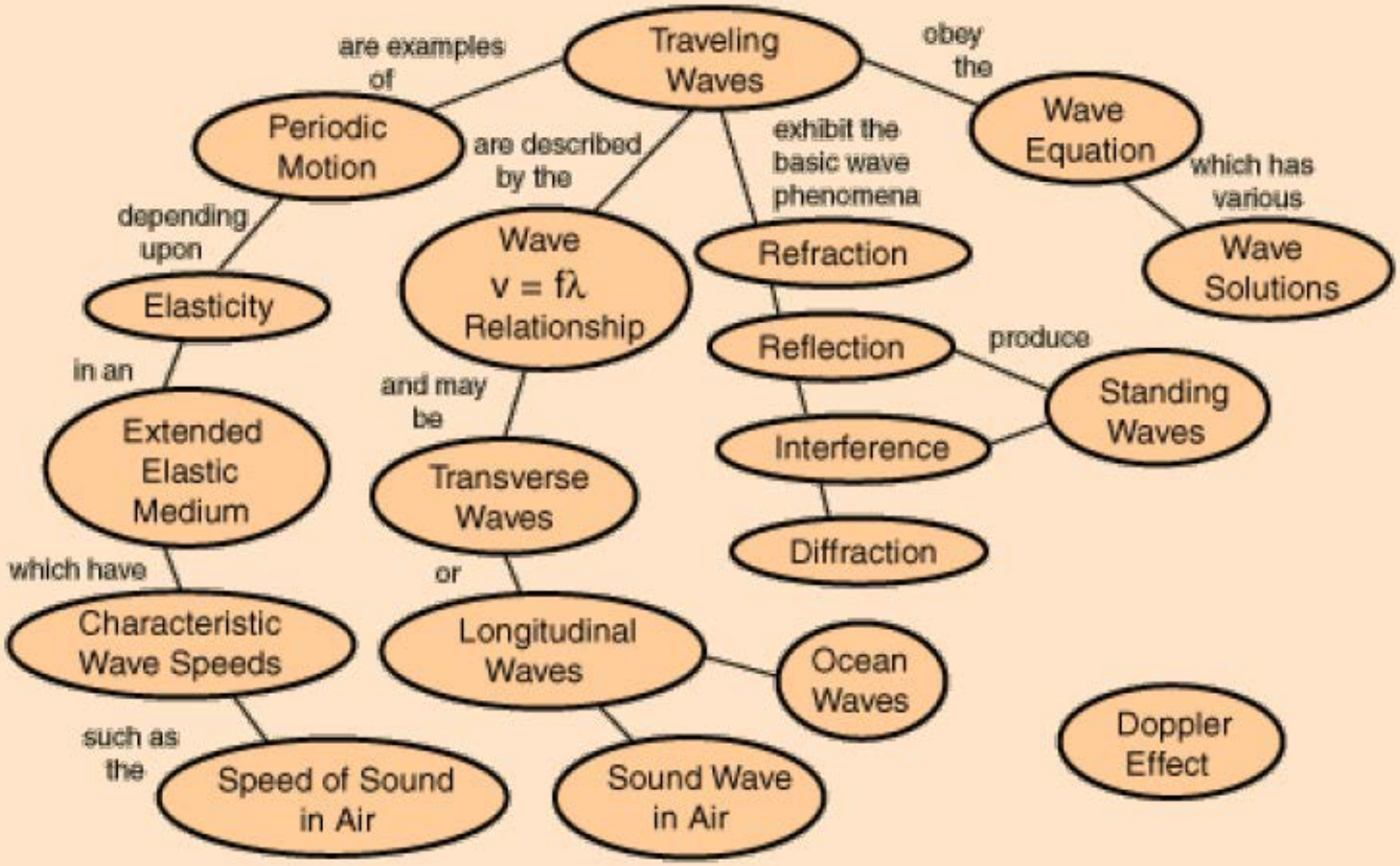


7. Wissen strukturieren

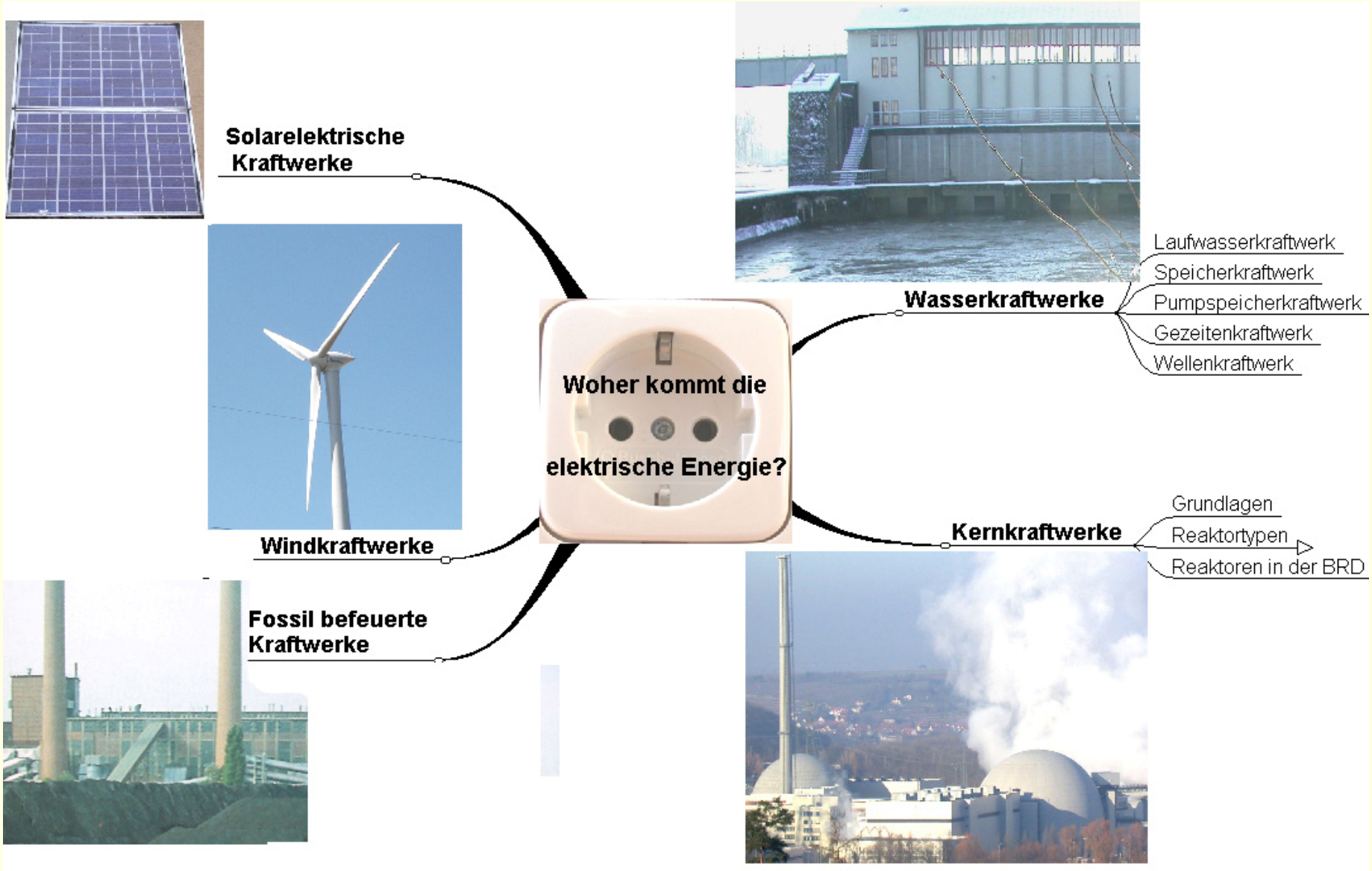
Concept maps



Power transported by string wave

Seismic Waves

7. Wissen strukturieren



8. Daten aufbereiten

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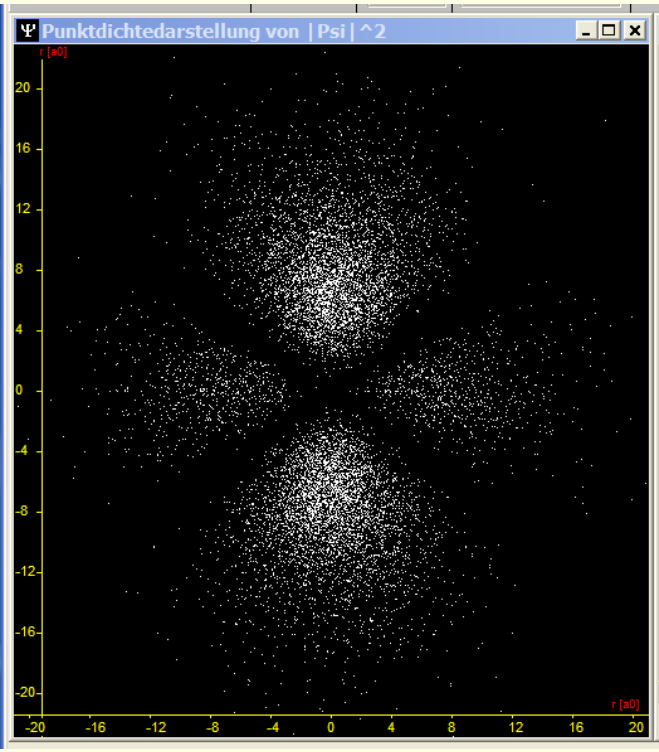

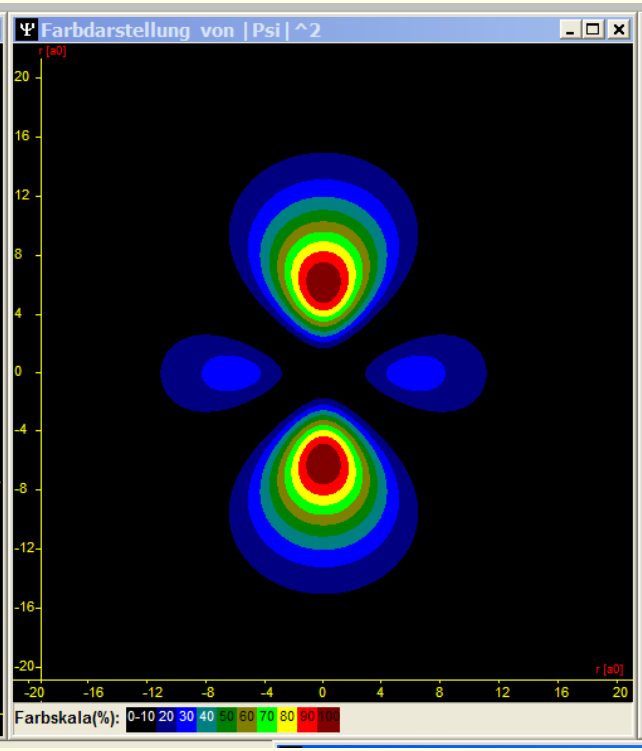

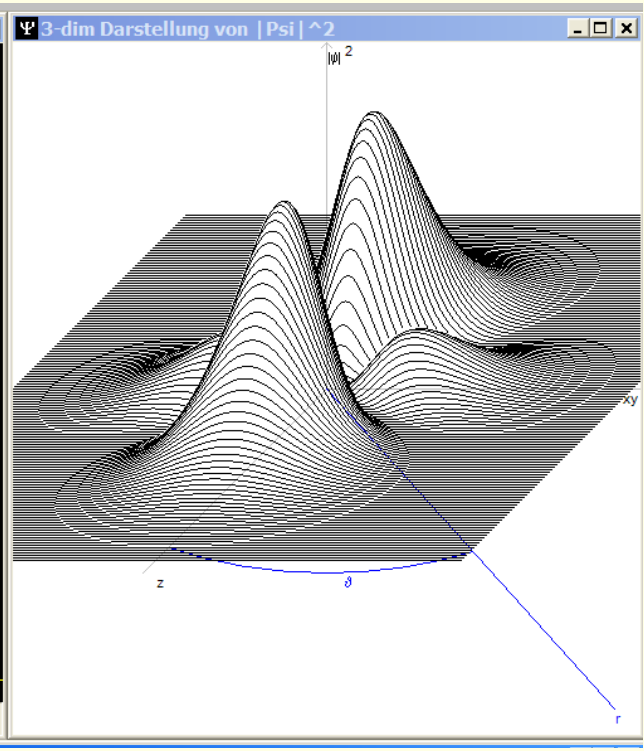

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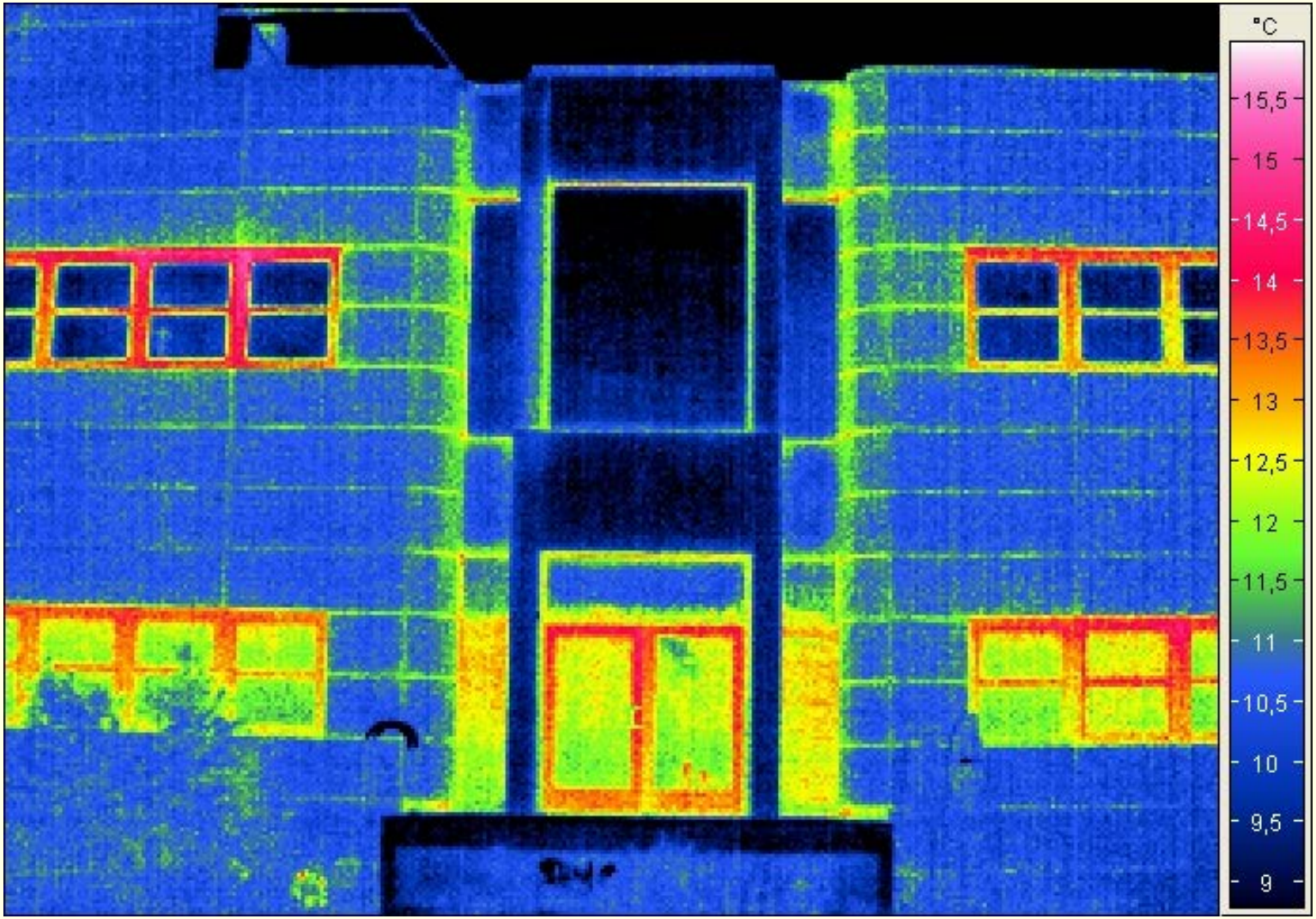
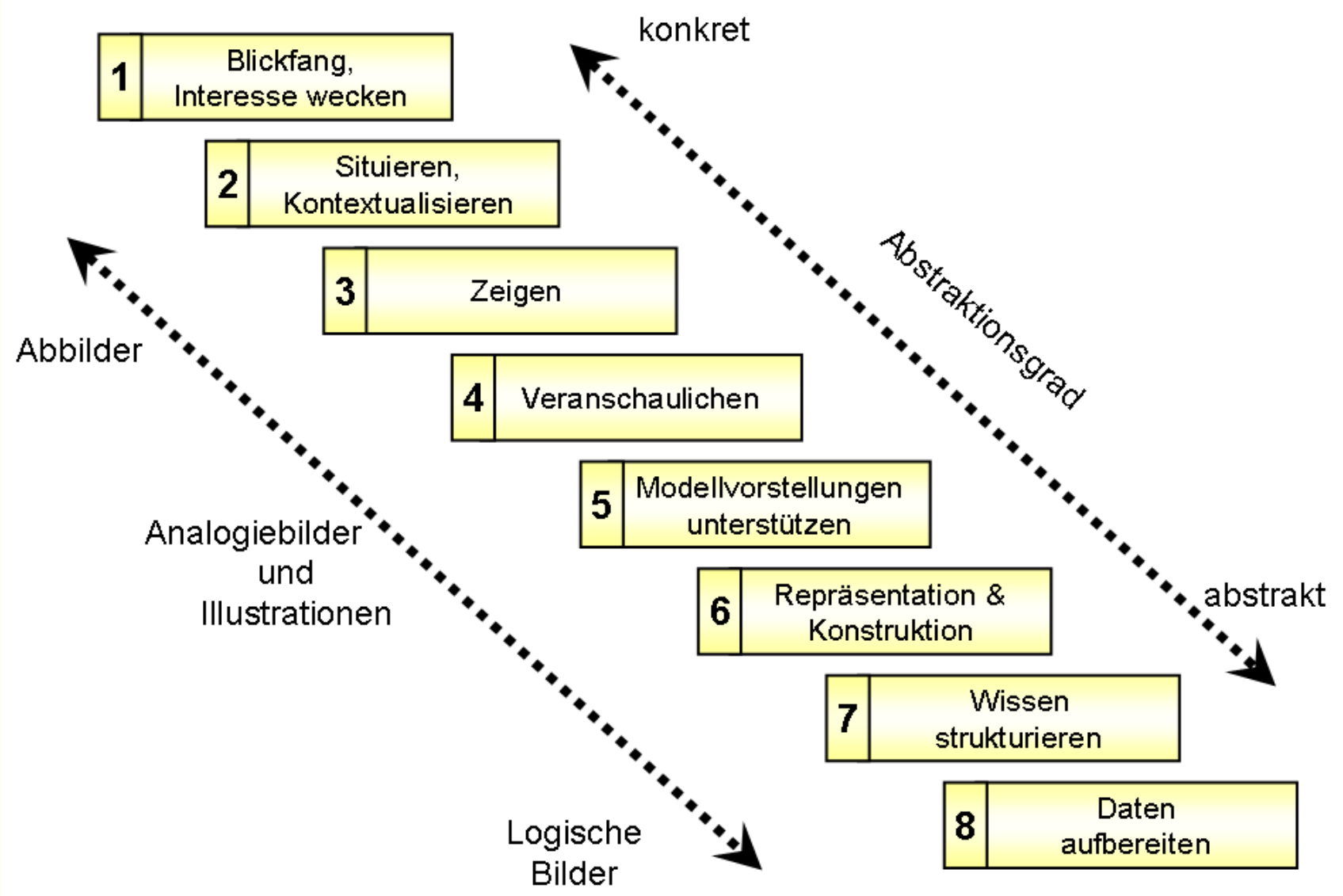


8 Funktionen



Bilder im Lernprozess

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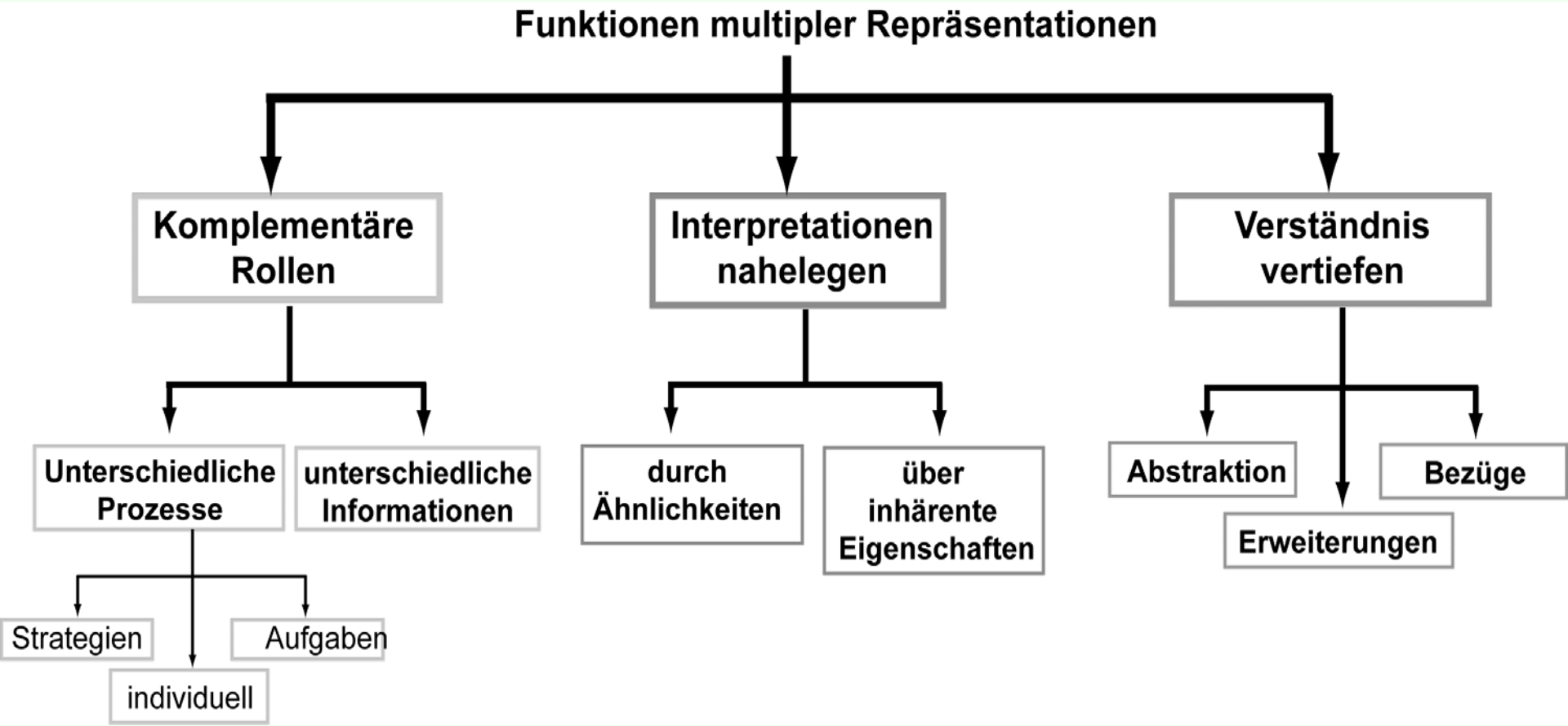
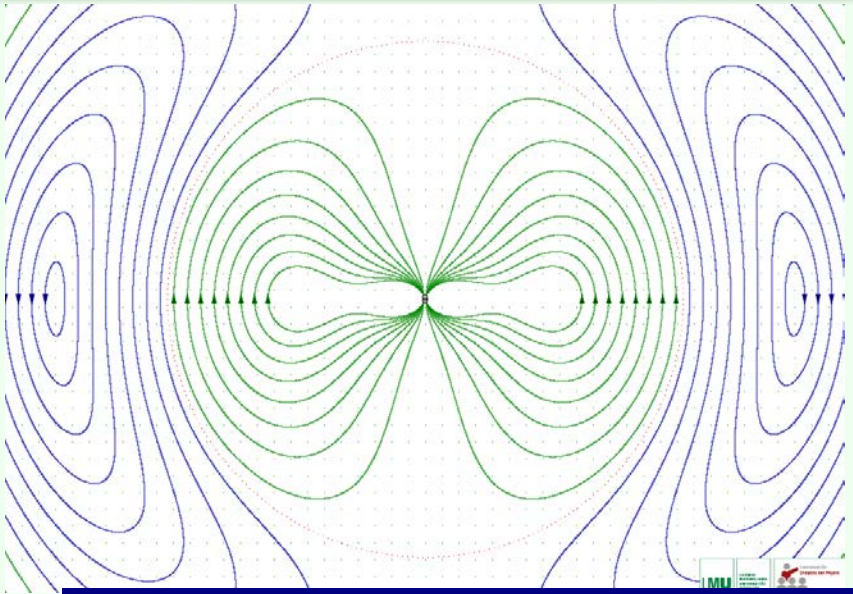
- An verschiedene Repräsentationsarten denken -

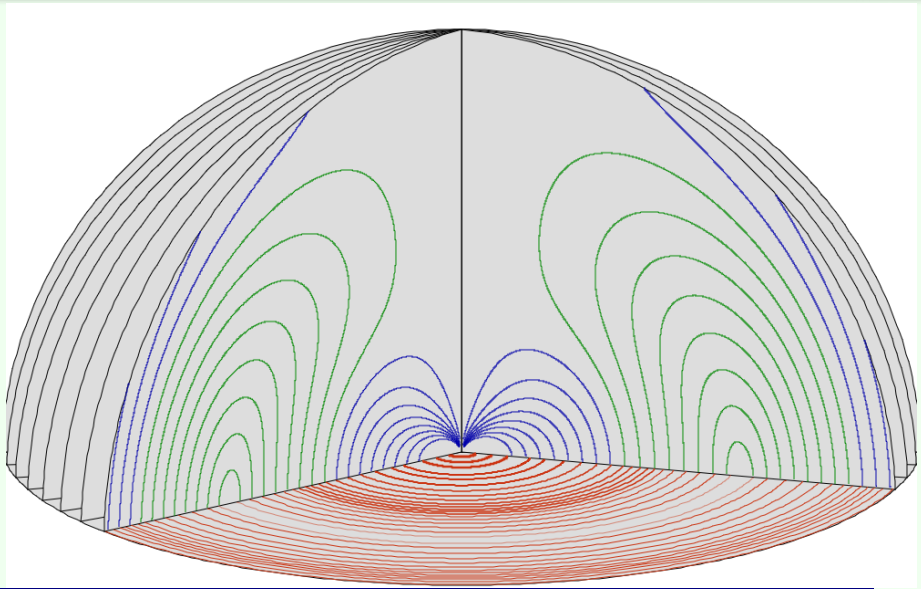
Multiple Repräsentationen



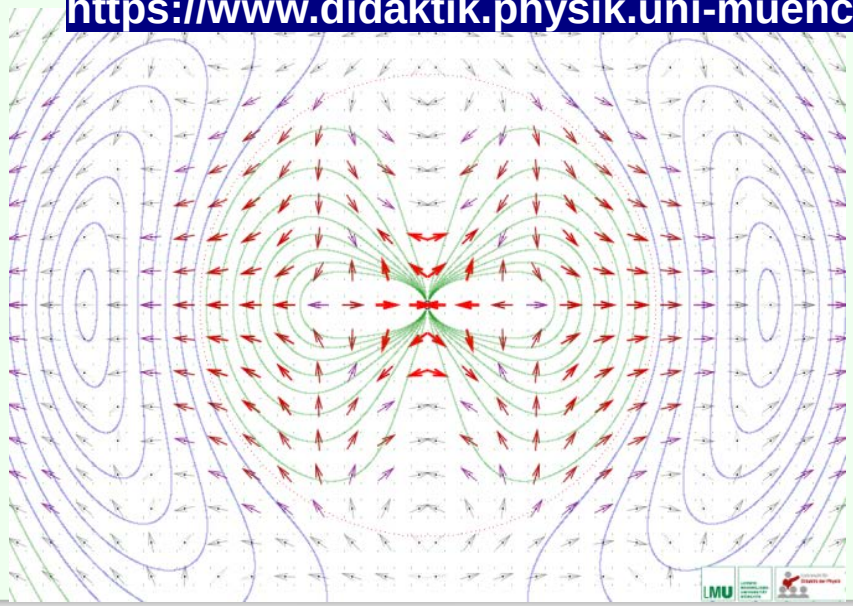
nach Ainsworth, S. (1999). The functions of multiple representations. Computers & Education 33, 131 – 152.

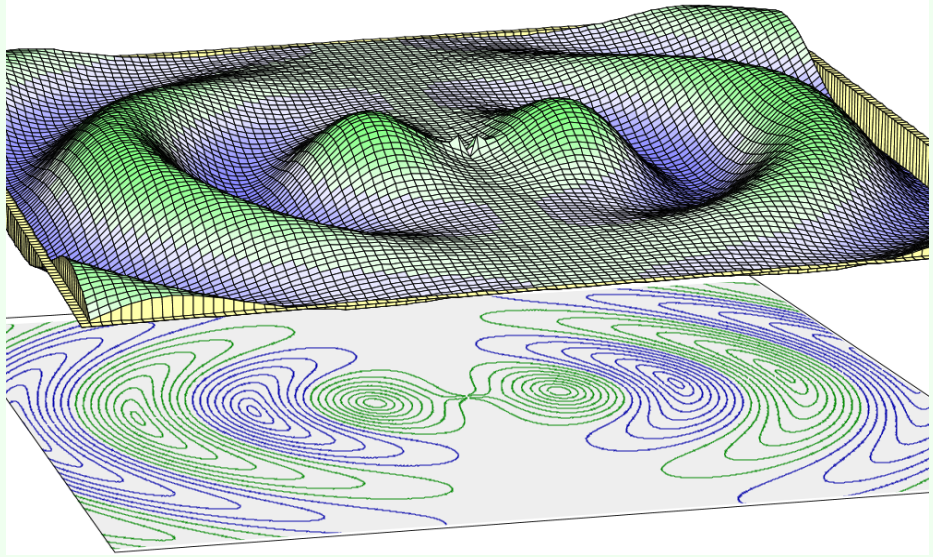
Multiple Repräsentationen



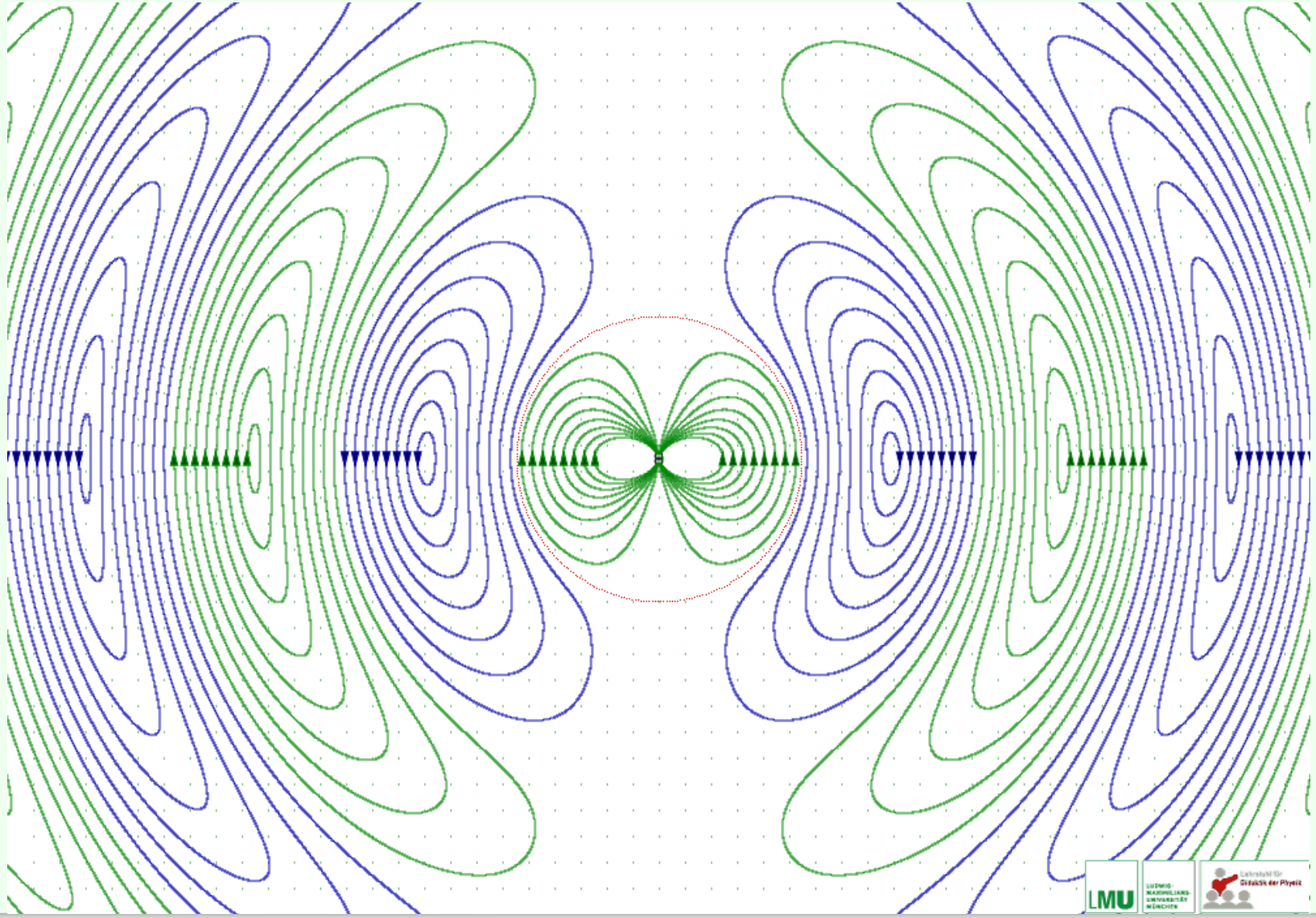


https://www.didaktik.physik.uni-muenchen.de/multimedia/programme_applets/e_lehre/





Multiple Repräsentationen



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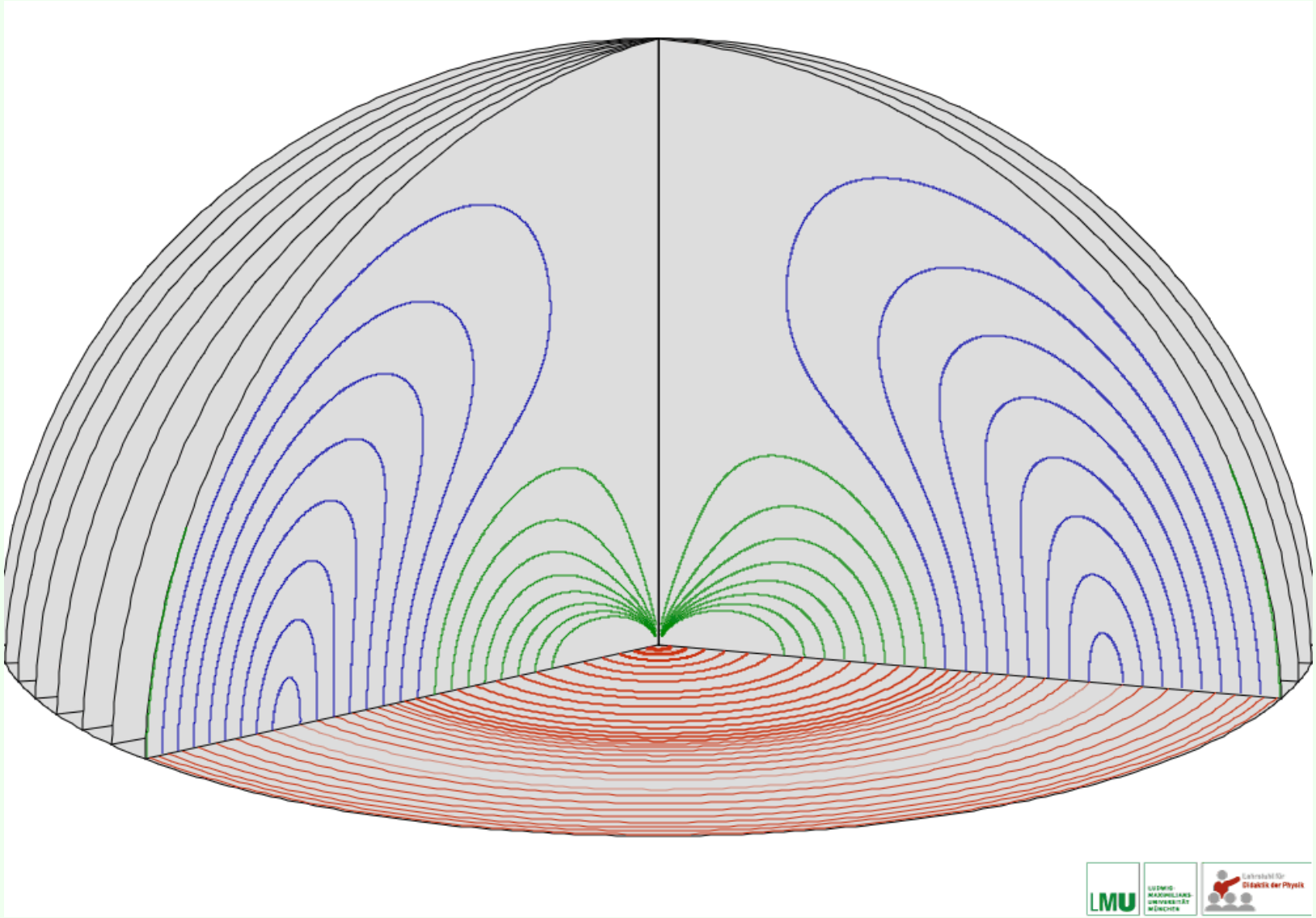

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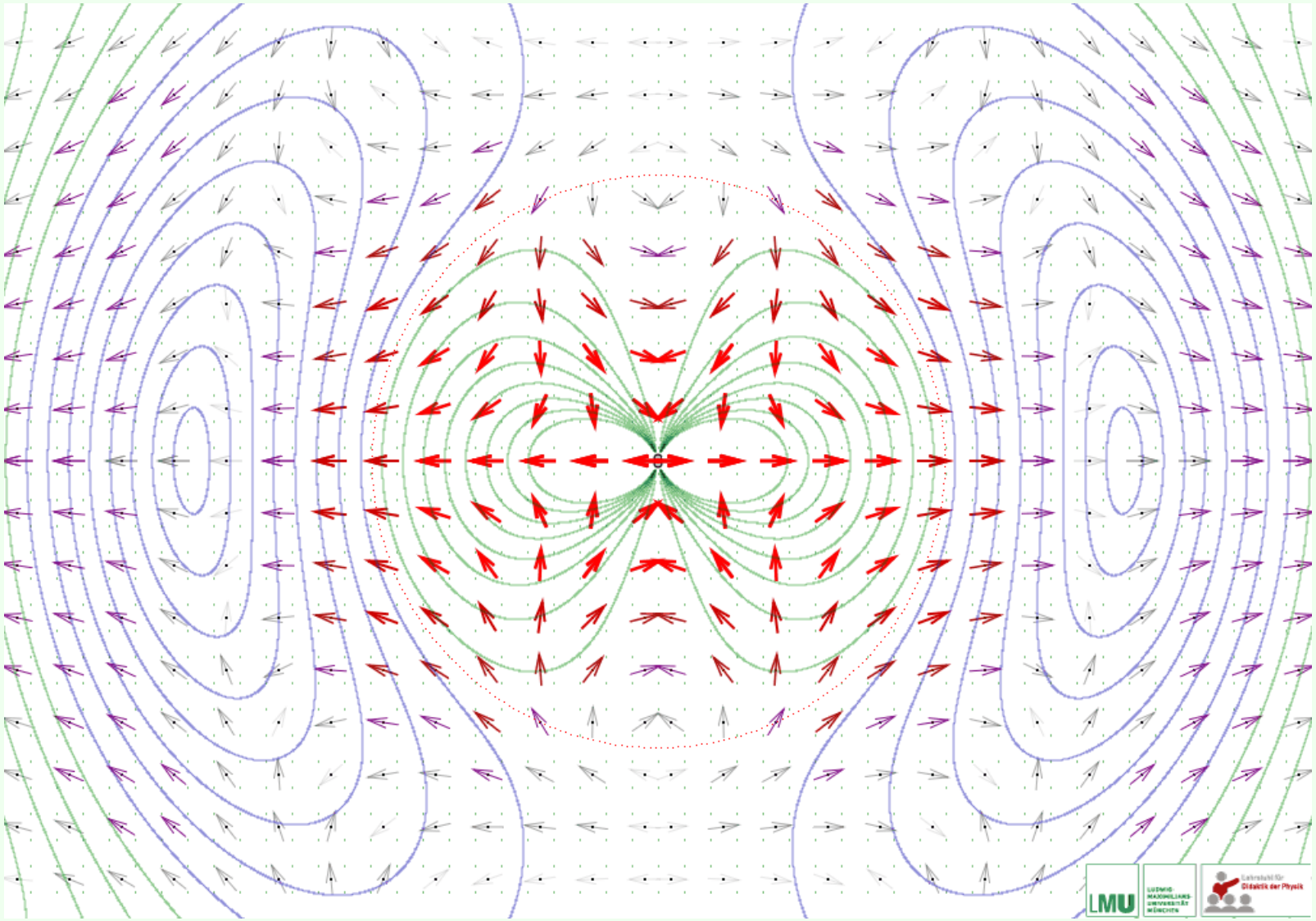

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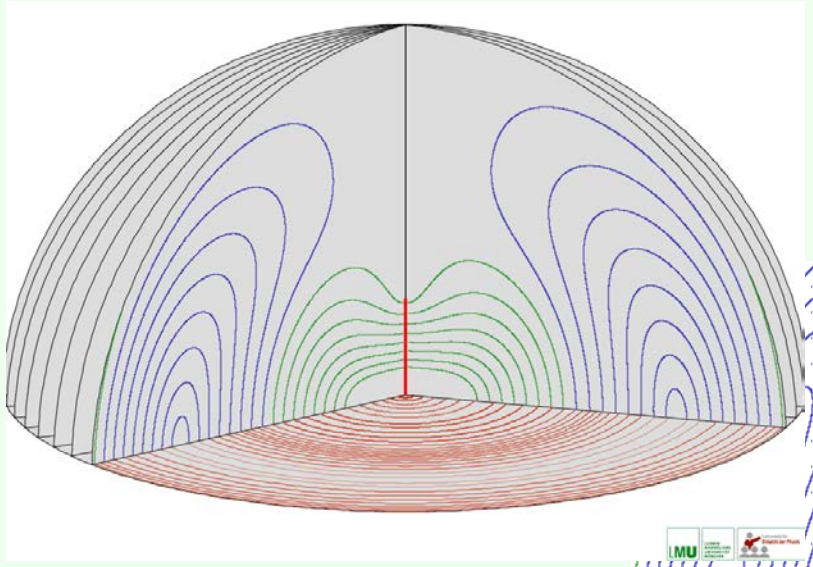

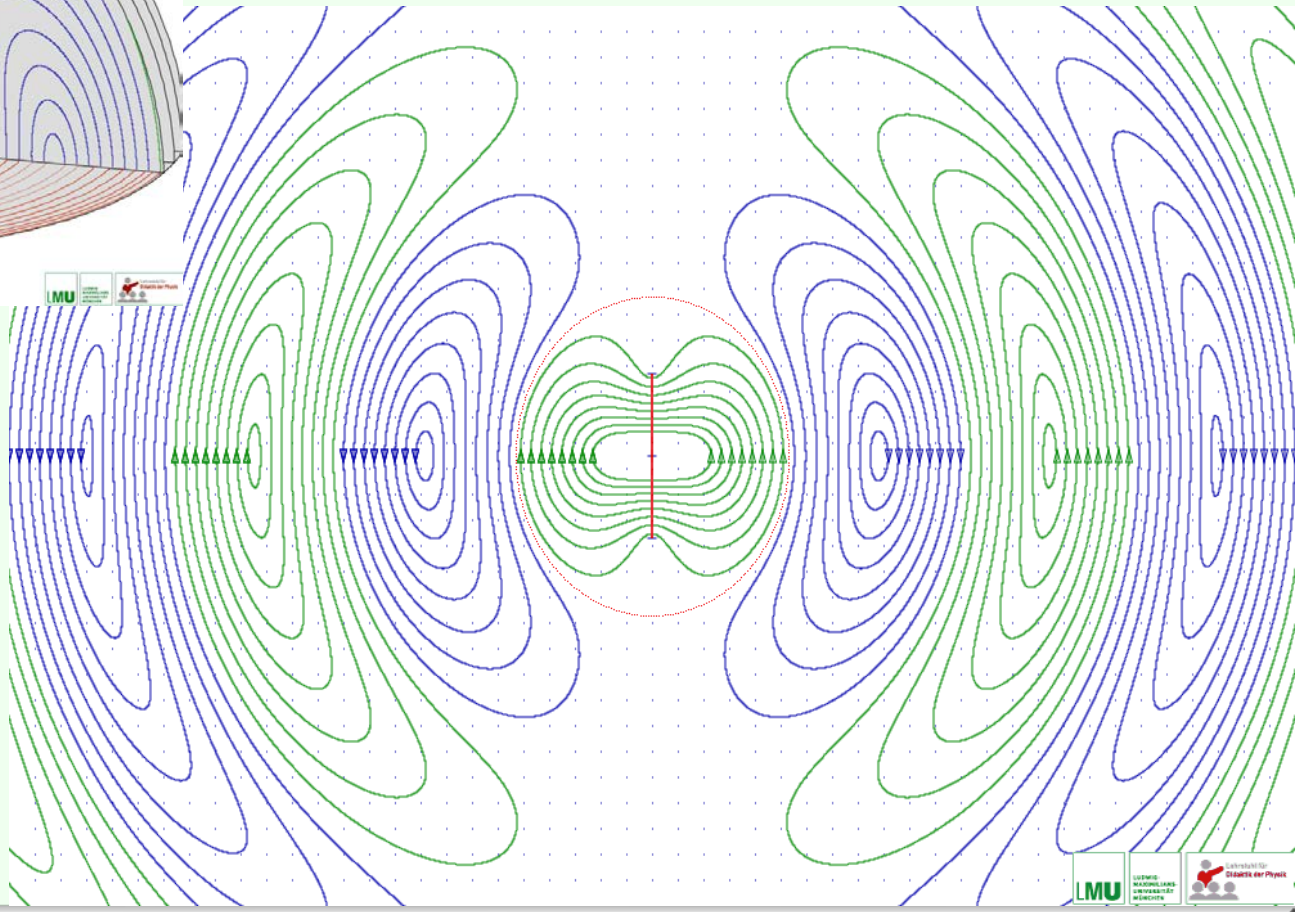

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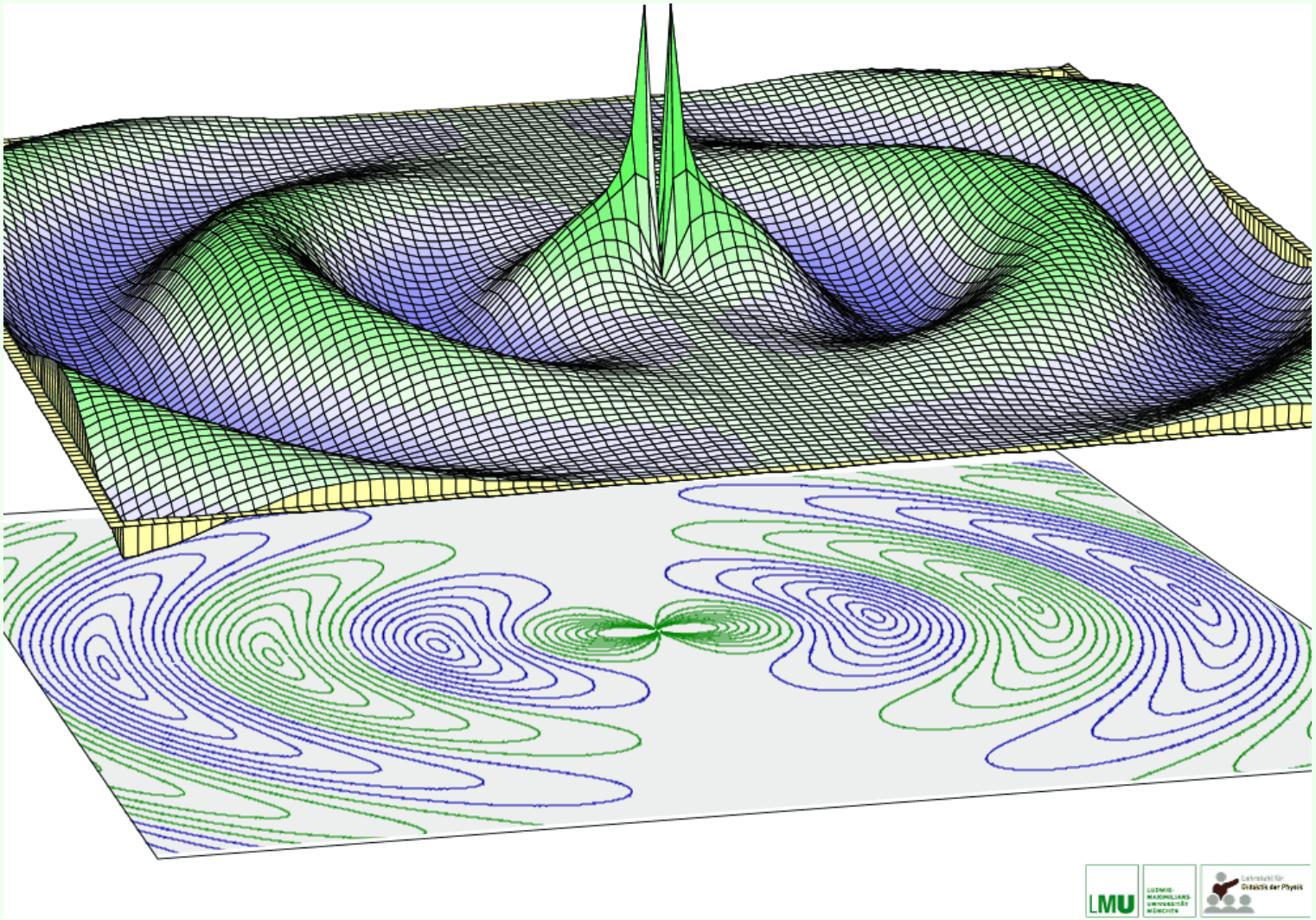
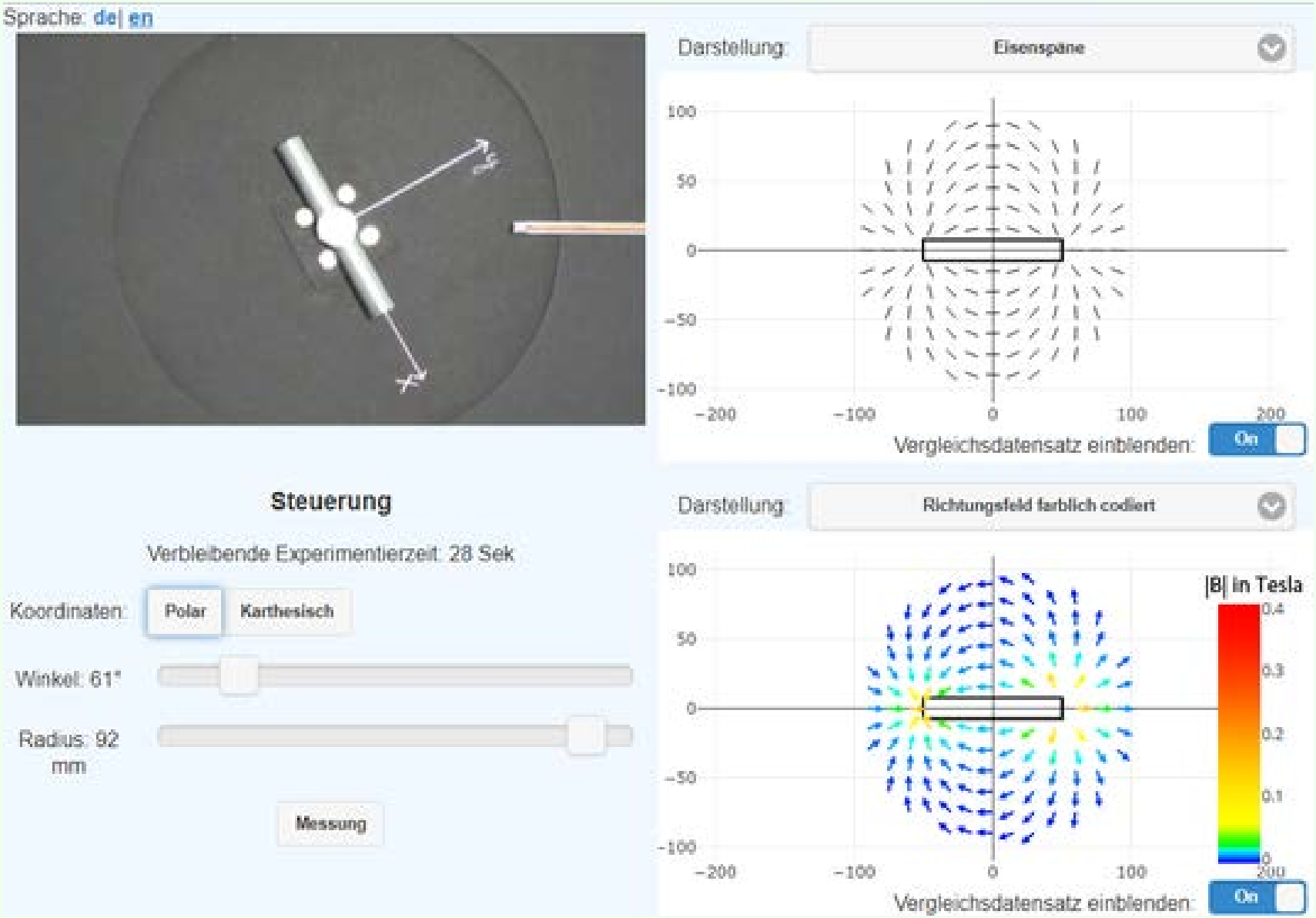
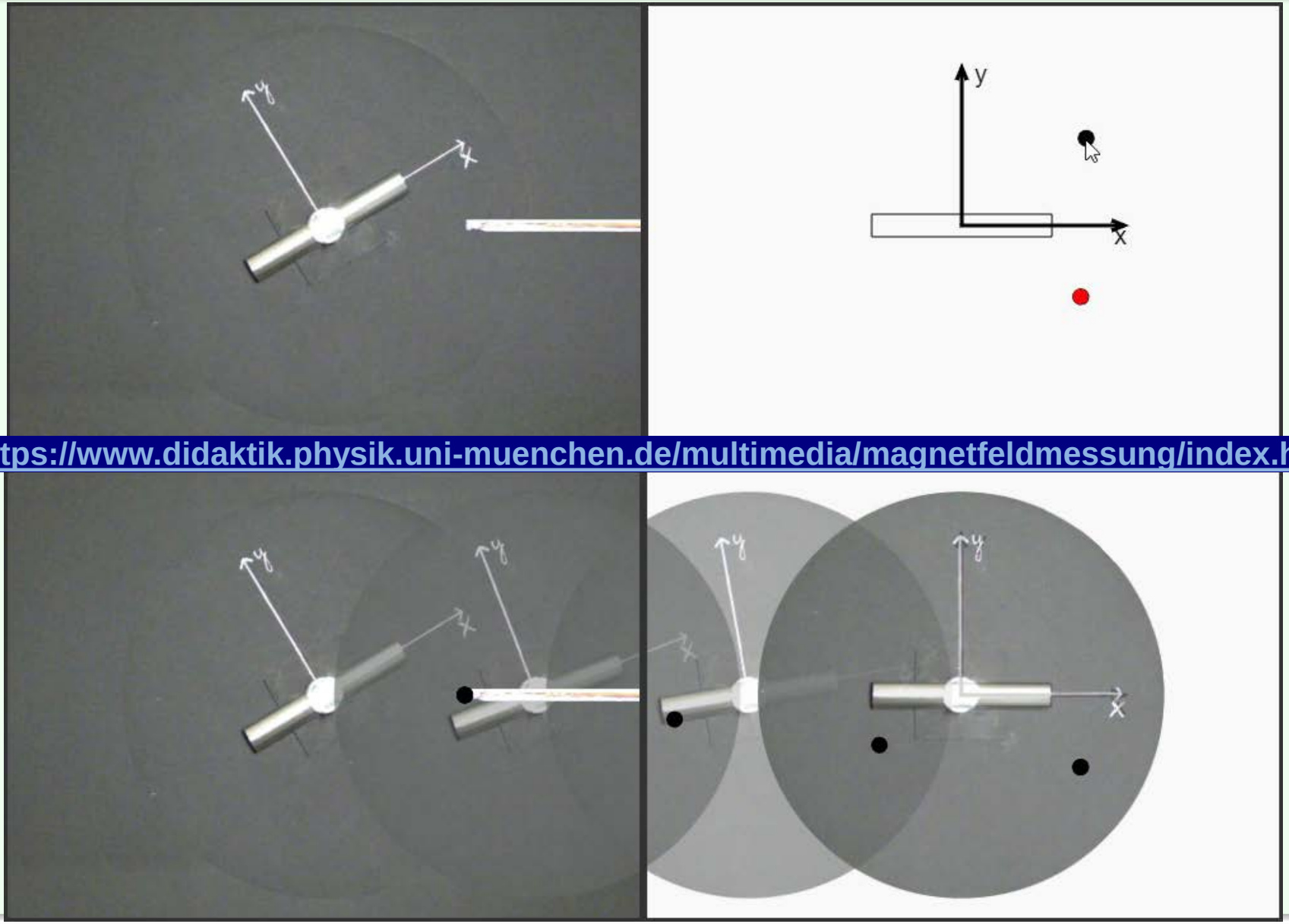


Anforderungen



Anforderungen



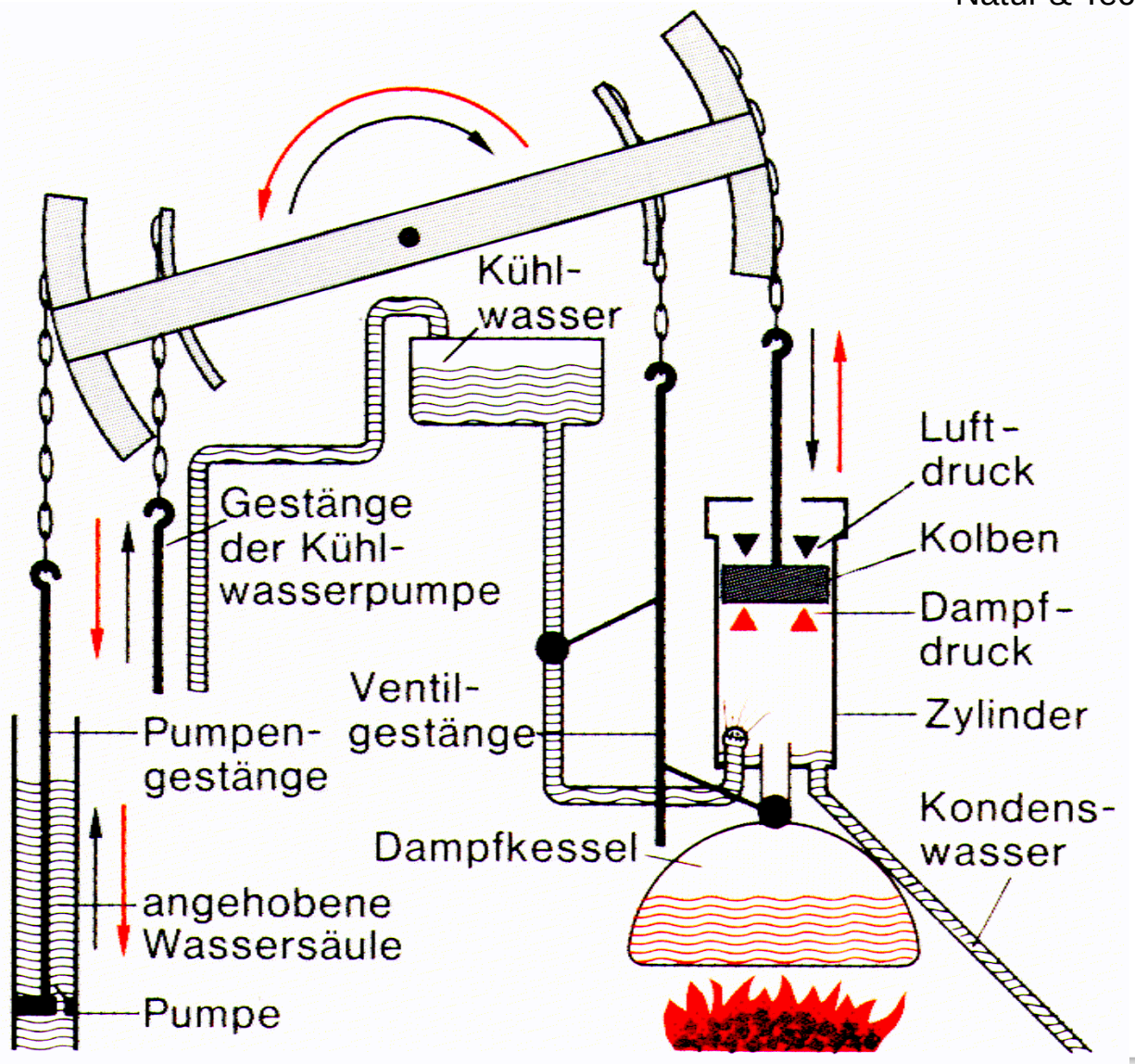
https://www.didaktik.physik.uni-muenchen.de/multimedia/magnetfeldmessung/index.html

Anforderungen

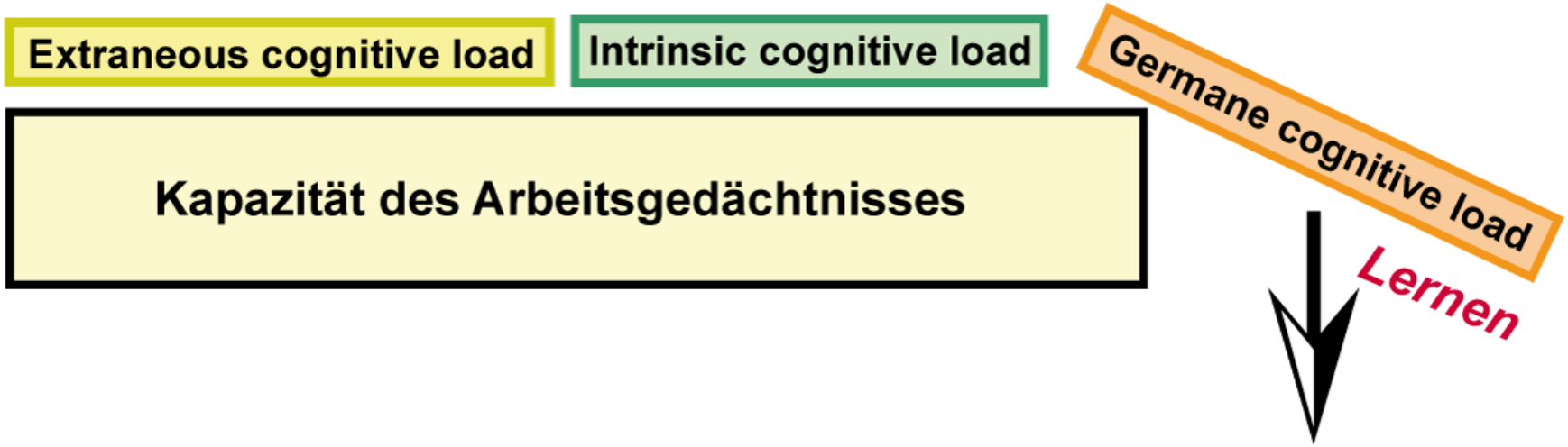
Text sequenziell <-> Bilder simultan

Anforderungen

Natur & Technik, 1980, 121



Anforderungen



Anforderungen

Mögliche Probleme:

- Cognitive overload
- Symbolik / Darstellung nicht klar
- Betrachtung nicht zielgerichtet (Nebensächlichkeiten dominieren)
- Oberflächliche Betrachtung ohne Bewusstseinsebene zu erreichen

Maßnahmen:

- Sequenzieren, Modalität, Single-Concept Principle
- Ergänzungsbedarf prüfen
- Informationsaufnahme lenken
- Verarbeitungstiefe sichern

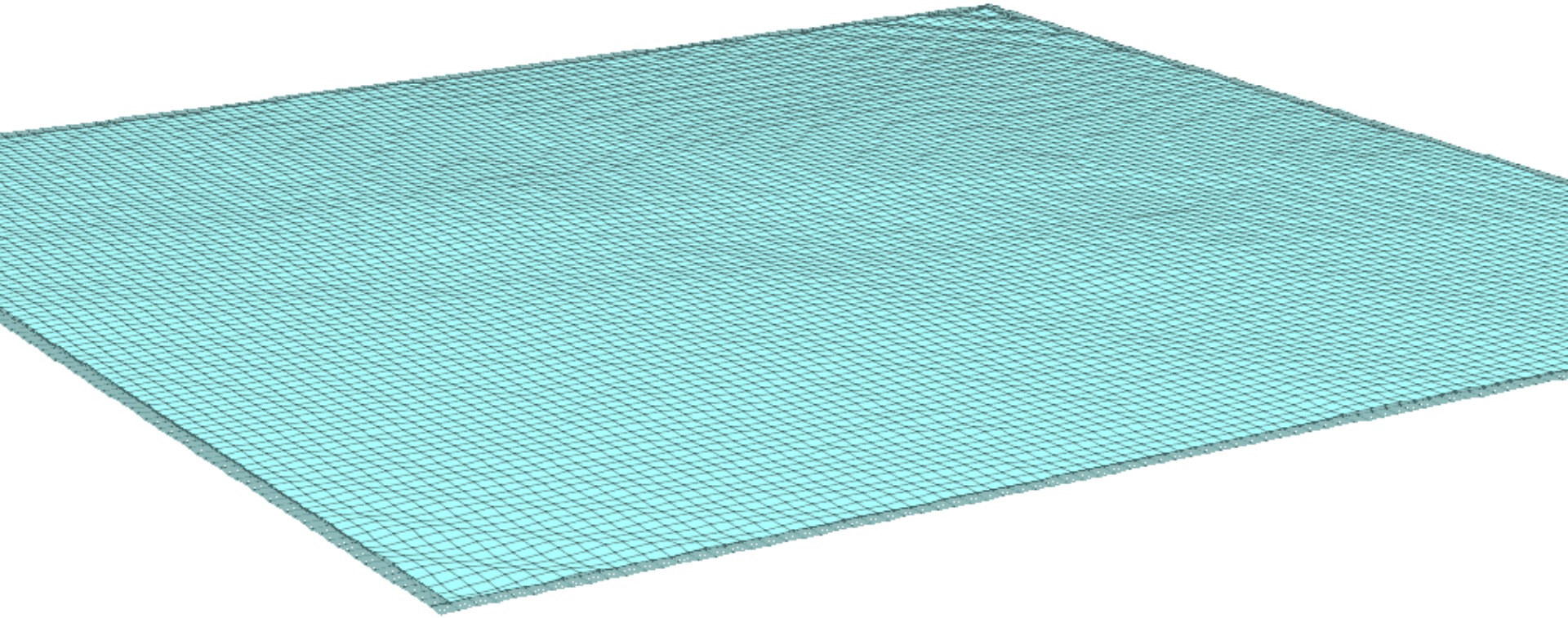
Anforderungen

Ein Ansatz:

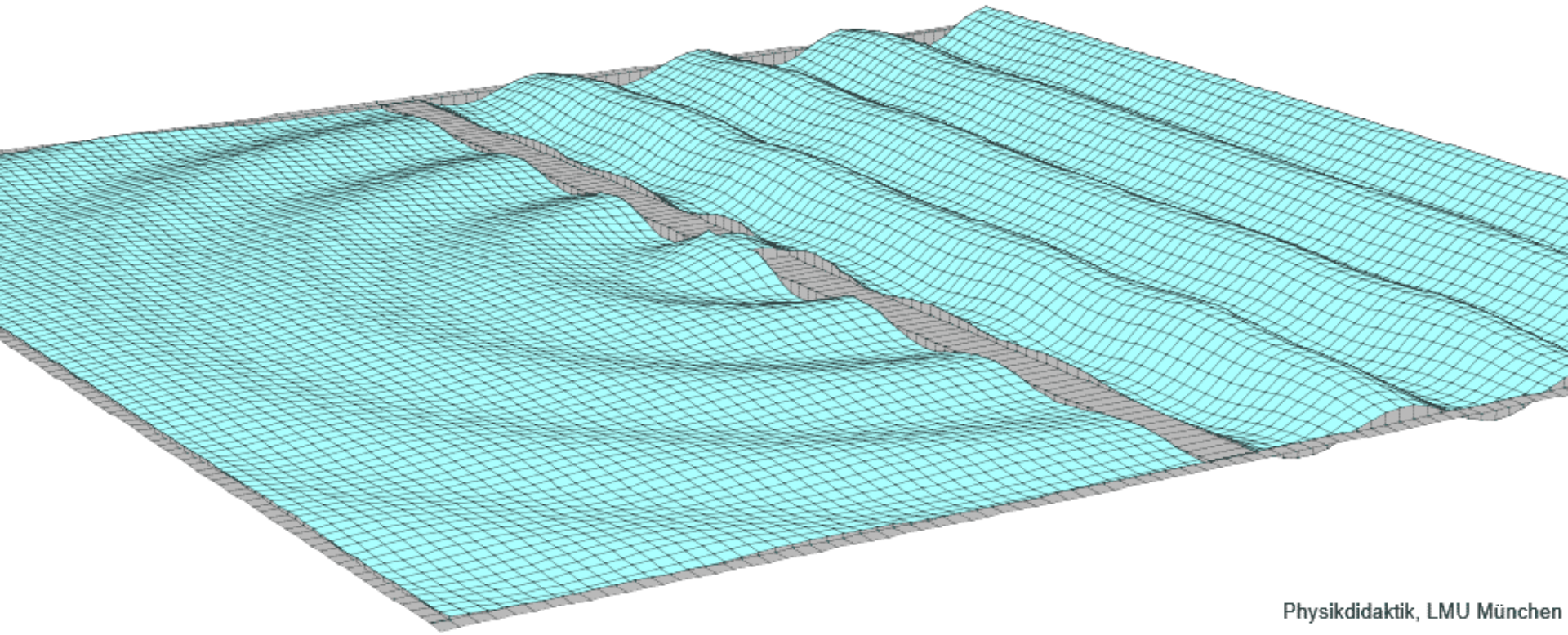
Single Concept Principle

https://www.didaktik.physik.uni-muenchen.de/multimedia/programme_applets/wellen/

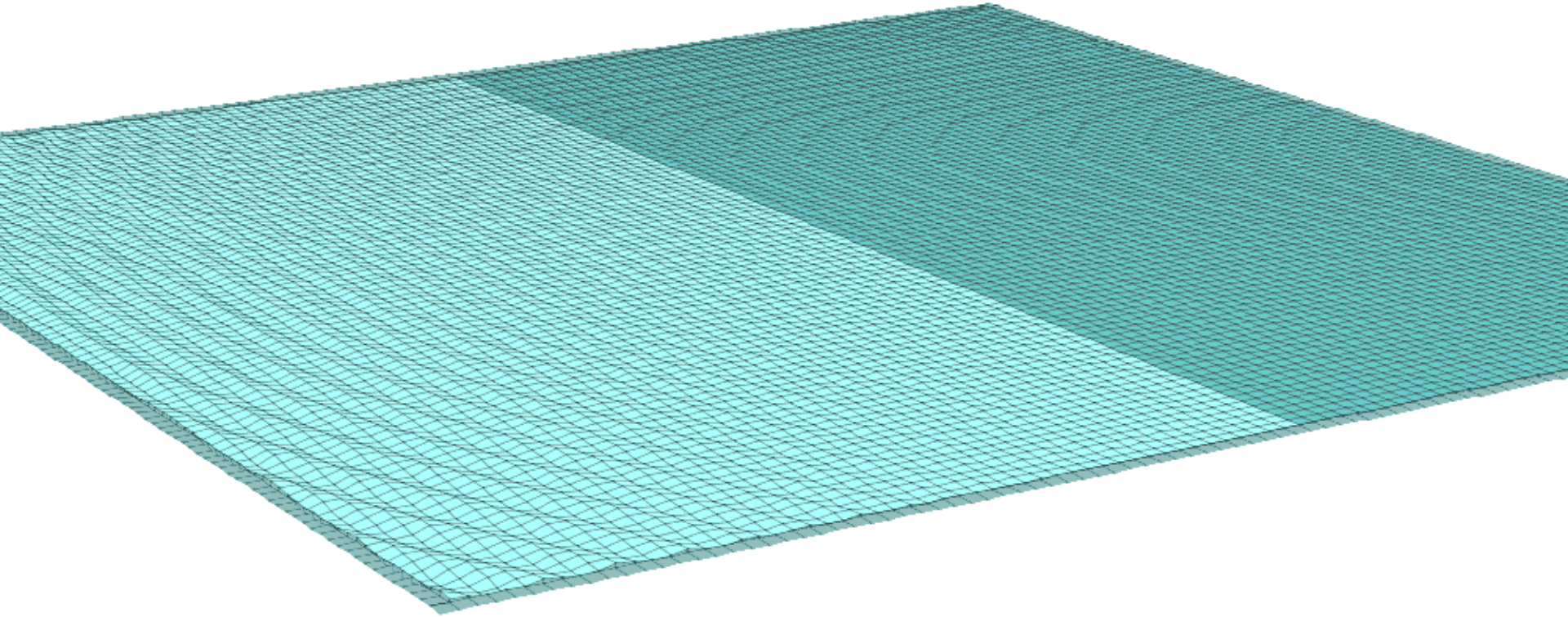
Single Concept Principle



Single Concept Principle

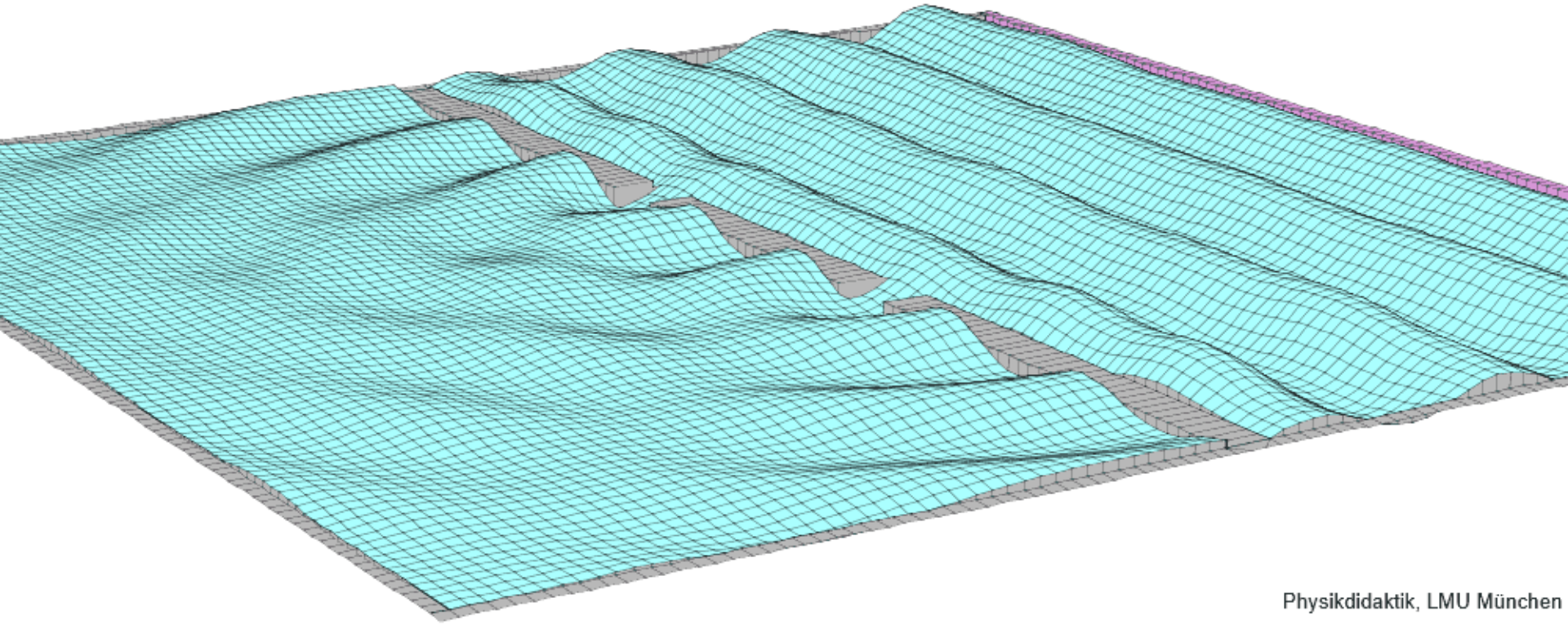


Single Concept Principle

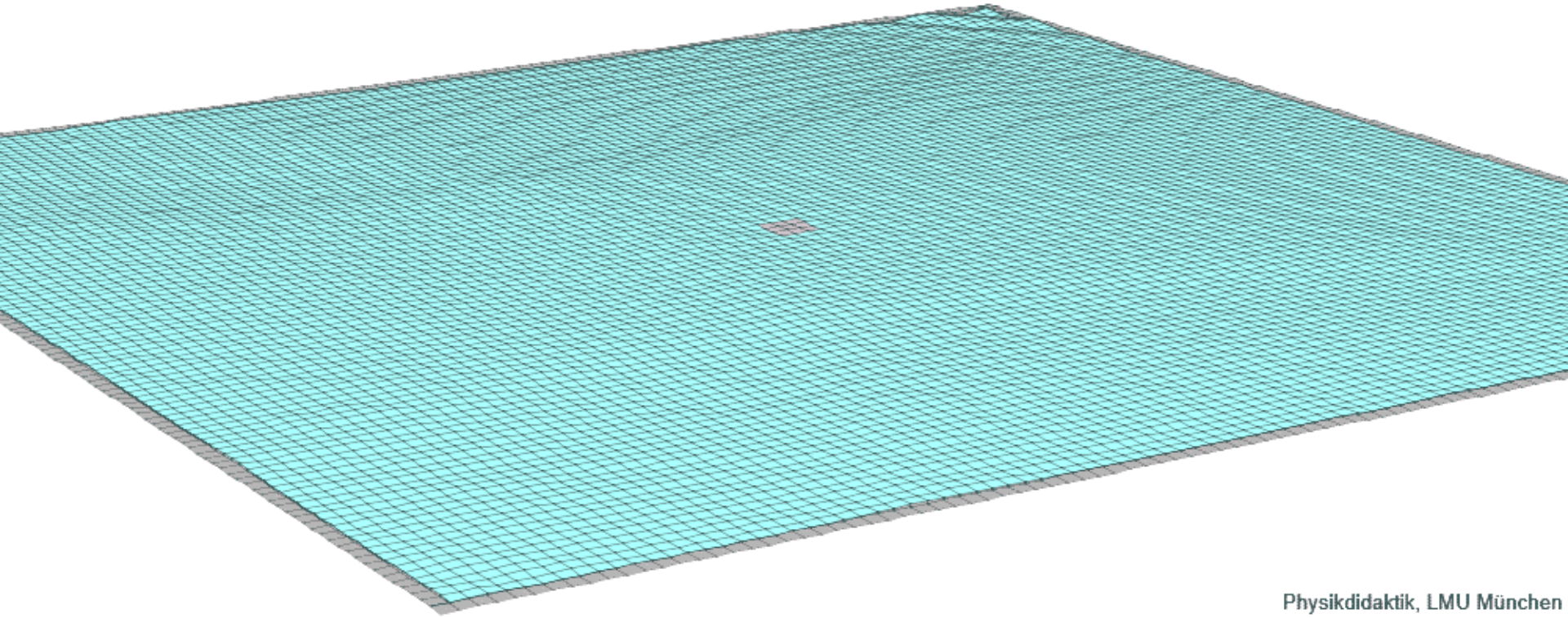


Physikdidaktik, LMU München

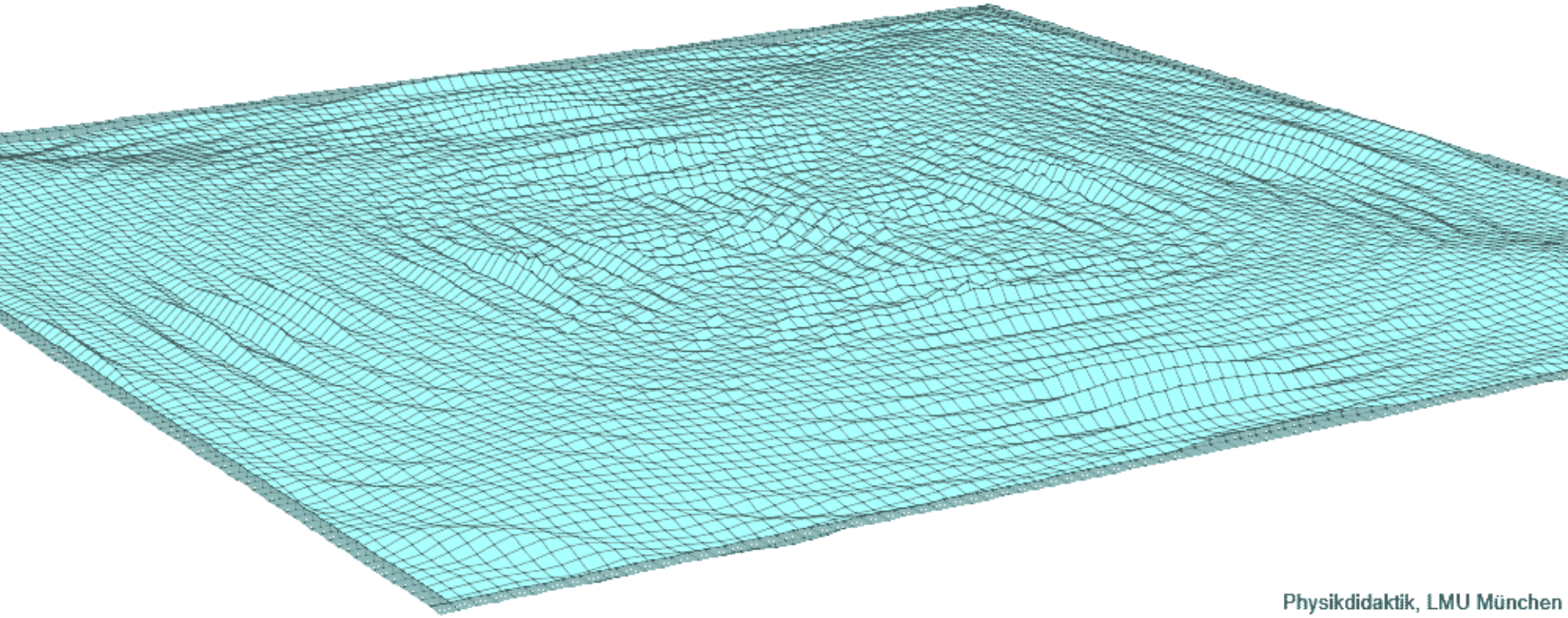
Single Concept Principle



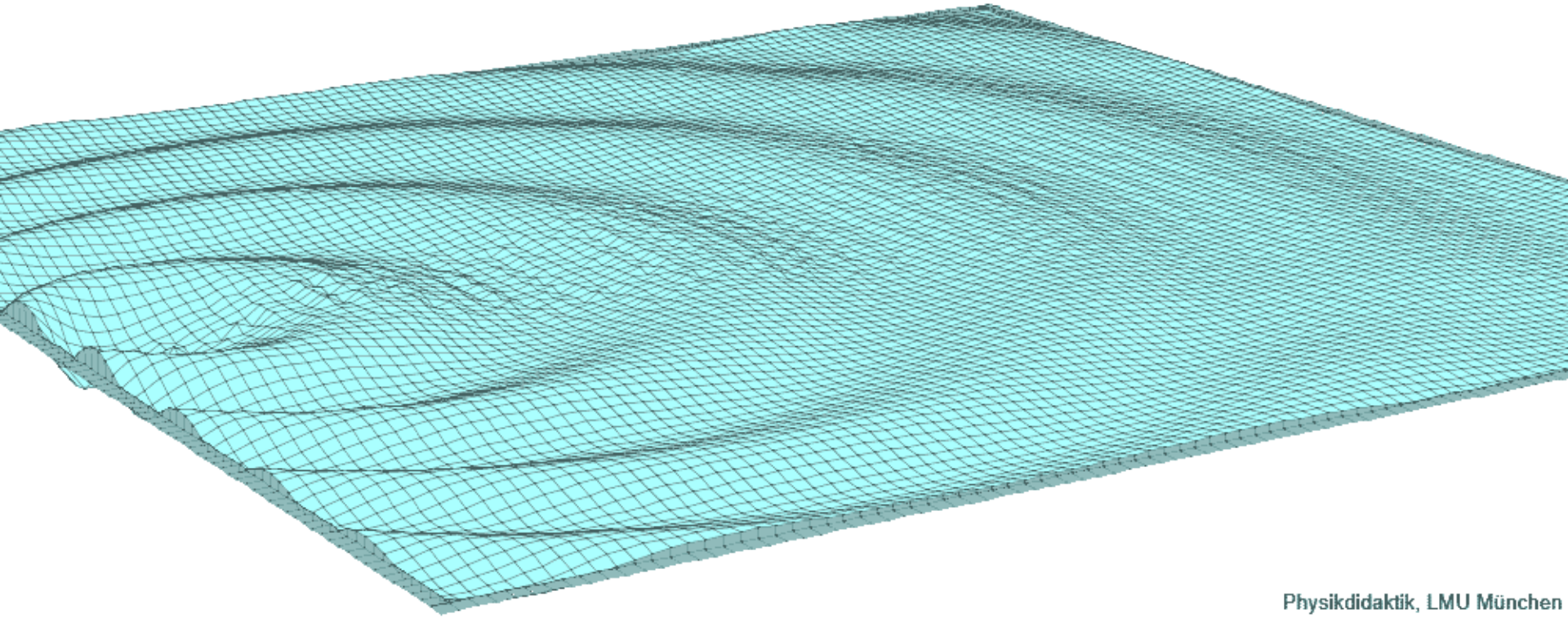
Single Concept Principle



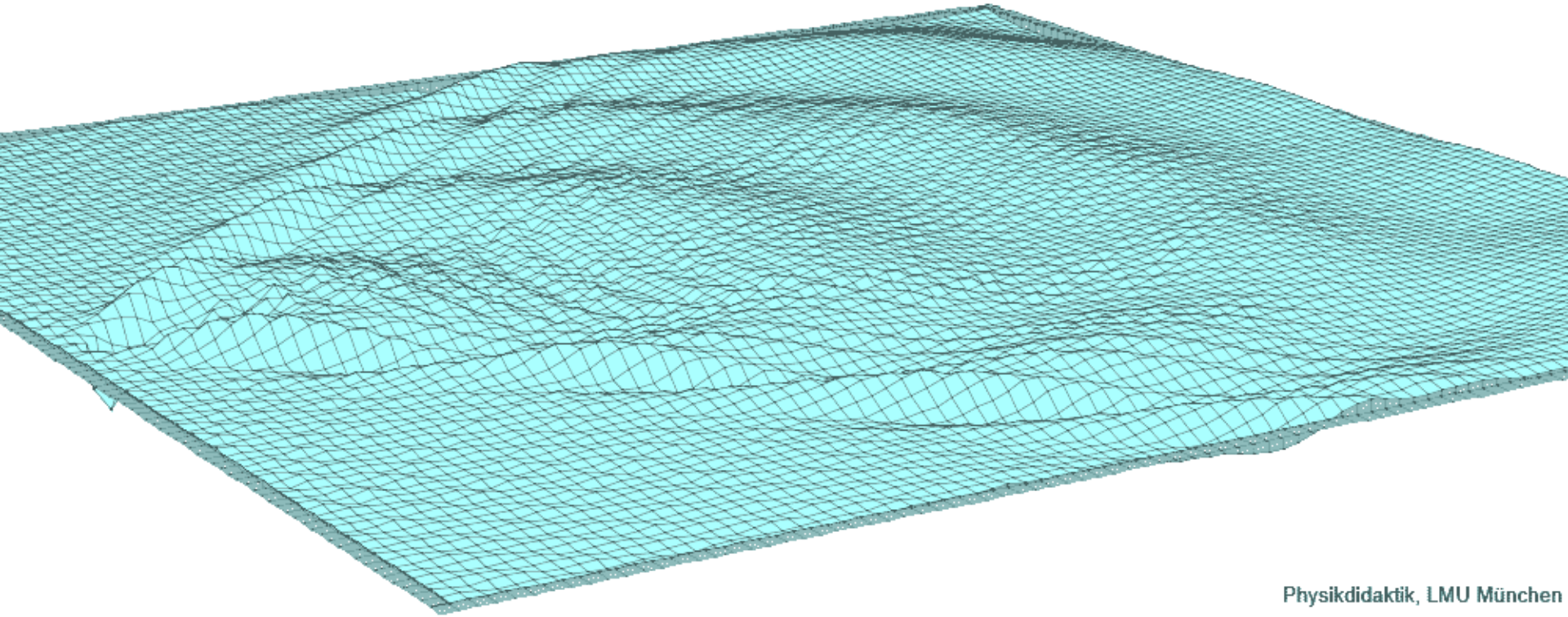
Single Concept Principle



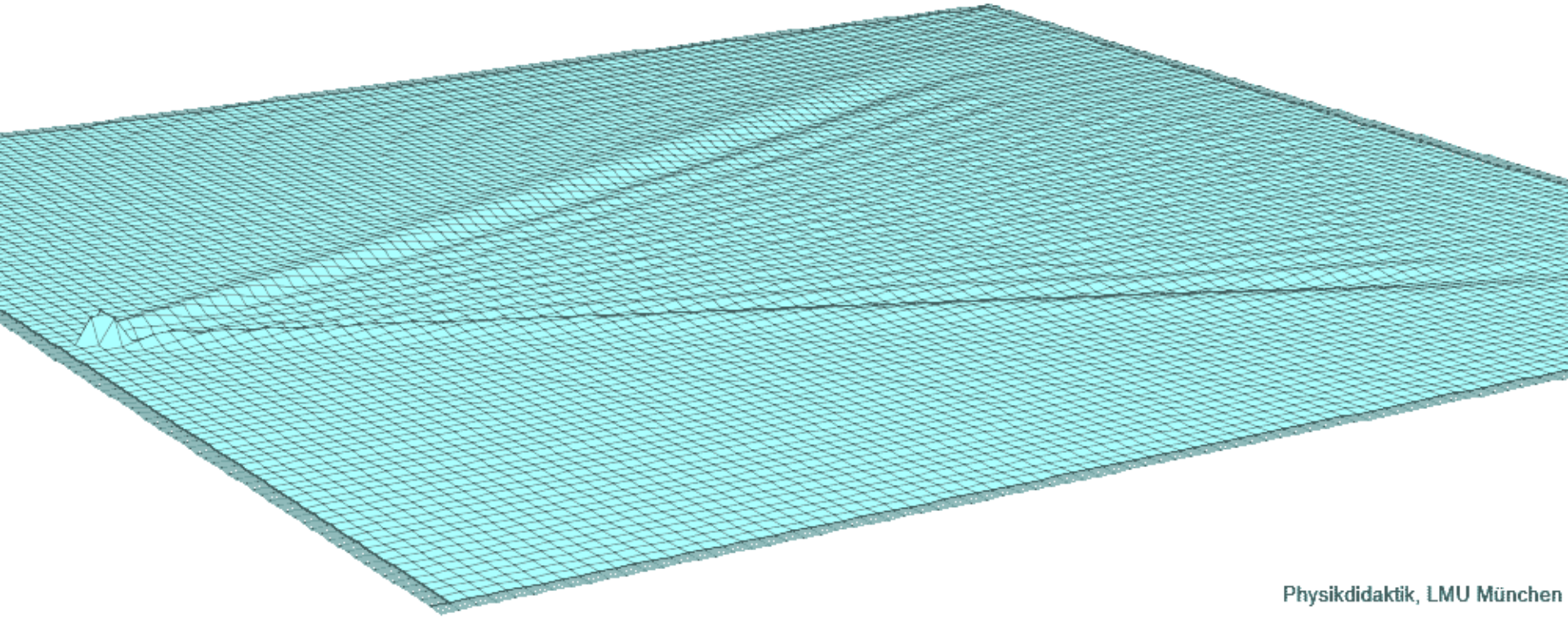
Single Concept Principle



Single Concept Principle



Single Concept Principle

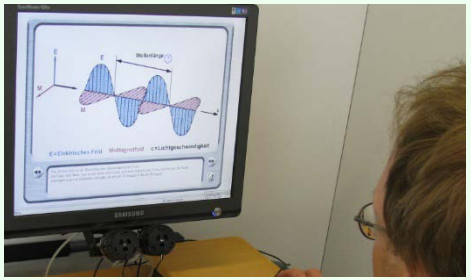


Single Concept Principle

Animated illustrations

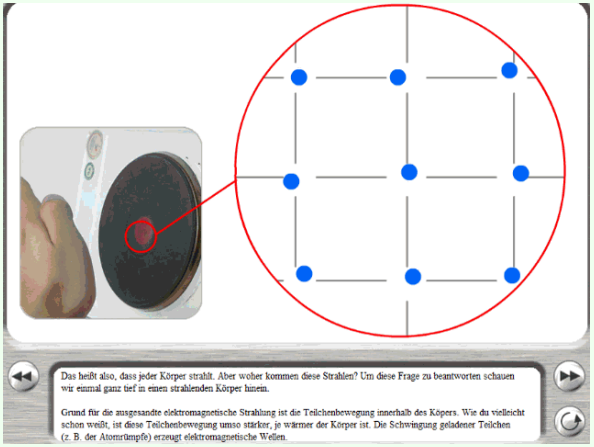
critical factors for effective information processing

- **Methode 1: Pre-post Tests (Fragebogen), zehn 9te Klassen (n=251)**
- **Method 2: Eye-tracker analysis**

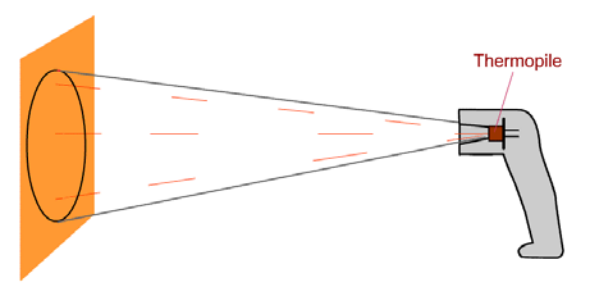


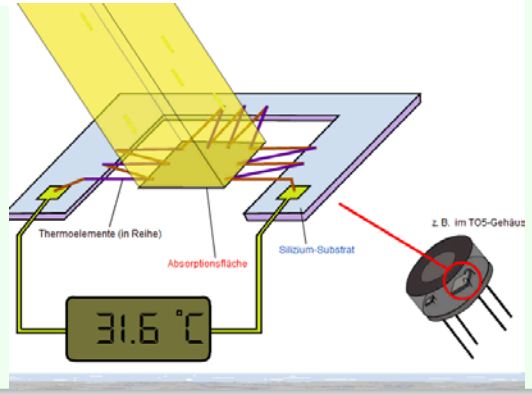
- Girwidz, R., Lippstreu, M. & Winterlin, A. (2010). Animated illustrations – finding critical factors for an effective information processing. In M. Michelini, R. Lambourne & L. Mathelitsch (eds.), Multimedia in Physics Teaching and Learning. Il Nuovo Cimento C, Vol. 33, N. 3. Italian Physical Society. (pp. 121-130).
- Lippstreu, M. & Girwidz, R. (2010). Multimodale, animierte Lernangebote im Physikunterricht – Zur Unterstützung von Visualisierungen durch Text und Ton. Notes on Educational Informatics — Section A: Concepts and Techniques 6 (2): 1-23, 2010.

Illustrations, Animations

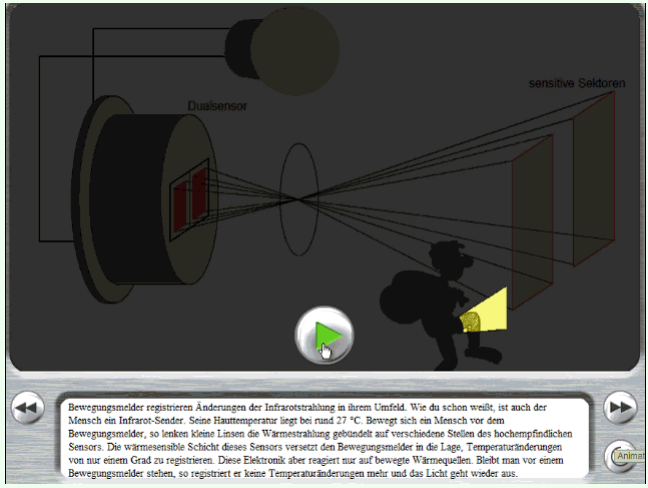


Bewegung geladener Teilchen

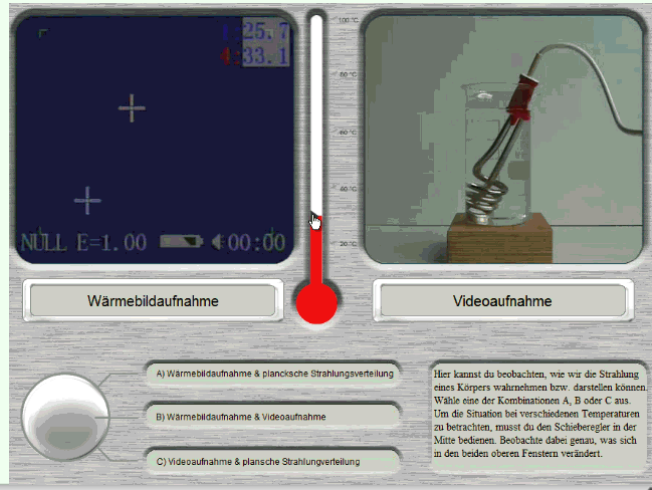




IR-Thermometer



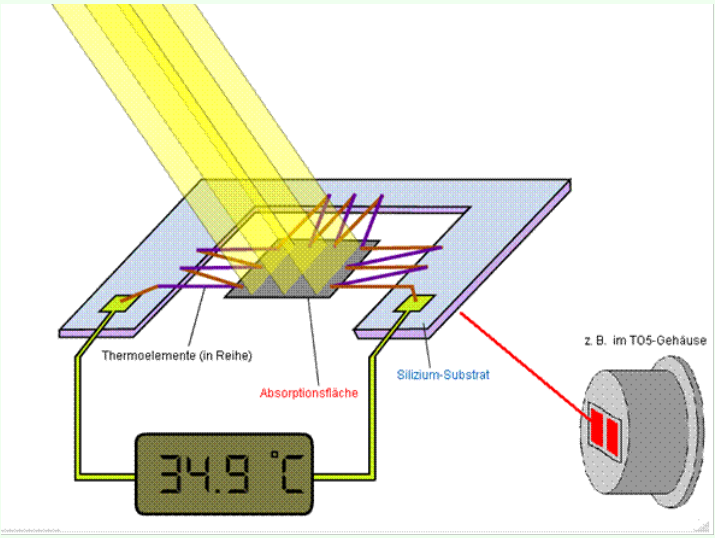
Infrarot Bewgungs-melder



Aufnahmen im IR und im Sichtbaren

Modalitätseffekt

- spoken text better for illustrations



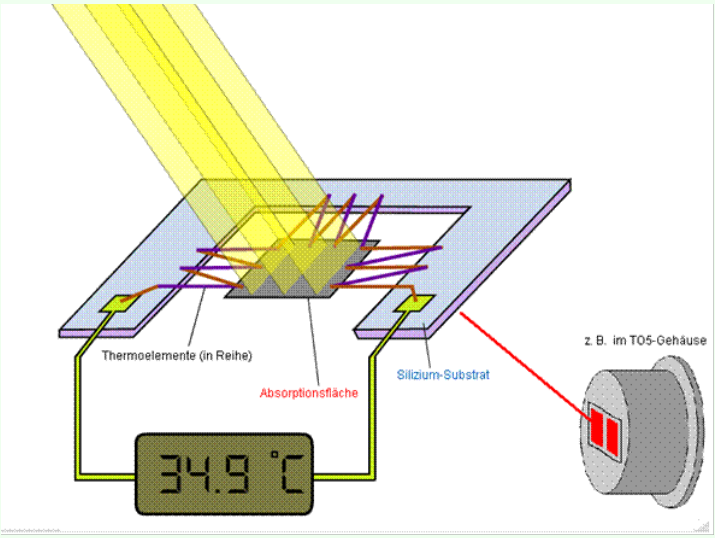
- written text for pure text knowledge

What is the surface temperature of the sun?

Modalitätseffekt

- spoken text better for illustrations

  not so gifted students



  good learners

- written text for pure text knowledge

What is the surface temperature of the sun?

Anforderungen

Informationsaufnahme lenken

Beispiel „Spotlight“

Anforderungen

Informationsaufnahme lenken

Faszinierende Bilder

naturwissenschaftlich arbeiten mit faszinierenden Bildern zur Physik

http://www2.didaktik.physik.uni-muenchen.de/bilder/

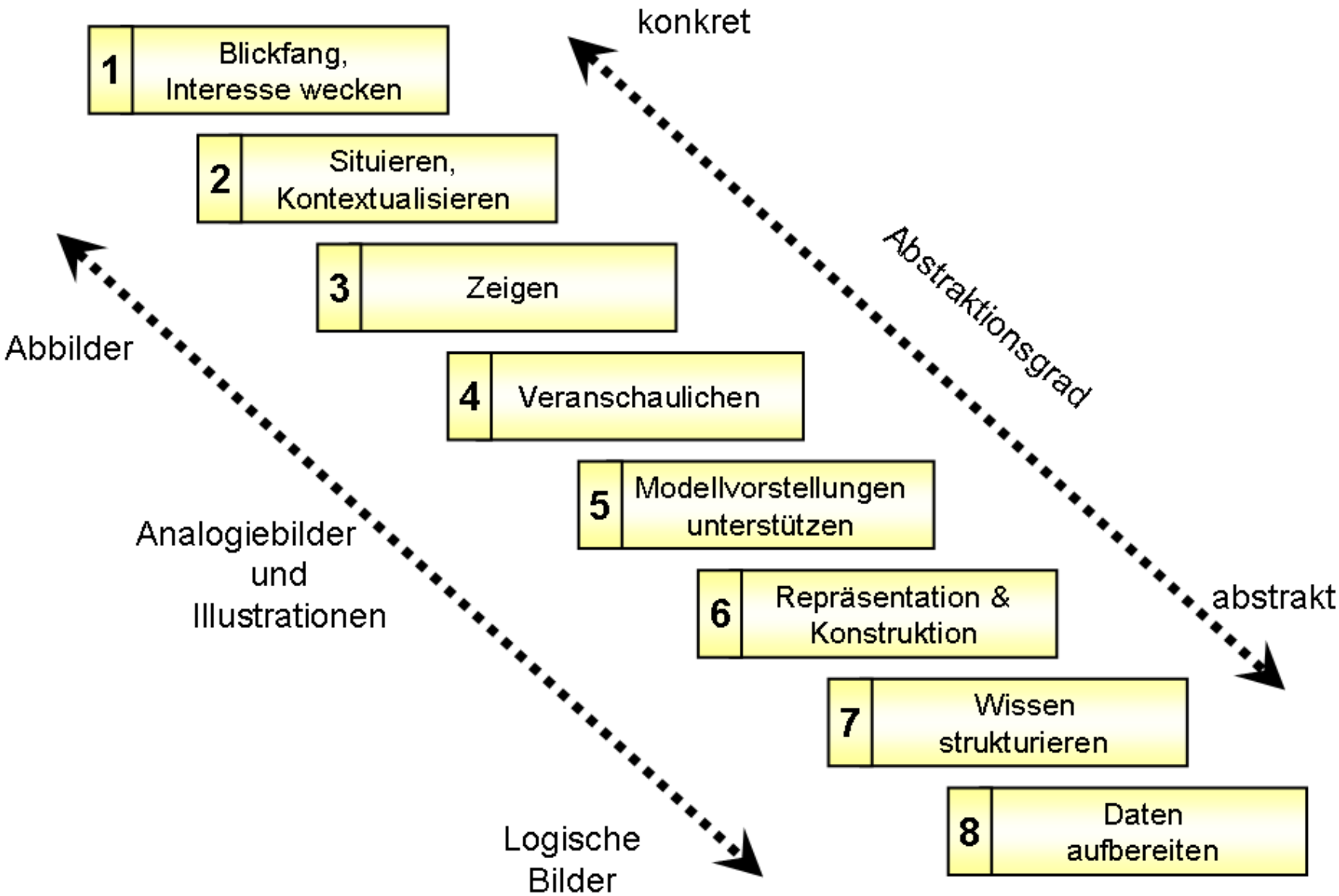
Zusammenfassung

A) Abbilder oder Abbildungen

B) Analogiebilder

c) Logische Bilder

Techniken - Anforderungen


konkret
abstrakt
Abstraktionsgrad
Abbilder
Analogiebilder und Illustrationen
Logische Bilder
1 Blickfang, Interesse wecken
2 Situieren, Kontextualisieren
3 Zeigen
4 Veranschaulichen
5 Modellvorstellungen unterstützen
6 Repräsentation & Konstruktion
7 Wissen strukturieren
8 Daten aufbereiten

Mögliche Probleme:

- Cognitive overload
- Symbolik / Darstellung nicht klar
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- Ergänzungsbedarf prüfen
- Informationsaufnahme lenken
- Verarbeitungstiefe sichern