

FACHDIDAKTISCHE KONZEPTE UND - UNTERRICHTSPRINZIPIEN

2025, Nikolaus Albrecht

Skript: <http://www.sigmadelta.at/>

INHALT:

1_Organisation, Ablauf und was Sie erwartet

2_Geometrical Reasoning

3_Diagnostic Questions

4_Mini Whiteboards

5_Onlineboards

6_Craig Barton's Websites

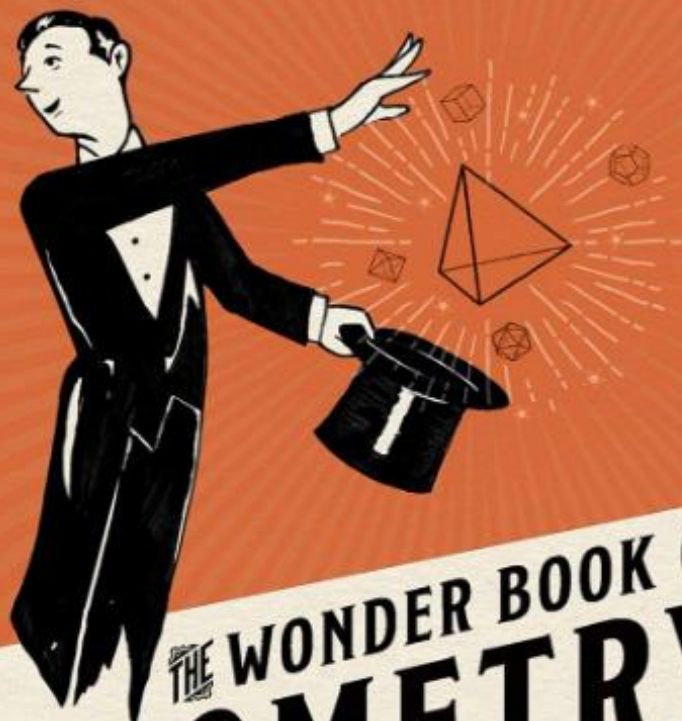
7_Why basics first

8_Map-competition

13:00 – 14:30	erster Block
14:30 – 14:45	Pause
14:45 – 16:00	zweiter Block
16:00 – 17:45	dritte Block

Geometrical reasoning

DAVID ACHESON



THE WONDER BOOK OF
GEOMETRY

a mathematical story

Thales

The key question is not

“What do we know?”

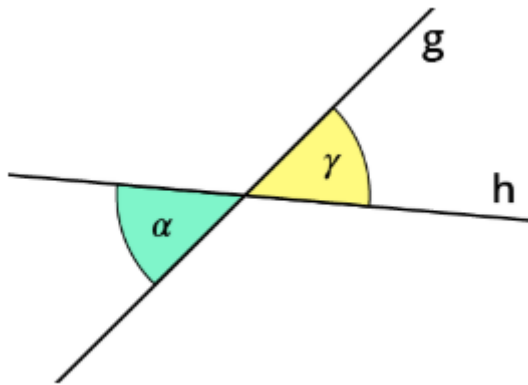
but rather

“How do we know?”

Aufwärmübung:

1

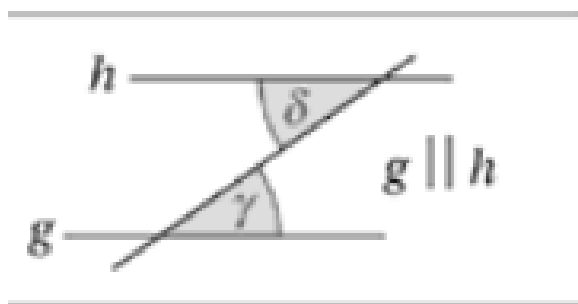
Gegenüberliegende Winkel / Opposite Angles:



2

Alternierender Winkel

Wechselwinkel
an geschnittenen Parallelen sind gleich groß.



3

Winkelsumme im Dreieck

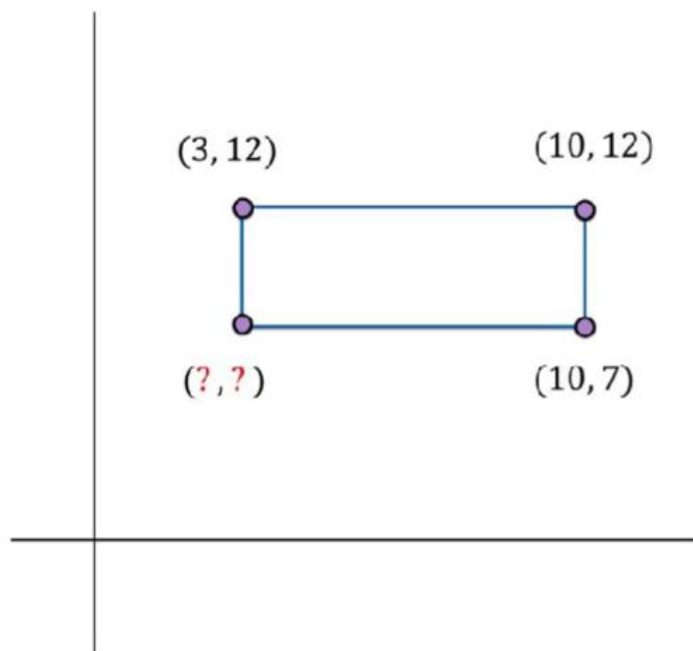
THE **TIPS FOR** TEACHERS GUIDE TO

Cold Call



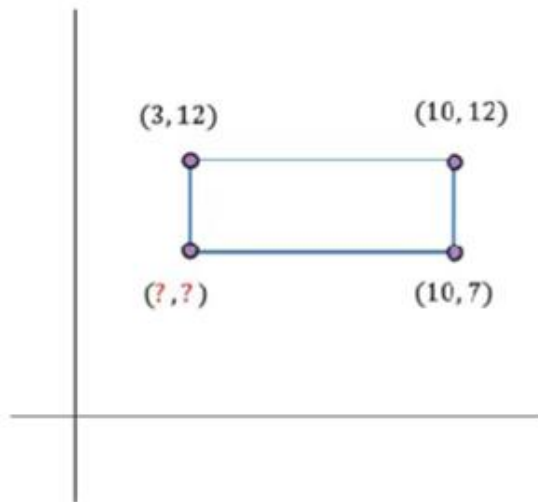
CRAIG BARTON

Punkte und Linien (im strikten Sinne)



What is the coordinate of the missing vertex of the rectangle?

- A $(7, 10)$
- B $(7, 3)$
- C $(3, 10)$
- D $(3, 7)$



What is the coordinate of the missing vertex of the rectangle?

- ☐ A $(7, 10)$
- ☐ B $(7, 3)$
- ☐ C $(3, 10)$
- ☐ D $(3, 7)$

A

B

C

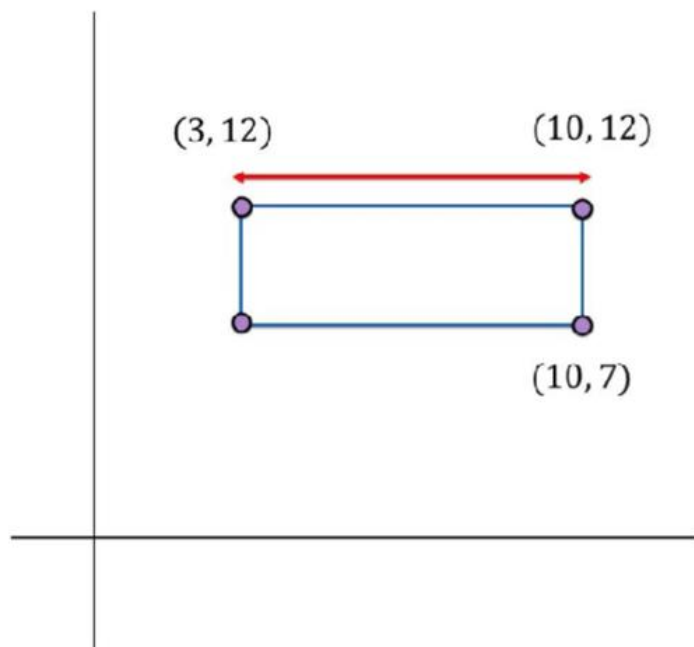
D

5%

6%

9%

80%



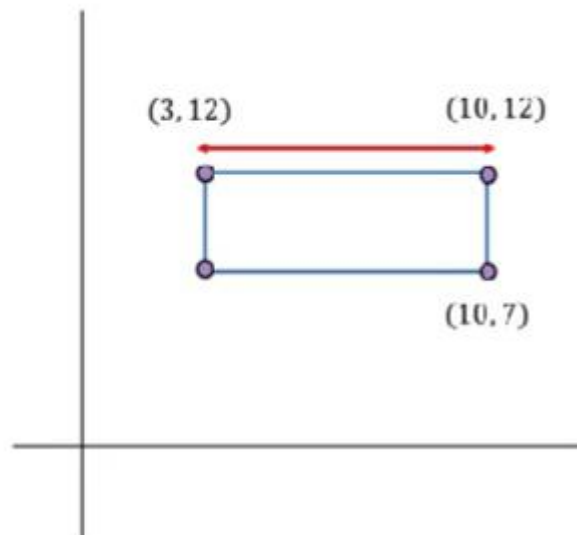
What is the width of
this rectangle as
indicated by the arrow?

A 12

B 7

C 5

D 13



What is the width of this rectangle as indicated by the arrow?

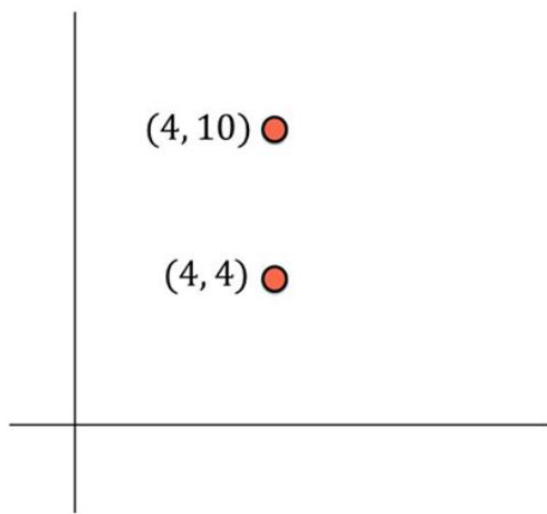
A 12

B 7

C 5

D 13

A**B****C****D****4 %****84 %****6 %****6 %**



Tom and Katie are discussing what coordinates would complete a square.

Tom says $(9, 4)$ and $(9, 10)$

Katie says $(1, 7)$ and $(7, 7)$

Who is correct?



Only
Tom



Only
Katie

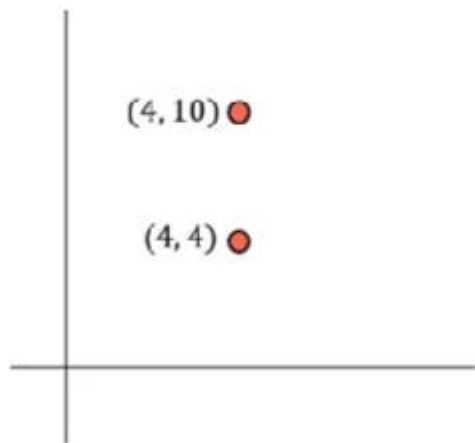


Both Tom
and Katie



Neither is
correct

- What is the correct answer?
- What reasons might students give for choosing each of the wrong answers?
- What do you predict is the most popular wrong answer?



Tom and Katie are discussing what coordinates would complete a square.

Tom says $(9, 4)$ and $(9, 10)$

Katie says $(1, 7)$ and $(7, 7)$

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

© Eedi 2018

A

B

C

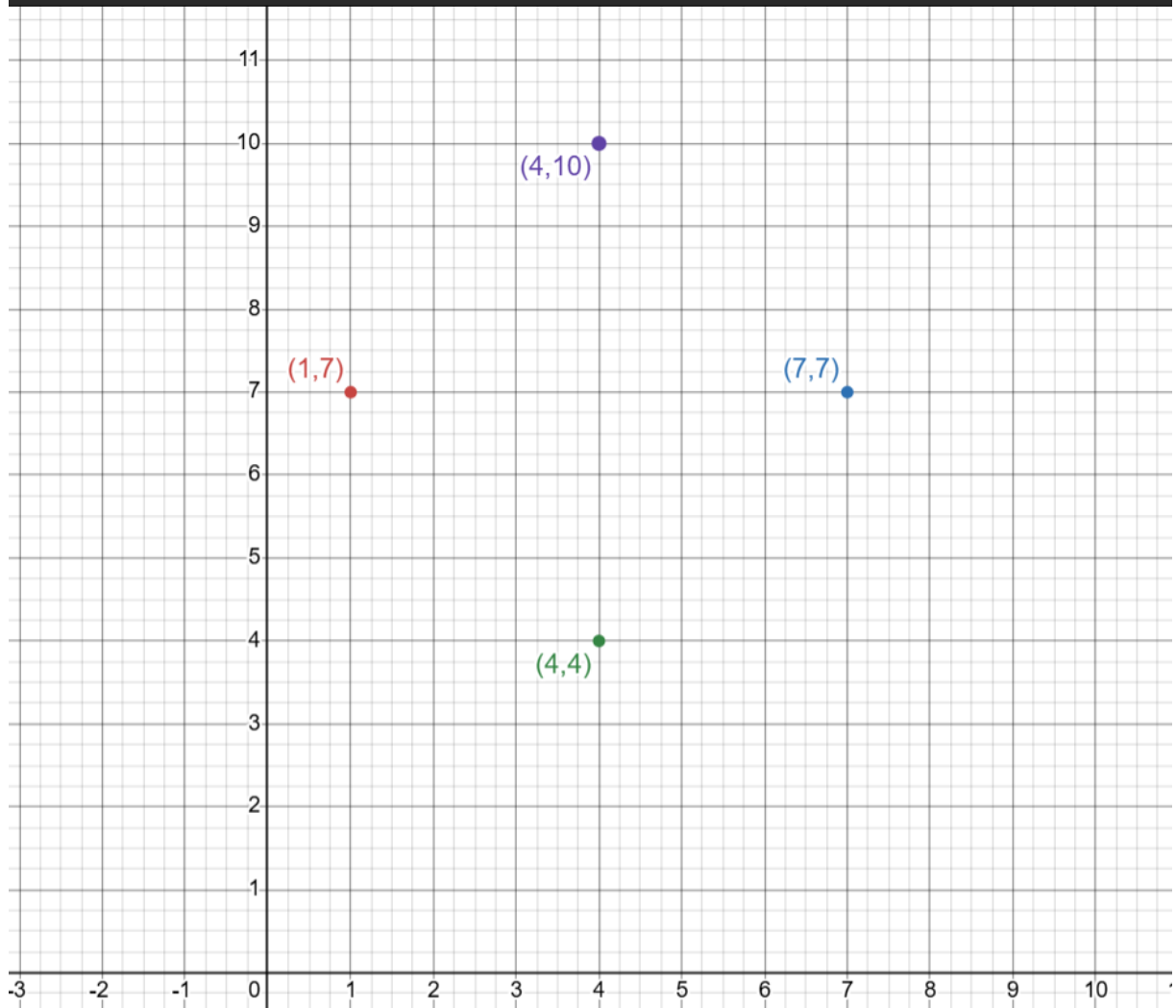
D

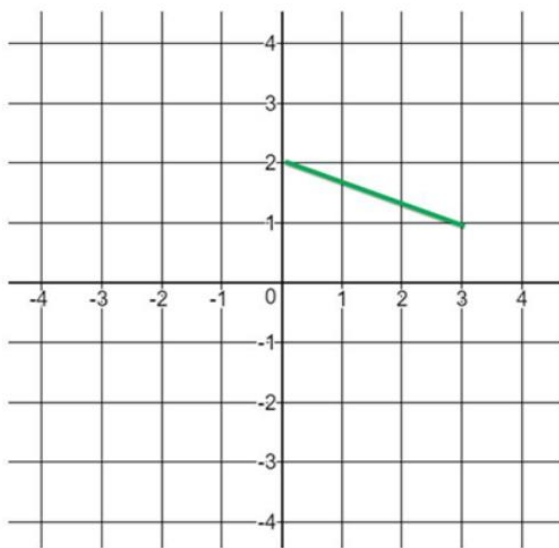
47 %

16 %

8 %

29 %





The line segment is one side of a square.

Tom says a vertex of the square could be $(2, -2)$.

Katie says a vertex of the square could be $(1, 5)$.

Who is correct?



Only
Tom



Only
Katie

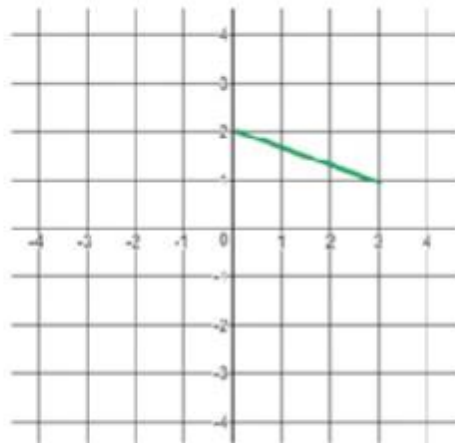


Both Tom
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Neither is
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The line segment is one side of a square.

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Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

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A

B

C

D

23 %

18 %

36 %

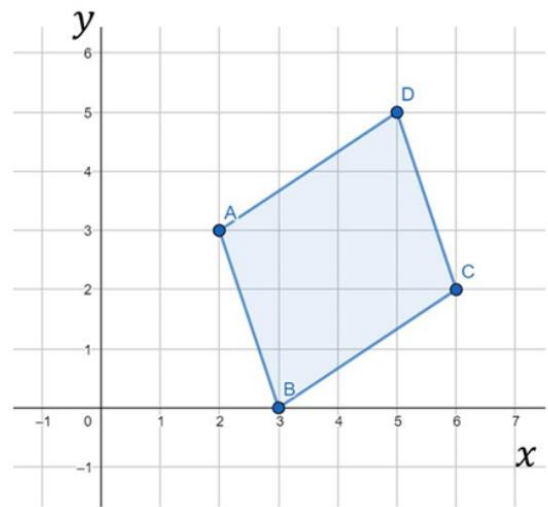
22 %

Tom and Katie are arguing about the shape on the right.

Tom says it is a parallelogram.

Katie says it is a rhombus.

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

- What is the correct answer?
- What reasons might students give for choosing each of the wrong answers?
- What do you predict is the most popular wrong answer?

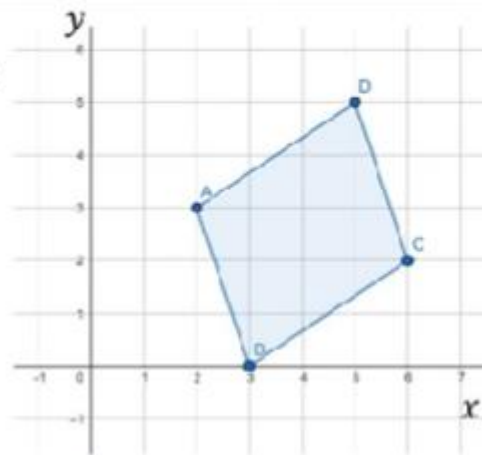


Tom and Katie are arguing about the shape on the right.

Tom says it is a parallelogram.

Katie says it is a rhombus.

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

© Eedi 2018

A

B

C

D

47 %

25 %

21 %

7 %

Tom and Katie are arguing about distance and coordinates.

Tom says $(3, -2)$ and $(2, -3)$ are equidistant from the origin.

Katie says $(4, 1)$ and $(3, 2)$ are equidistant from the origin.

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

- What is the correct answer?
- What reasons might students give for choosing each of the wrong answers?
- What do you predict is the most popular wrong answer?



Tom and Katie are arguing about distance and coordinates.

Tom says $(3, -2)$ and $(2, -3)$ are equidistant from the origin.

Katie says $(4, 1)$ and $(3, 2)$ are equidistant from the origin.

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

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A

B

C

D

40 %

19 %

21 %

20 %

Line segment P joins up $(1, 1)$ and $(3, 6)$.

Line segment Q joins up $(3, 1)$ and $(7, 3)$.

Which line segment is longer?



P



Q



They are the
same length



We need more
information

- What is the correct answer?
- What reasons might students give for choosing each of the wrong answers?
- What do you predict is the most popular wrong answer?



Line segment P joins up (1, 1) and (3, 6).

Line segment Q joins up (3, 1) and (7, 3).

Which line segment is longer?



P



Q



They are the
same length



We need more
information

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A	B	C	D
35 %	38 %	16 %	11 %



5.-8. Schulstufe

+ Religion

+ Sprachen

- Mathematik und Naturwissenschaften

+ Mathematik

+ Geometrisches Zeichnen (Realgymnasium und Mittelschule_Schwerpunkt Mathematik und Naturwissenschaften)

+ Digitale Grundbildung

+ Chemie

+ Physik



Zentrale fachliche Konzepte (1. bis 4. Klasse):

Dem Mathematikunterricht der Sekundarstufe I liegen die folgenden vier inhaltlichen Kompetenzbereiche zugrunde:

Zahlen und Maße sind Mittel, um die Eigenschaften realer Objekte und Phänomene durch Zählen bzw. Messen quantitativ zu erfassen und einer Berechnung zugänglich zu machen.

Aufbauend auf den Erfahrungen aus der Primarstufe werden Grundvorstellungen und operative Fertigkeiten im Bereich der natürlichen Zahlen gefestigt. Diese werden zunächst zu den nichtnegativen Dezimal- und Bruchzahlen, dann weiter zu den ganzen und rationalen Zahlen und schließlich zu den reellen Zahlen erweitert. Im Zuge dieser Zahlbereichserweiterungen treten sowohl realitätsbezogene Aspekte (Zahlen als Messergebnisse) als auch innermathematische Arbeits- und Denkweisen (Zahlen als eigenständige, abstrakte Objekte) in Erscheinung.

Variablen und Funktionen sind zentrale mathematische Konzepte, mit denen sich Zusammenhänge zwischen Größen bzw. Zahlen beschreiben und untersuchen lassen.

Die Vorstellung von Variablen als Platzhalter wird bereits in der Primarstufe thematisiert. Der weitere Ausbau des Variablenbegriffs ist eine Voraussetzung für den Übergang vom arithmetischen hin zum algebraischen Denken. Funktionale Betrachtungsweisen treten bereits zu Beginn der Sekundarstufe auf, zB bei

Figuren und Körper

Der Variablenbegriff wird allerdings erst am Ende der Sekundarstufe I eingeführt. Figuren und Körper werden zur Beschreibung realer Objekte. Sie werden zeichnerisch dargestellt, ihre Lagebeziehungen werden beschrieben und

untersucht. Das räumliche Vorstellungsvermögen wird im Unterricht weiterentwickelt und gefestigt. Winkel-, Längen-, Flächen- und Volumenbeziehungen werden begründet und zu Berechnungen genutzt. Arithmetische Beziehungen werden geometrisch dargestellt; umgekehrt werden geometrische Darstellungen arithmetisch gedeutet.

Daten und Zufall werden im Informationszeitalter immer wichtiger. Kenngrößen und Diagramme der beschreibenden Statistik dienen der Orientierung und Entscheidungsfindung. Der Wahrscheinlichkeitsbegriff ist grundlegend für die Quantifizierung von Sicherheit.^{6,7}

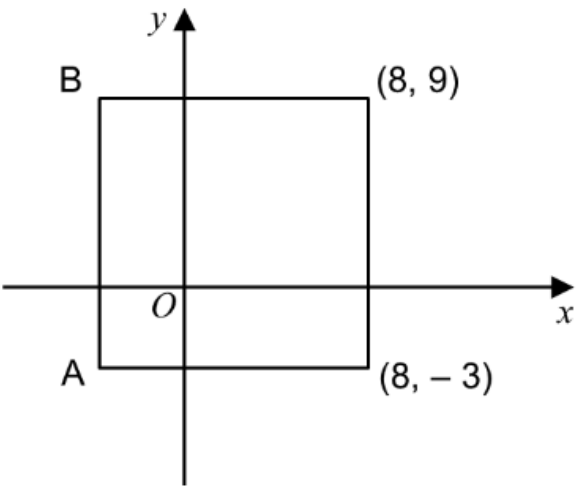
Der Wahrscheinlichkeitsbegriff wird – ausgehend vom alltäglichen Sprachgebrauch von „wahrscheinlich“ – intuitiv entwickelt und der Zusammenhang von Wahrscheinlichkeiten mit relativen Häufigkeiten bei wiederholbaren Zufallsexperimenten hergestellt.

***** Figuren und Körper *****

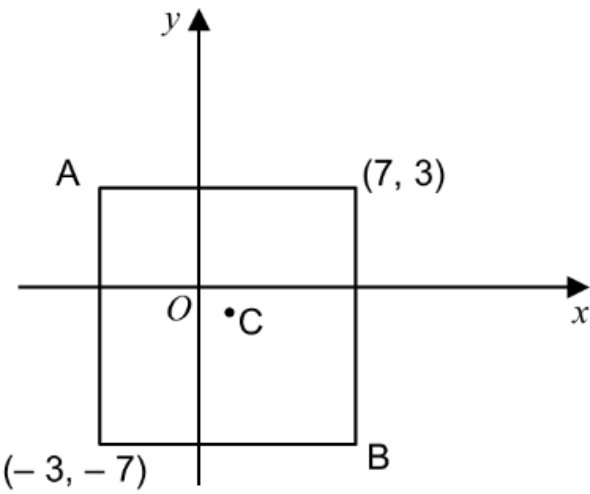
1. Klasse	• Rechtecke, deren Umfang und Fläche • Quader, deren Oberfläche und Volumen
2. Klasse	• Kartesisches Koordinatensystem (hier auch Anbindung der negativen ganzen Zahlen) • Dreiecke / Vierecke und deren Fläche
3. Klasse	• Ähnlichkeit (insbesondere ähnliche Dreiecke) • Prisma
4. Klasse	• Pythagoras • Kreis, dessen Umfang und Fläche • Kreisteile • Volumen Zylinder und Kegel

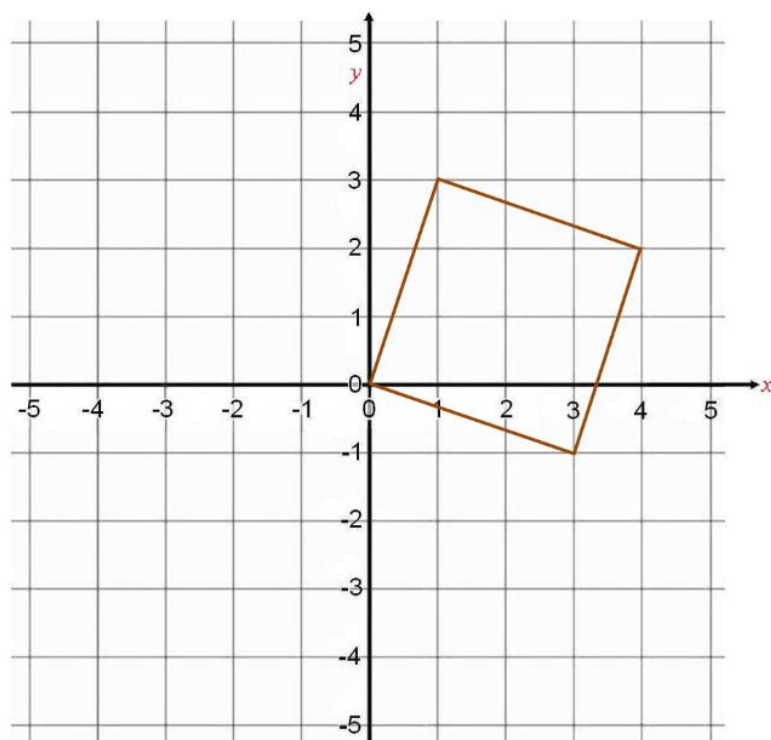
squares and coordinates (ii)

(1)



(2)





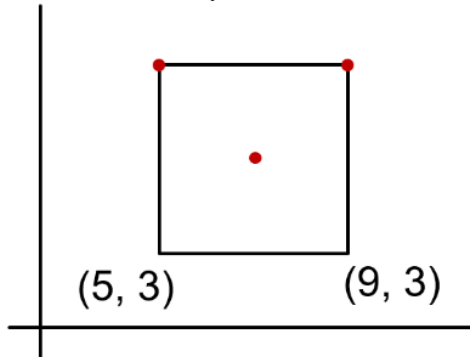
one corner = $(0, 0)$

one corner = $(1, 3)$

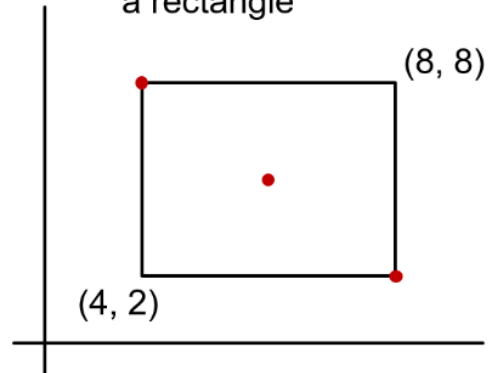
other corners?

squares on a grid

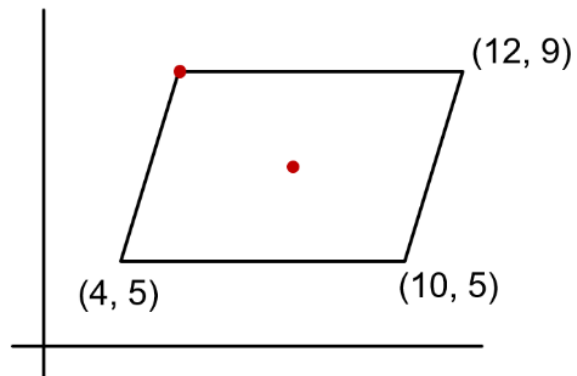
a square



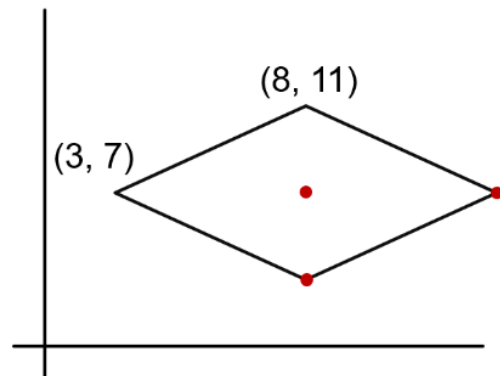
a rectangle



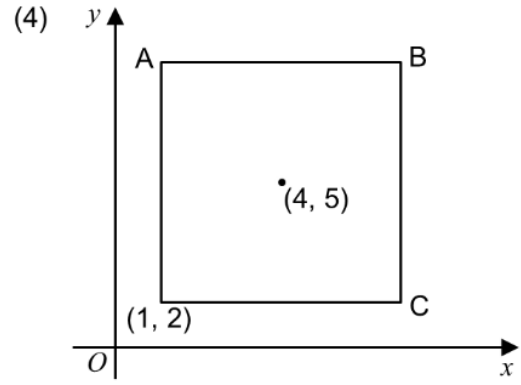
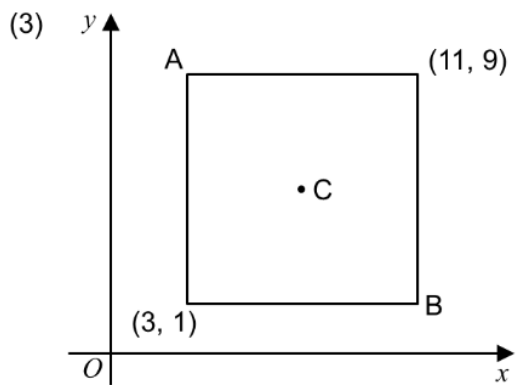
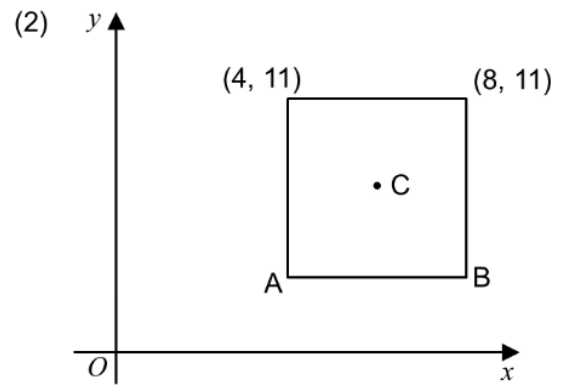
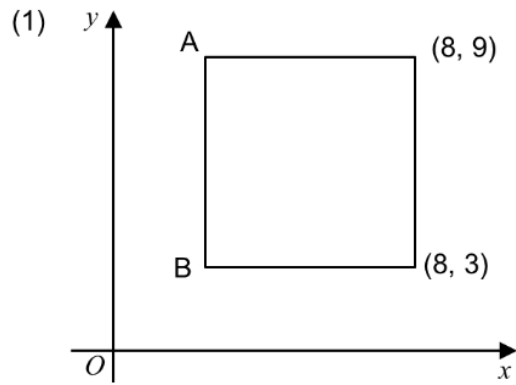
a parallelogram



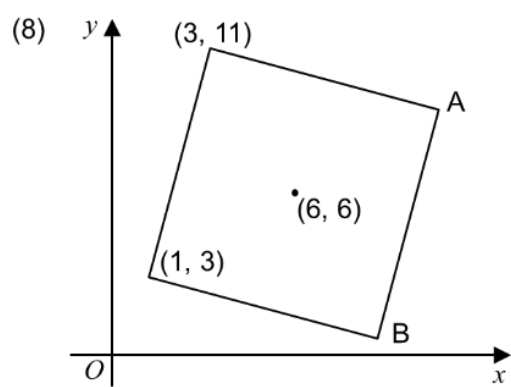
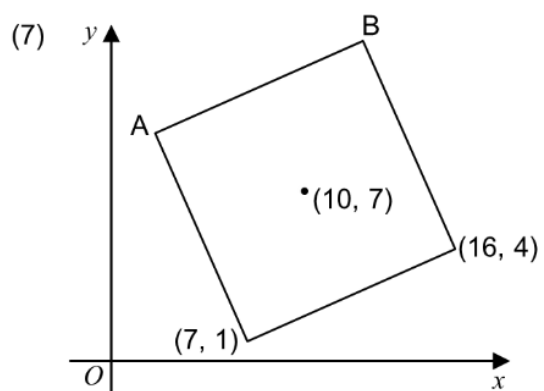
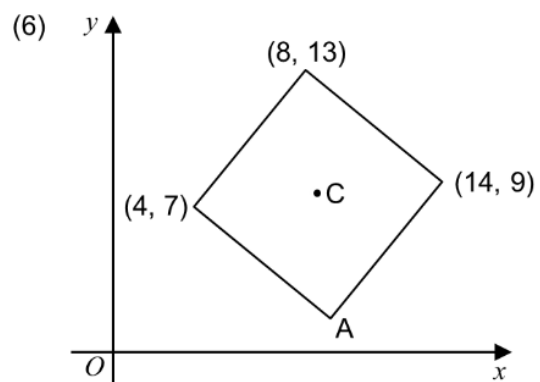
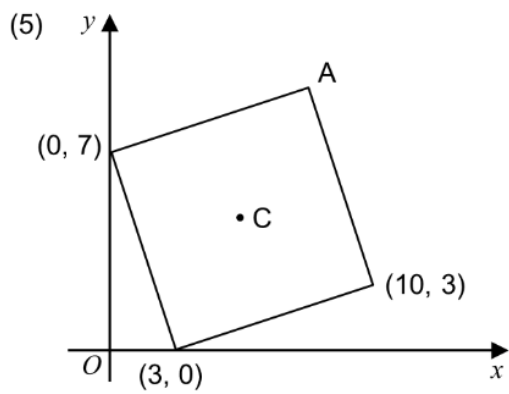
a rhombus



squares and coordinates (i)



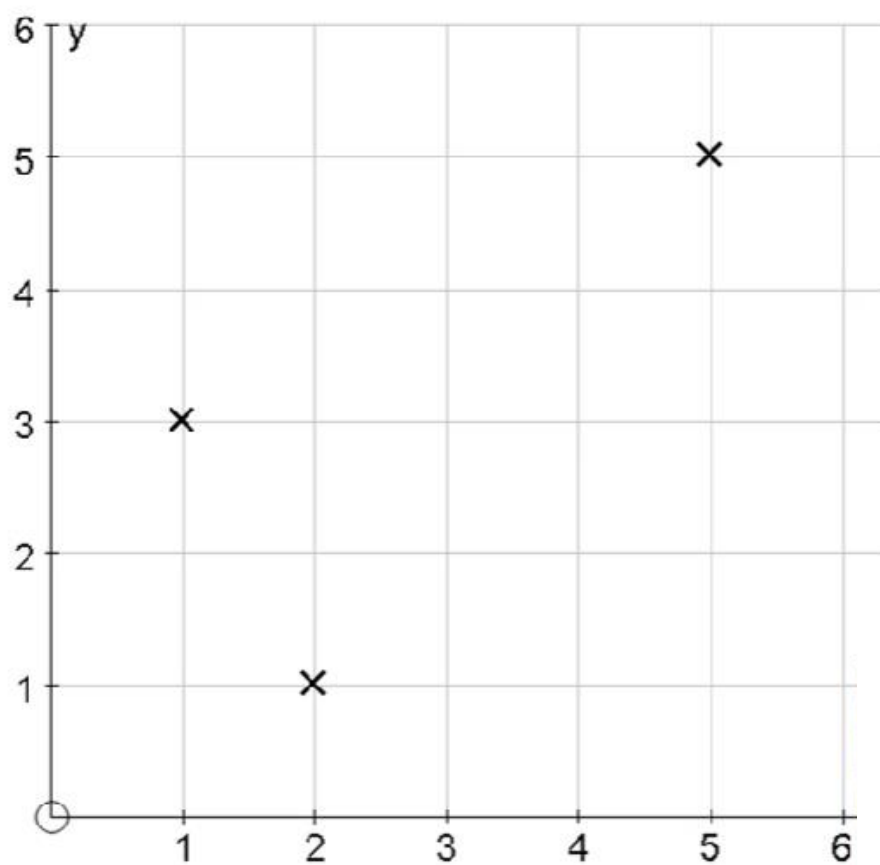
squares and coordinates



Resource:

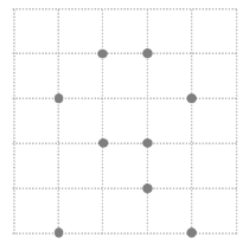
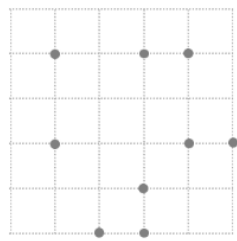
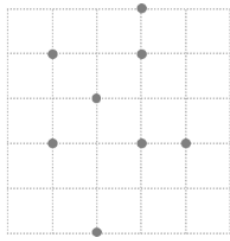
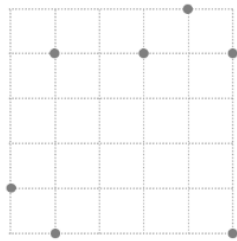
<https://donsteward.blogspot.com/>

Find the point needed to make a **rectangle**

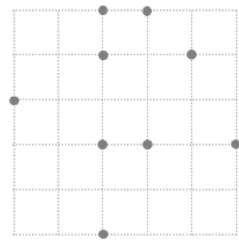
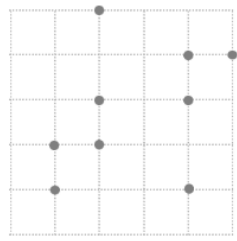
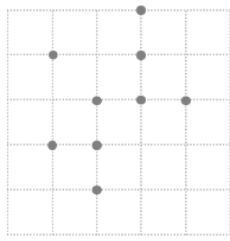
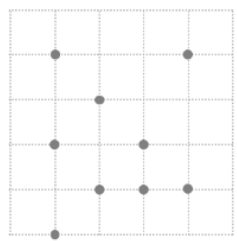


squares

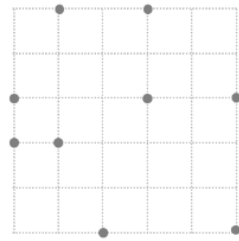
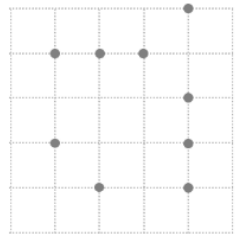
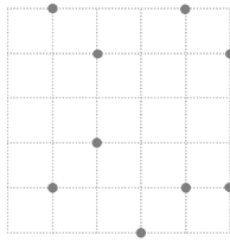
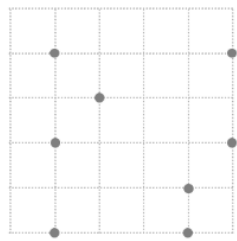
(1)



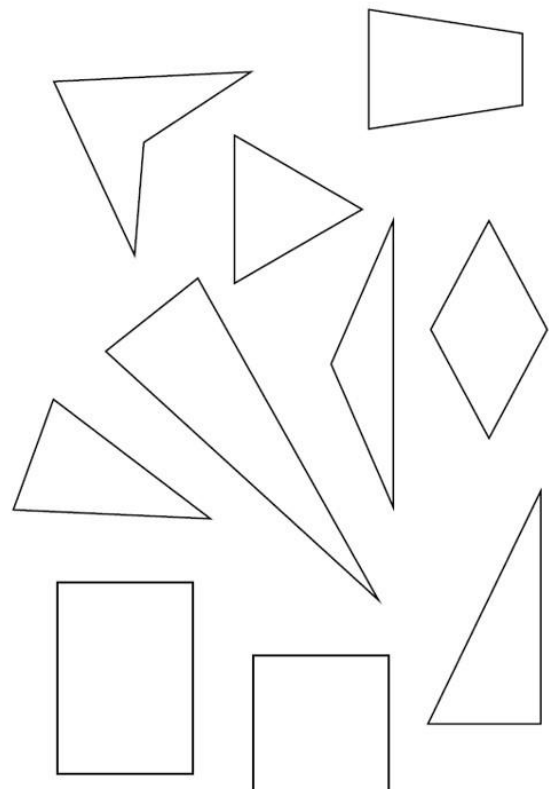
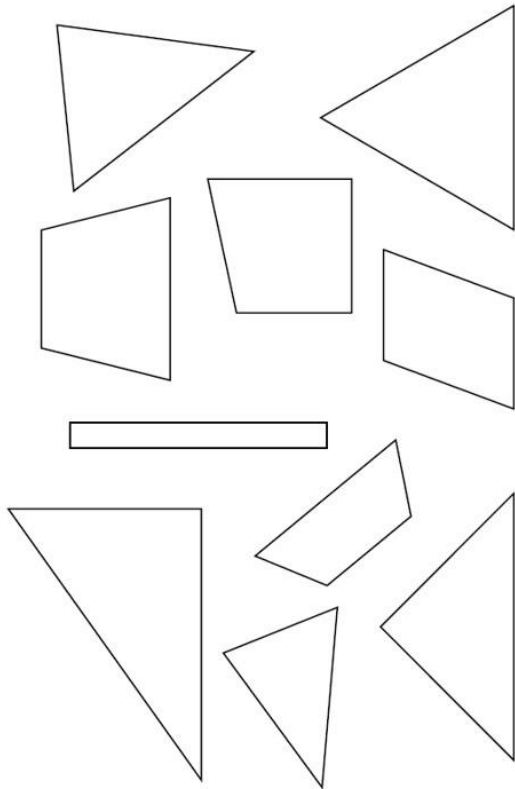
squares



rectangles



Kein Wunder ...



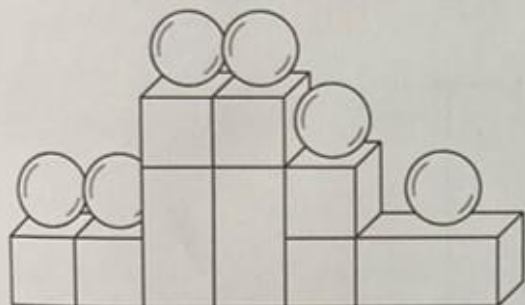
Dreiecke

Quadrate

Rechtecke

Vierecke

2 Male an: die Quader gelb , die Würfel grün , die Kugeln rot .

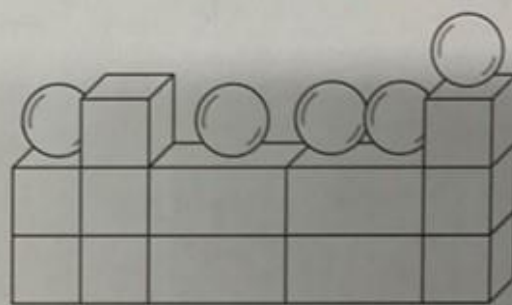


3



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—



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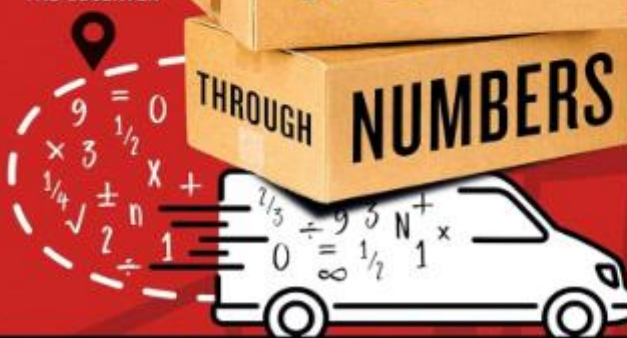
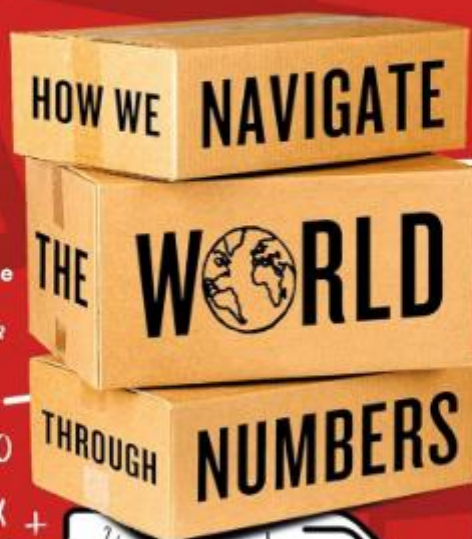
—

'Opens our eyes to the use of mapmaking'
JOHN GRIBBIN

Mapmatics

'An
expansive
journey
through space
and time'
THE OBSERVER

'I love maps.
I love math.
And gosh,
do I love
this book'
BEN ORLIN

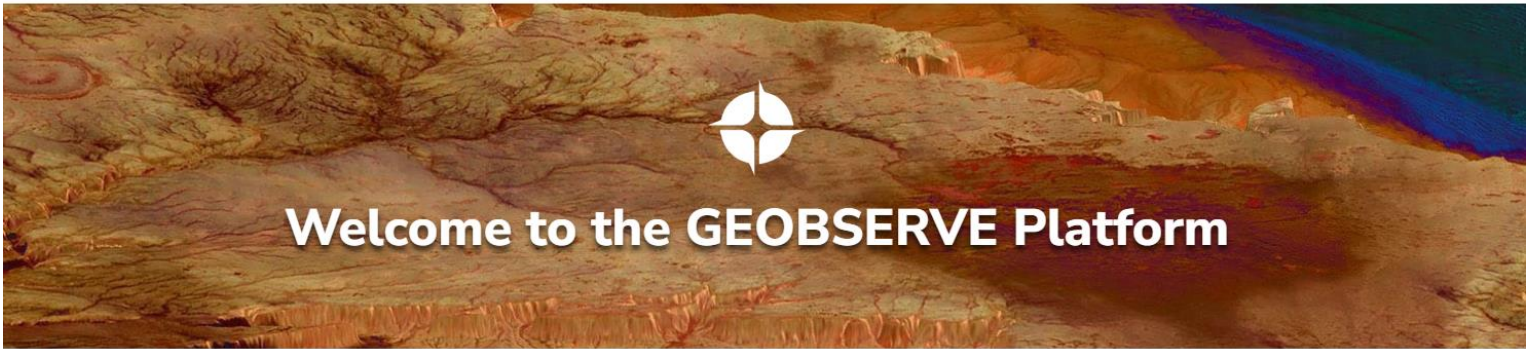


Paulina Rowińska

<https://portal.geoacademy.eu/courses/the-numbers-beneath-the-map/>



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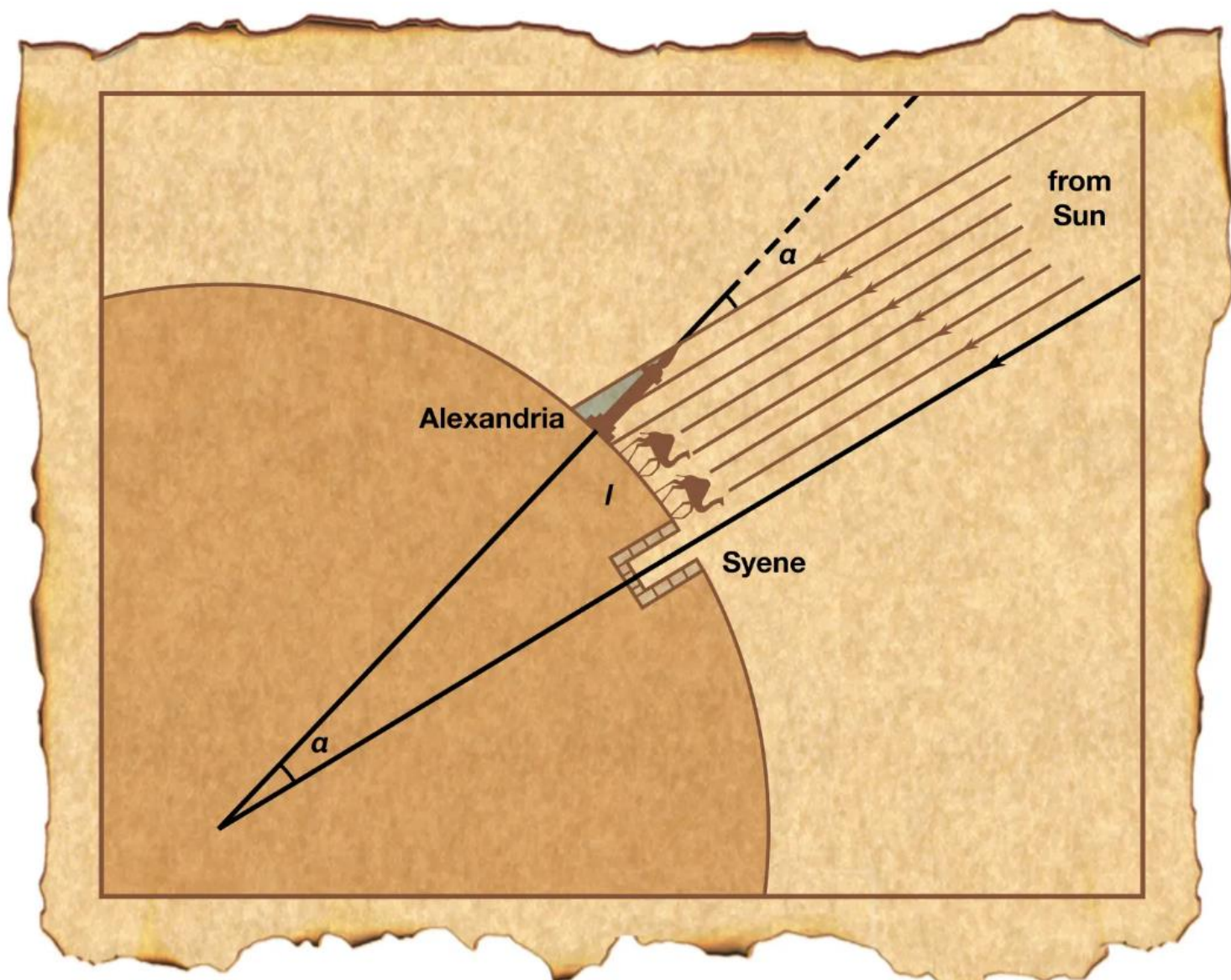
[Join Group](#)

Freiwillig, aber dennoch ...

ANMELDEN / LOGIN / REGISTIEREN

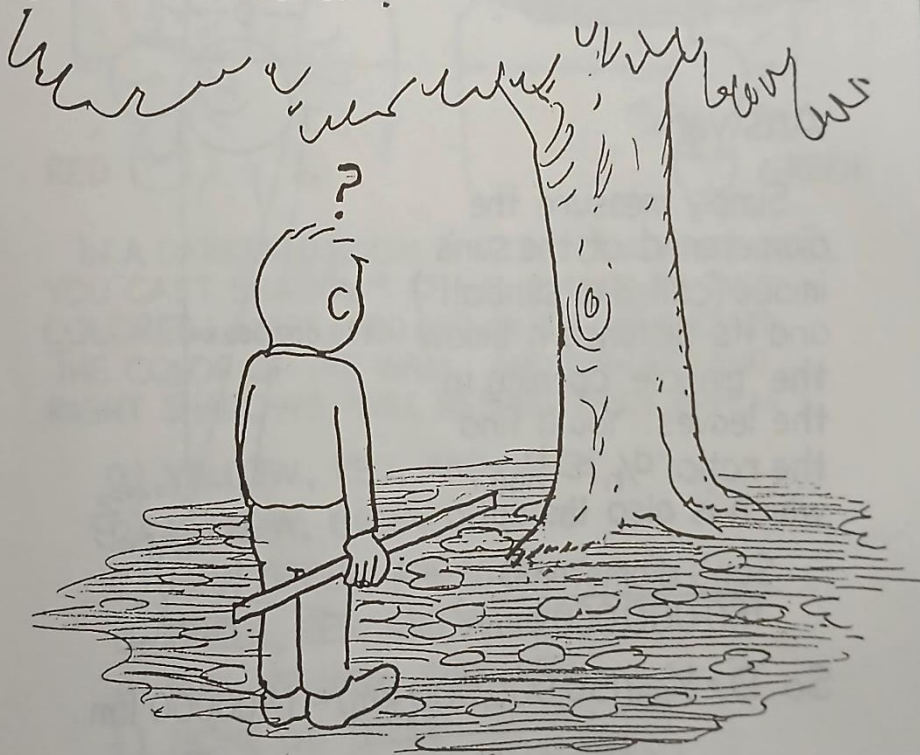
BEITRETEN DER „AUSTRIA-GROUP“

<https://docs.google.com/forms/d/e/1FAIpQLSehsNGUZwEaKla2CR6mp3SU2WOTUgNsgHRENDeeTIV0pRzalw/viewform?usp=header>



CONCEPTUAL **Physics**

Openings between leaves in the tree act as "pinholes" and cast images of the sun on the ground below. With only a meter-stick and the knowledge that the sun is 150,000,000 kilometers distant, how can one estimate the sun's diameter?



THANKS TO FRANK CRAWFORD

Hewitt
Drew it!

What comes next?

Instead of just watching examples, asking “What comes next?” before revealing the next step can significantly boost learning.

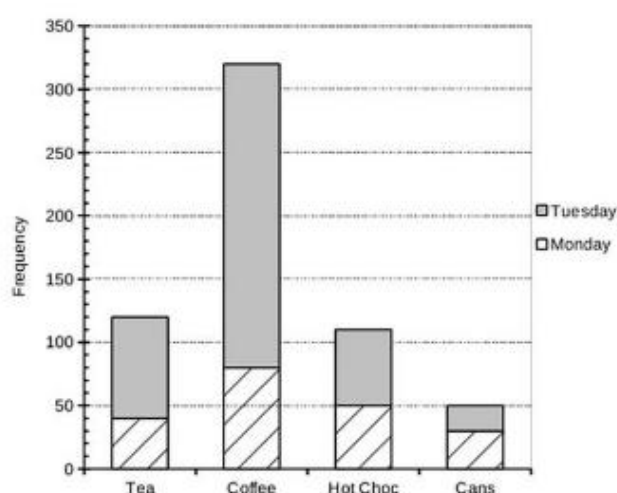
This study offers decent evidence that prompting students to *predict the next step* in a **worked example** (before showing it) can meaningfully improve learning. Instead of simply watching or reading worked-out problems, learners were asked to retrieve and articulate each next step out loud before being shown the correct answer. This small but powerful tweak improved performance on both recall and problem-solving tests after a week, particularly for recalling procedural steps. Crucially, the success of this strategy depended on **learners actually retrieving the correct steps**, highlighting that retrieval quality, not just quantity, matters.

So when using worked examples in maths, science, or other procedural subjects, teachers might pause before each step and ask students, “What comes next?” Whether done aloud, in writing, or via think-pair-share, this encourages active engagement and taps into the well-documented **“testing effect.”** Importantly, this approach avoids common **pitfalls of previous retrieval-based designs that made learners solve whole problems too soon and risked failure without feedback.** Instead, this stepwise method builds confidence while strengthening memory and understanding.

Step 1: Ask the question with the choices of answers removed

This taps into research that suggests that delaying presenting the choices of answers boosts the retrieval benefits of multiple-choice questions.

I= Eedi



The bar chart shows the drinks sold in Caroline's Café on Monday and Tuesday last week.

Approximately how many Hot Chocs were sold on Tuesday?

Once students have had sufficient thinking time, you could:

1. Ask them to show you their answer on a mini-whiteboard
2. Ask them to show you their answer, and what they think a popular wrong answer might be - asking for a plausible incorrect answer taps into research into the Derrington Effect.
3. Let students keep their answers to themselves, and show them the version of the question with the answer choices revealed

Don't respond at this stage.

Derring Effect:

https://tipsforteachers.co.uk/research-the-derring-effect-deliberate-errors-enhance-learning/?utm_source=substack&utm_medium=email

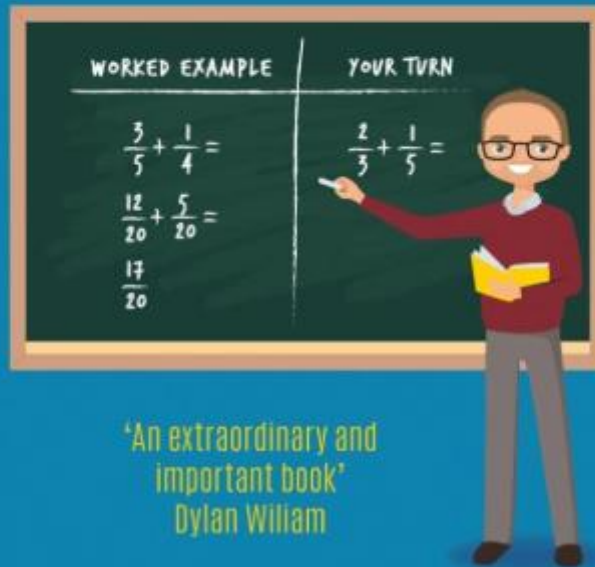
Find the rest of the this here:

<https://eedi.substack.com/p/dq-a-week-8-reading-bar-charts>

A JOHN CATT PUBLICATION

—CRAIG BARTON— HOW I WISH I'D TAUGHT MATHS

LESSONS LEARNED FROM RESEARCH, CONVERSATIONS
WITH EXPERTS, AND 12 YEARS OF MISTAKES



'An extraordinary and
important book'
Dylan William

UNDERSTANDING HOW WE LEARN

A VISUAL GUIDE



A David Fulton Book

A JOHN CATT PUBLICATION

Oliver Lovell

SWELLER'S
COGNITIVE LOAD THEORY
IN ACTION



IN ACTION
SERIES

EDITOR
**TOM
SHERRINGTON**

WITH ILLUSTRATIONS BY OLIVER CAVIGLIOLI

 **WALKTHRU'S**
PRODUCTION

NEXT ...

Diagnosefragen

Am Lehrplan orientieren (Kompetenzbereich und Break-out rooms)

Fermi-Aufgaben

Diagnosefragen:

Ausgangspunkt: Lehrplan | Arbeiten in Break-out Rooms (Zoom)

Lehrplan | Sekundarstufe I

Kompetenzbereich

Sehen und Hören

Tonhöhe / Frequenz

 Bundesministerium
Bildung, Wissenschaft
und Forschung



PHYSIK

(Sekundarstufe I)

Bildungs- und Lehraufgabe (2. bis 4. Klasse):

Ziel des Physikunterrichts ist die Weiterentwicklung der naturwissenschaftlichen Grundbildung von Schülerinnen und Schülern, damit diese kompetent handeln können. Dazu erwerben sie altersadäquates

Check for Understanding / Quellen für Diagnosefragen:

ONLINE:

The Physics Teacher | FIGURING PHYSICS | Paul Hewitt
and Paul Hewitt's "Next-Time Questions" (Print)

LINK: <https://pubs.aip.org/aapt/pte>

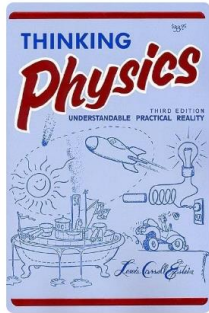
<https://www.arborsci.com/pages/next-time-questions>

<https://www.physicslab.org/compilations/nexttime.aspx>

PRINT:

Thinking Physics: Practical Lessons in Critical Thinking

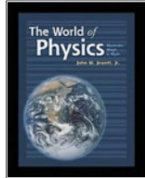
https://archive.org/details/ThinkingPhysicsPracticalLessonsInCriticalThinking_201808



https://ia803106.us.archive.org/35/items/ThinkingPhysicsPracticalLessonsInCriticalThinking_201808/Thinking-Physics-Practical-Lessons-in-Critical-Thinking.pdf

The World of Physics: Mysteries, Magic & Myth | John W. Jewett, Jr.

The World of Physics: Mysteries, Magic & Myth



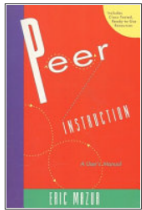
[John W. Jewett](#)

Harcourt College Publishers, 2001 - 397 Seiten

The Mysteries, Magic, and Myth (the "M"s) of the physics of everyday life are revealed in this engaging new resource for students, physics teachers, general science teachers, and anyone intrigued by the physical world. The book follows the subjects of more traditional physics books, but with a truly enlightening presentation.

Peer Instruction: A User's Manual | Eric Mazur

Peer Instruction: A User's Manual, Teil 1



[Eric Mazur](#)

Prentice Hall, 1997 - 253 Seiten

Peer Instruction: A User's Manual is a step-by-step guide for instructors on how to plan and implement Peer Instruction lectures. The teaching methodology is applicable to a variety of introductory science courses (including biology and chemistry). However, the additional material-class-tested, ready-to-use resources, in print and on CD-ROM (so professors can reproduce them as handouts or transparencies)-is intended for calculus-based physics courses.

Diagnostic Questions

...

PRINT:

Thinking Physics: Practical Lessons in Critical Thinking

https://archive.org/details/ThinkingPhysicsPracticalLessonsInCriticalThinking_201808



Use of Mini-Whiteboards

White Board

Dry Erase 21x30cm Double Sided Mini Whiteboard with 16 Pens and 16 Erasers
Durable Portable for Classroom, Home and Office



Anki-Kartenset

LINK:

https://www.sigmadelta.at/temp/6_1_SEHEN-HÖREN.apkg

https://www.sigmadelta.at/temp/6_2_OPTISCHE-SYSTEME.apkg

... GRIP

KLAUS

ALBRECHT

(c) On this page, the laws of thermodynamics apply.

n.albrecht@ph-tirol.ac.at | <https://klausalbrecht.substack.com/about>

Diagnosefragen | Was ist zu bedenken?



craig barton diagnostic questions

×

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Diagnostic Questions

<https://diagnosticquestions.com> ⋮

Diagnostic Questions

Diagnostic Questions is a world leading assessment tool that provides detailed insights into student understanding in a fraction of the time.

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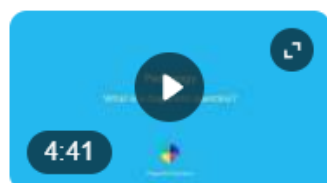
Tips for Teachers by Craig Barton

<https://tipsforteachers.co.uk> › [diagnostic-questions](#) ⋮

Diagnostic questions

All the multiple-choice questions I write have the same structure: **one correct answer and three wrong answers** – known as distractors – each designed to reveal ...

Videos :



What is a Diagnostic Question? - Diagnostic Questions ...

YouTube · mrbartonmaths1

14 Nov 2016



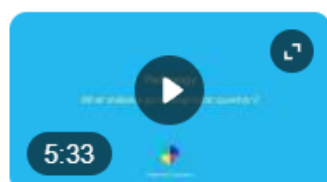
6 key moments in this video



Diagnostic Questions - the perfect exit ticket? - Tips for Teachers

YouTube · Tips for Teachers

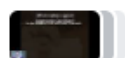
10 Mar 2022



What makes a good Diagnostic Question? - Diagnostic ...

YouTube · mrbartonmaths1

14 Nov 2016



5 key moments in this video



Medium · Craig Barton

80+ likes · 7 years ago



What is a Diagnostic Question?

Diagnostic questions are **designed to help identify, and crucially understand students' mistakes and misconceptions** in an efficient and accurate manner.



Third Space Learning

<https://thirdspacelearning.com> › blog › diagnostic-quest... 

Diagnostic Questions for Teachers: A Comprehensive ...

A complete guide to using **diagnostic questions** to identify and address misconceptions. Plus free primary and secondary **diagnostic questions**.



Mr Barton Maths

<https://mrbartonmaths.com> › formulae-and-functions 

Functions: Diagnostic Questions

I built **Diagnostic Questions** to help you identify, understand and resolve key misconceptions. Here is a selection of free resources to get you started. Contents.



AFT - American Federation of Teachers

https://www.aft.org/ae_summer2018_barton PDF ⋮

On Formative Assessment in Math: How Diagnostic ...

by C Barton · 2018 · Cited by 32 — By Craig Barton. I am going to start with a rather big claim: **asking and respond- ing to diagnostic questions is the single most important thing.** I do every ...



Medium · Craig Barton

310+ likes · 7 years ago ⋮

What makes a good Diagnostic Question? | by Craig Barton

A key feature of a good diagnostic question is that we should be able to **accurately infer a student's understanding from** their answer alone without needing to ...



ERIC (.gov)

<https://eric.ed.gov> > ... ⋮

On Formative Assessment in Math: How Diagnostic Questions ...

by C Barton · 2018 · Cited by 32 — A good diagnostic question (1) **should be clear and unambiguous;** (2) should test a single skill or concept; (3) should allow students to answer in fewer than 10 ...



Loughborough University

<https://www.lboro.ac.uk/services/lumen> PDF ⋮

Formative assessment and diagnostic questions

Extension. • Write the best explanation you possibly can for the correct answer. • Convince me why each of the alternative answers is wrong.

37 pages



0



ADD TO QUIZ

An aeroplane accelerates at 2.5m/s^2 and undergoes a change of velocity of 40m/s . How long does it take the aeroplane to achieve this change in velocity?

- A. Time = 100 s
- B. Time = 37.5 s
- C. Time = 0.0625 s
- D. Time = 16 s



0



ADD TO QUIZ

<https://tipsforteachers.co.uk/diagnostic-questions/>

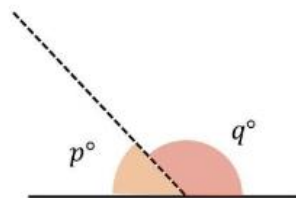
Diagnosis

1. What role do multiple-choice questions play in your teaching?
2. What is your process for asking them and collecting students' responses?
3. How do you respond to the data?

What things can diagnostic questions assess?

1. Factual recall

I= Eedi



Which of the following is true?

A

$$p + q = 90^\circ$$

B

$$p + q = 100^\circ$$

C

$$p + q = 180^\circ$$

D

$$p + q = 360^\circ$$

© Eedi 2018

Can students recall a fact or relationship?

2. Procedural

I= Eedi



Tom and Katie are arguing about a first step to solve this equation:

$$\frac{m - 1}{4} = 20$$

Tom says you can write: $\frac{m}{4} = 21$

Katie says you can write: $m - 1 = 80$

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

© Eedi 2018

Can students correctly carry out a given procedure?

3. Conceptual

I= Eedi



Tom and Katie are arguing about factors and multiples.

Tom says two numbers might not have a highest common factor.

Katie says two numbers might not have a lowest common multiple.

Who is correct?



Only
Tom



Only
Katie



Both Tom
and Katie



Neither is
correct

© Eedi 2018

How secure is students' conceptual understanding?

Some take-aways:

Good diagnostic questions have targeted distractors

Multiple-choice questions can be more cognitively challenging than open-response questions. Whilst it may seem that multiple-choice questions are easier than open-response questions because students can guess the answer or pick up on cues as to what the correct answer is, a well-constructed multiple-choice question, with plausible and well-designed distractors, can be more challenging than an open-ended question because it forces students to engage in a process of active evaluation, reasoning and retrieval and to avoid the lure of the distractors in their quest to get the question correct.

Thinking does not need to stop with the correct answer.

When might teachers use a multiple-choice diagnostic question?

During a spaced retrieval

Letzte U-Einheit / 1 Woche / 2 Wochen / 1 Monat / 2 Monat

To assess relevant prior knowledge.

Following an explanation.

What makes a good multiple-choice diagnostic question?

Each distractor should be plausible and reveal the specific nature of a child's misunderstanding

It should not be possible to get the question correct for the wrong reasons

Negativ-Beispiel:

What is the mean of the following numbers?
0, 1, 4, 5, 10

A	B	C	D
4	5	20	10

Mean || Median

A student could get the correct answer of 4 by working out the mean or the median.

Challenge students first to answer the question without the choice of answers

Challenge students to explain the wrong answers to a diagnostic question

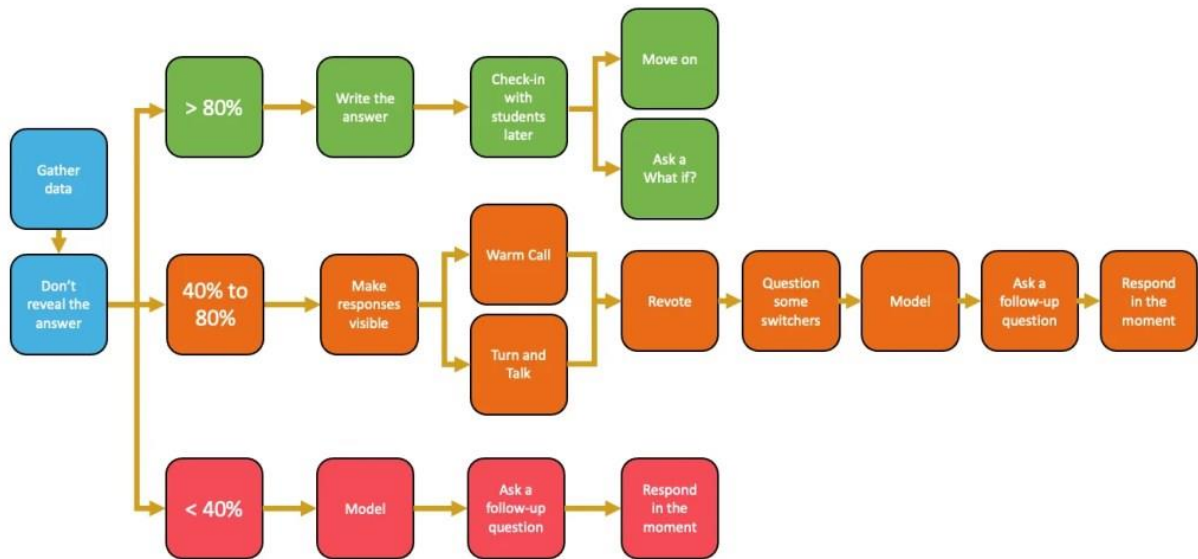
Routines

1. Think in silence... so you can fully concentrate
2. You can do working out if you like... to help organise your thoughts
3. Think about the answer and rehearse how you would explain it... so you are ready to share with the class
4. Don't look at anyone else's working... as I want to know what you think so I can help you if needed (everyone needs help sometimes)
5. Only show your me your answer when I ask... so everyone has a chance to think for themselves

Heads-down

<https://tipsforteachers.co.uk/wp-content/uploads/2024/11/Heads-down.mp4>

What next ?



Make sure students know the correct answer

Which of the following means the same as

$$ab^2$$

A

$$a \times b \times b$$

B

$$a \times b \times 2$$

C

$$a \times b \times a \times b$$

D

$$a \times a \times b$$

Eine Überlegung wert ...

Derrington Effect | Students are asked to generate good distractors

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The derring effect: Deliberate errors enhance learning.

©REQUEST PERMISSIONS

Wong, S. S. H., & Lim, S. W. H. (2022). The derring effect: Deliberate errors enhance learning. *Journal of Experimental Psychology: General*, 151(1), 25–40. <https://doi.org/10.1037/xge0001072>

How can we strategically and systematically learn from our errors? Over their long history, errors have traditionally been prevented entirely or, at best, permitted to occur spontaneously. Across three experiments, we tested and found evidence for a counterintuitive phenomenon that we termed the derring effect—deliberately committing errors even when one already knows the correct answers produces superior learning than avoiding them, particularly when one's errors are corrected. Learners engaged in an educationally relevant task of learning scientific term-definition concepts via open-book study by deliberately generating conceptually incorrect definitions with or without correction, or copying and underlining them (Experiment 1). On a cued recall test, deliberate erring outperformed errorless copying,

Get Access

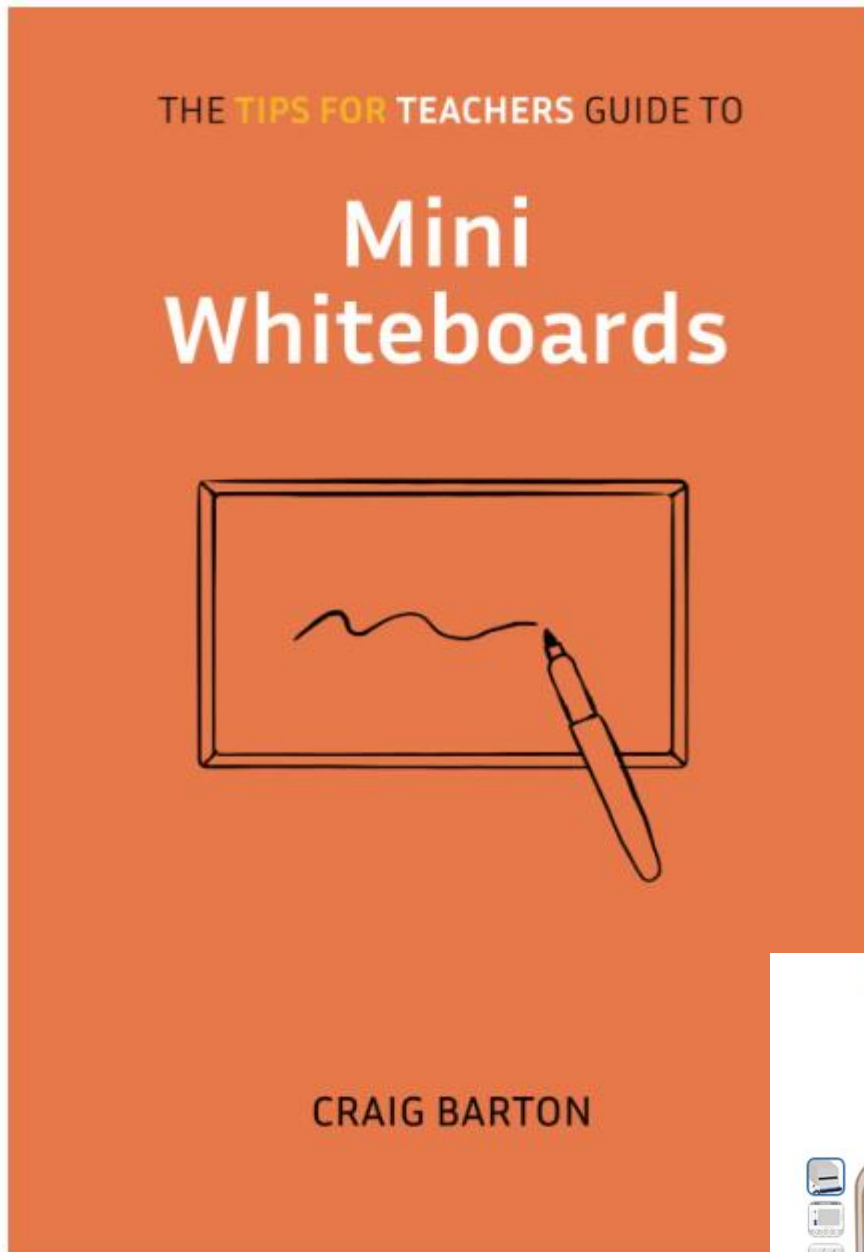
Exit-Tickets ...

Students must

generate a question, the correct answer, plausible wrong answers, and reasons for those answers. This makes a fantastic Exit Ticket, homework assignment, or assessment question, allowing students to demonstrate the depth of their understanding.

MINI-WHITEBOARDS

(Diagnostic Questions) & **Mini-Whiteboards**:



White Board

Dry Erase 21x30cm Double Sided Mini Whiteboard with 16 Pens and 16 Erasers
Durable Portable for Classroom, Home and Office



If you want to use them ...

1) Plan Mini-Whiteboards access

Where will the Mini-Whiteboards, rubber and pen be stored?

When will students collect the Mini-Whiteboards?

How will students collect the Mini-Whiteboards?

Where will the Mini-Whiteboards go when they are not being used?

What happens to the Mini-Whiteboards at the end of the lesson?

2) Be prepared to ...

Some pens may not working ...

3) Front-load the means of participations ...

Adam Boxer

<https://mrbartonmaths.com/blog/adam-boxer-cpd/>

4) Ask ...students to write their names at the top of their board

5) Train you students to write **BIG** ...

6) Hover boards face-down ...

**7) Ask students to show their boards on your signal –
not before ...**

8) Carefully select the required response time.

9) Decide what to write – if they do not know the answer.

10) Insist everyone holds up their board

11) Combat students looking at each other's work

12) Tell the students not to erase their answers until you give them permission to do so.

13) THIS WOULD BE OF GREAT HELP: Having a departmental Mini-Whiteboard policy

Example:

- When using Whiteboards, we are silent.
- We don't doodle.
- When we've finished writing, hover our boards face down.
- We hold up our whiteboards, after 3 – 2 - 1

14) Explicitly model the steps of the routine.

15) Start with non-subject (or easy) content.

16) TEACH the routine explicitly!

17) Showcase excellent Mini-Whiteboard use

18) Don't let standards fall throughout the lesson.

19) Overcome the “Valley of Latent Potential”

Peps Mccrea

<https://snacks.pepsmccrea.com/p/valley-of-potential>

20) The difficulty to process 30 responses ... (back row, middle row, front row)

21) A different way to control the flow of information: selectively lowering students boards.

22) Limit the information you want to be shown

**23) Assess multi-step questions / procedures
using step-by-step**

24) Pay attention to the responses of certain students

Low attainers – if they are correct, there is a good chance everyone is.

High attainers – if they are struggling, there is a good chance everyone is.

Students who struggled previously – to see if they now understand.

Students who show low or high confidence.

25) Ask students to add a confidence score in the corner.

Hypercorrection Effect

<https://tipsforteachers.co.uk/research-learning-from-errors>

**26) Einzelne Schülerantworten auf die
Klassentafel übernehmen.**

27) Schüler arbeiten an der Lösung einer Aufgabe in ihrem Heft. Check final answer with Whiteboards.

28) Wertvolle Ergänzungsfragen für Diagnosefragen im Multiple-Choice Format

Warum könnte ein Mitschüler / eine Mitschülerin eine der falschen Antworten wählen?

Wie würdest du diesen Mitschüler / diese Mitschülerin überzeugen, dass die Antwort falsch ist?

29) **Alternative:** Spiralblock (DIN A4 Format)

Testlauf:

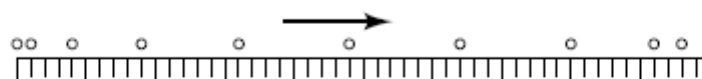
Welche Abschätzung für die Masse einer Person erscheint realistisch:

(Mehrfachnennungen sind erlaubt)

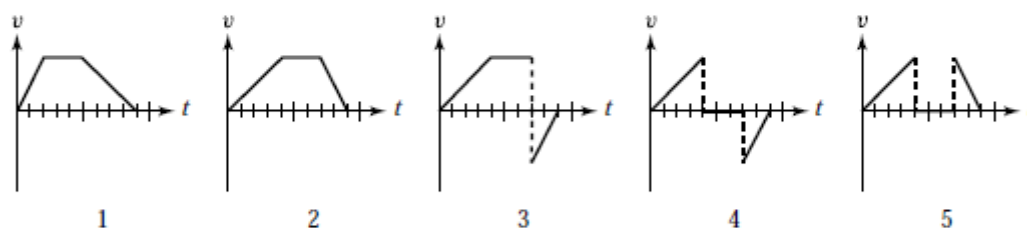
- A) 70 Kilogramm**
- B) 7 Gramm**
- C) 0,7 Tonnen**
- D) 7 Hektogramm**

Refer to the figure below when answering the first two questions (1 and 2).

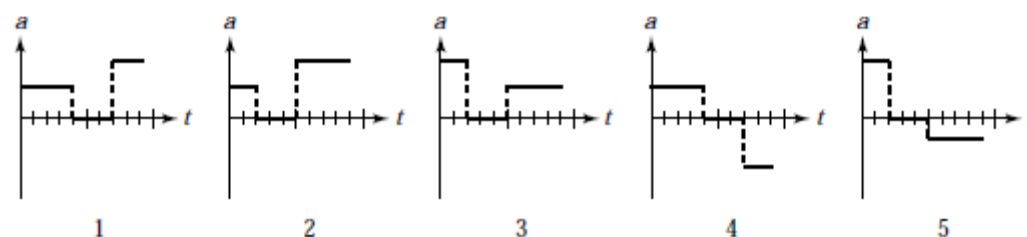
This diagram represents a multiframe photograph of an object moving along a horizontal surface. The positions indicated in the diagram are separated by equal time intervals. The first flash occurred just as the object started to move and the last just as it came to rest.



- Which of the graphs 1–5 below best represents the object's velocity as a function of time?



- Which of the graphs 1–5 below best represents the object's acceleration as a function of time?



ONLINEBOARDS

Testlauf / mögliche Kandidaten

<https://mathswiteboard.com>

<https://onlineboard.eu>

<https://draw.chat>

CRAIG BARTON'S WEBSITES

<https://mrbartonmaths.com>

<https://diagnosticquestions.com>

<https://variationtheory.com>

<https://ssddproblems.com>

<https://dqaday.com>

<https://mathsvenns.com>

Map-competition

Subject: Invitation: 1st European School Map Storytelling Competition

Dear Educator,

Following your training in the framework of **GEO-Academy**, we are happy to invite you to the **1st European School Map Storytelling Competition!**

In the European Map Storytelling Competition, your task is to identify a story that **connects** your **school** or wider community to at least **one of the 17 Sustainable Development Goals (SDGs)**, and tell that story using maps.

The Competition officially launches on **Tuesday, 11 November 2025, 17:00 -19:00 CET** at the kick-off event: <https://us02web.zoom.us/j/85651453167>

Learn more about the competition here:

<https://geoacademy.eu/mapstorytelling-competition/>

We look forward to your participation!

Official competition page: [GeoVoices: Map Storytelling for Global Sustainability Goals – Geo Academy](#)

Why basics first

Storytelling & Function machine

See also

<https://klausalbrecht.substack.com/about>

➔ Check for understanding (Beispiel: Tonhöhe / Spannung der Saite)

Schemas and Mental Models

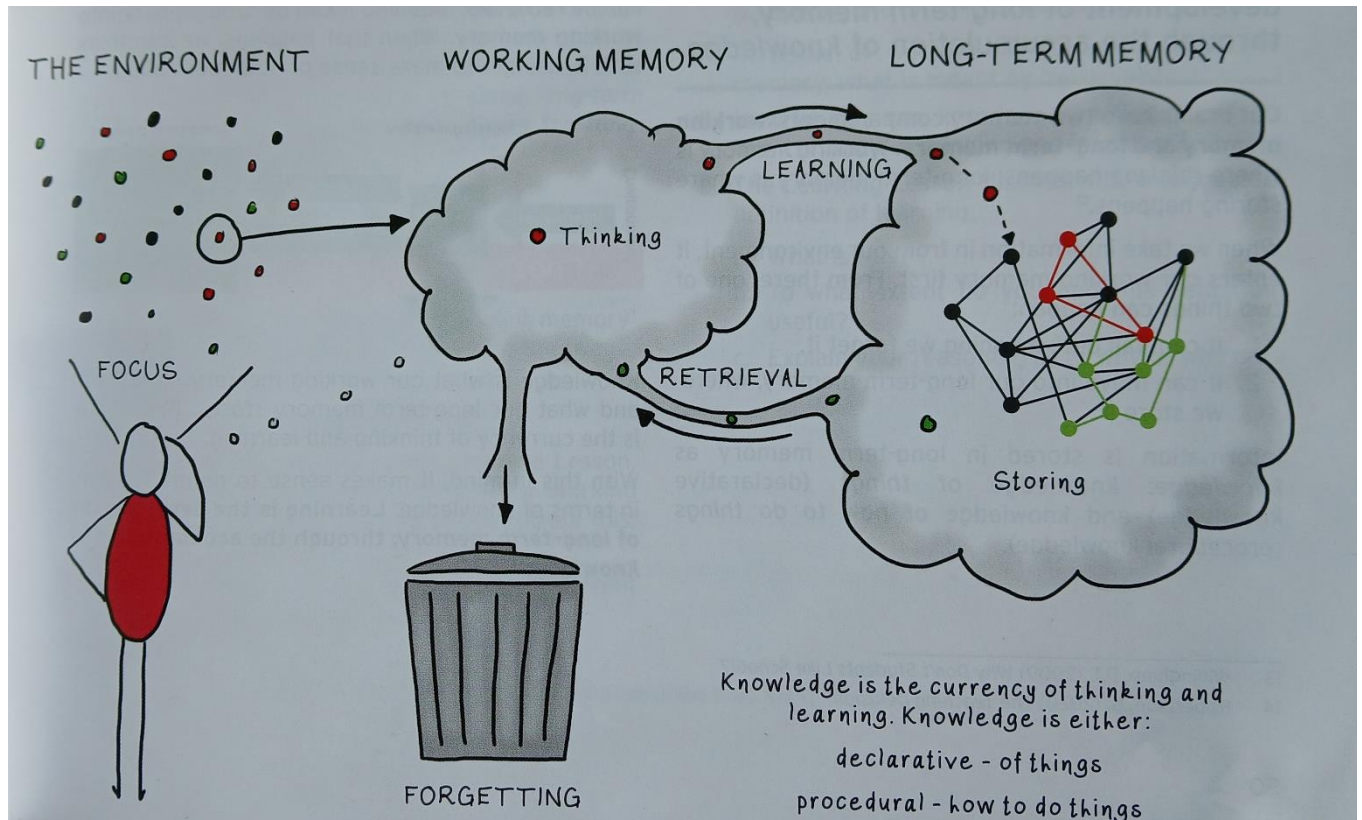
David Didau

<https://daviddidau.substack.com/p/schemas-vs-mental-models-does-the>

What begins as an attempt at conceptual clarity soon becomes an act of rebranding. “Growth mindset” sounds more progressive than “self-efficacy”; “adaptive teaching” feels fresher than “differentiation.” “Knowledge organisers,” “learning maps,” and “concept maps” are all close cousins, yet each arrives trumpeted as a new discovery.

But without changes in practice or outcomes, new terminology merely repackages old ideas, giving us the illusion of movement while we stand still.

Paul Kirschner draws a clear line between **schemas** and **mental models**. Schemas, he says, are automatic and implicit — the mind's way of organising experience into tidy, retrievable frameworks. Mental models, by contrast, are explicit and deliberate. They are the representations we consciously manipulate when reasoning, planning, or predicting.



For novices, we must first build schemas, automatic recognition and fluent recall of patterns. Only once those are solid should we move to mental models, enabling reasoning about systems. In that sense, schema-building and model-building represent successive stages in learning: first fluency, then understanding.

There is strong evidence for *schema theory* itself. Decades of research confirm that knowledge is stored and retrieved through interconnected frameworks. Schema formation reduces cognitive load by allowing information to be chunked, meaning we can process complex material without overloading working memory.

The trouble is, we have no direct access to long-term memory. No one can inspect the contents of LTM or observe its architecture. All we can do is construct explanatory models that allow us to speculate about how our minds work and why we behave as we do. Terms like *schema* and *mental model* are not discoveries of mental furniture but metaphors for unseen processes, useful fictions that help us organise our thinking about cognition. Their value lies not in what they reveal about the brain but in how they guide the design of teaching.

Kirschner's distinction is not without practical value. It can act as a heuristic for thinking about **what kind of knowledge** we are trying to build.

In teaching we might begin by developing *schemas* of patterns: repeated, guided practice that builds automatic recognition. Only once these patterns and basic vocabulary are fluent do we shift toward *mental models*.

Distinguishing between schemas and mental models may help by making explicit the different cognitive demands placed on students at different stages of learning. **If everything is treated as ‘understanding,’ we risk asking novices to reason before they have anything stable to reason with.** By separating schema-building from model-building, teachers can see that fluency and understanding are not simultaneous but sequential. Schema-building tasks aim to automate recognition and recall, so that working memory is freed for higher-order reasoning. Mental model tasks, by contrast, require that freed capacity to be used for deliberate manipulation: planning, predicting, evaluating.

For early instruction, then, the focus is on automaticity: imitating and internalising patterns until they no longer consume attention. For advanced instruction, the focus is on reasoning: manipulating those patterns to achieve deliberate effects.

This progression echoes a broader truth about expertise. The novice struggles to recall and apply isolated facts; the expert operates through rich networks of knowledge that can be reasoned with, adapted, and applied flexibly. Whether we label this as moving from schema to model or from shallow to deep understanding is less important than recognising the transition itself.

The important thing is: **Designing sequences of instruction that move students from practice to understanding, whatever theoretical label we choose to attach.**

When planning a lesson, ask: Am I trying to build fluency or understanding?

When planning curriculum and early instruction, *schema* might be the more helpful term, foregrounding, as it does, structure, accumulation, and organisation. Talking about “building schemas” reminds teachers that knowledge must be stable and retrievable before it can be flexibly applied. It justifies repetition, modelling, and tightly scaffolded practice, the kinds of teaching sometimes dismissed as mechanical but which are essential to long-term retention. Using the language of schema helps to legitimise the deliberate cultivation of fluency, and to explain why overloading novices with open-ended reasoning tasks is counterproductive.

By contrast, *mental model* can serve as a productive metaphor when the goal shifts from consolidation to application. It invites teachers and students to think of knowledge as something that can be run, tested, and revised: a simulation that allows us to predict, explain, or imagine outcomes. Framing a lesson around “building mental models” could legitimise exploratory and reflective activity once sufficient knowledge exists to support it. It suits discussion, hypothesis-testing, or creative recombination: the phase of learning where we begin to reason about how things work rather than simply knowing that they do.

In this sense, the two terms operate like zoom levels on the same map. *Schema* keeps the focus on the terrain, the detailed knowledge that must be mastered; whereas *mental model* pulls back to show the routes between places, how that knowledge interacts to form systems of understanding. Used together, they offer teachers a vocabulary for sequencing: from map-making to map-reading, from accumulation to integration.

For now, the available evidence seems to suggest that schemas and mental models are two faces of the same process: the gradual organisation of knowledge into structures that first automate performance and then enable flexible reasoning.