# Using Concepts as Scaffolding for Mathematics English Language Development

ha_@berkeley.edu

# Today:

1. What is language?
2. What is Mathematical Proficiency?
3. What do English learnes need?
4. Academic Language vs. Everyday Language

# What is Language?

You write to ask me for my opinion of X, who has applied for a position in your department. I cannot recommend him too highly nor say enough good things about him. There is no other student of mine with whom I can adequately compare him. His thesis is the sort of work you don't expect to see nowadays and in it he has clearly demonstrated his complete capabilities. The amount of material he knows will surprise you. You will indeed be fortunate if you can get him to work for you.

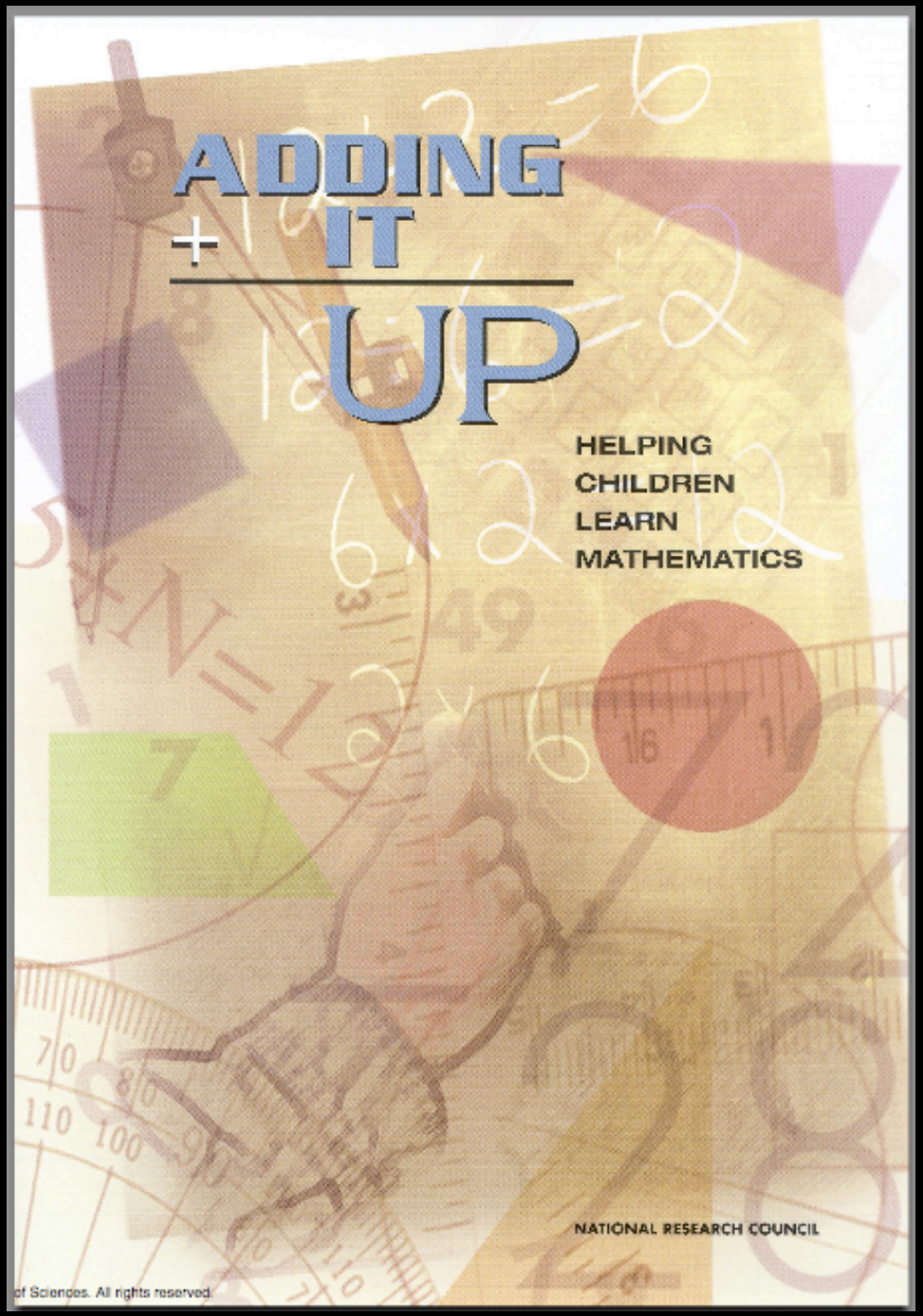
# What is the answer we need in schools?

**Planning/delivering lessons with dual goals of developing mathematics understanding and academic language will improve ELLs ability to become proficient in DOING mathematics.**

# Doing Mathematics?


# Principles and Standards for School Mathematics

National Council of Teachers of Mathematics NCTM

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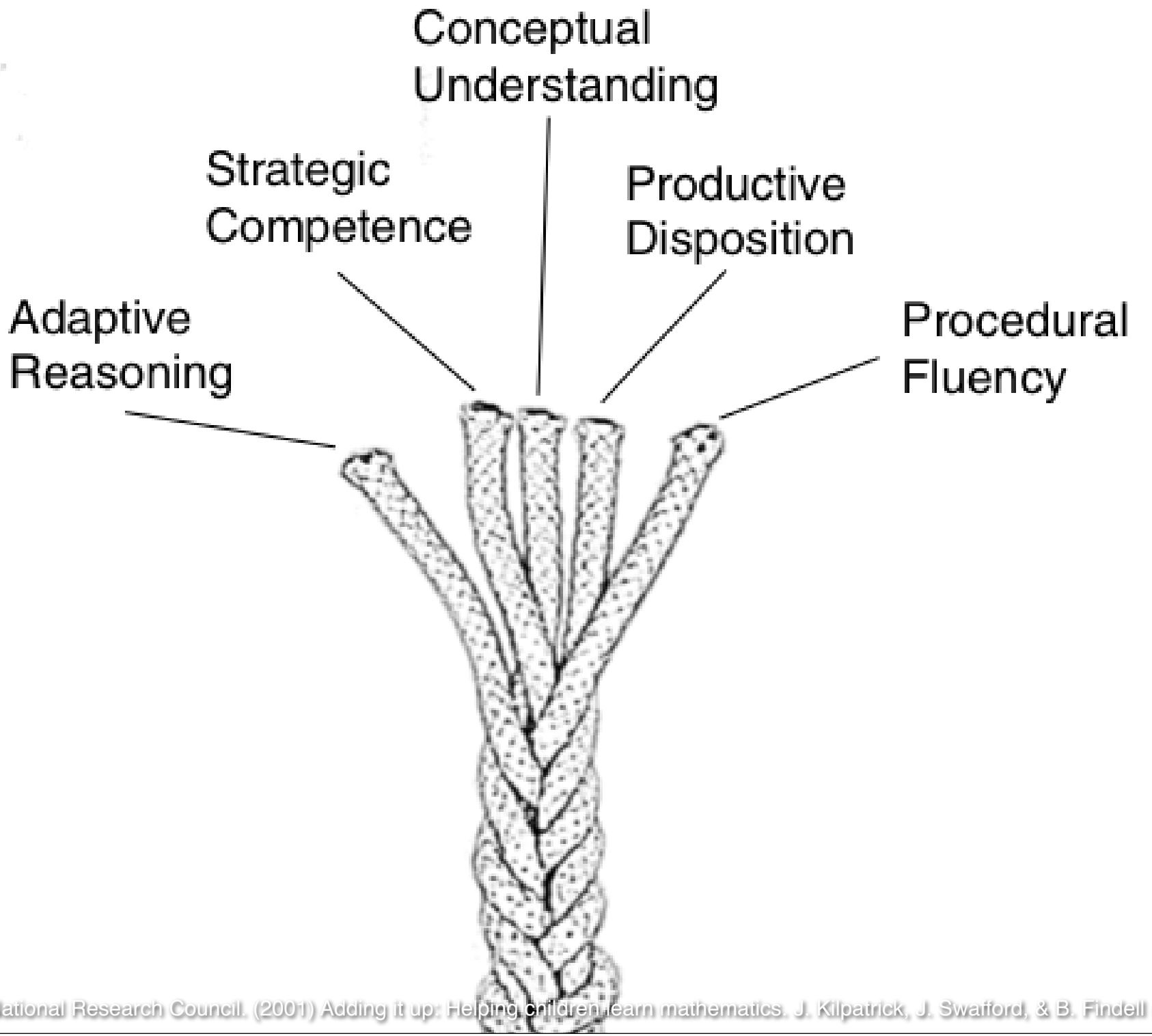


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# COMMON CORE STATE STANDARDS FOR

## Mathematics

COMMON CORE
STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

## Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

# What is language?

# Language

# System

# communicating

# concepts

# ideas

# feelings

# & thoughts…

# sounds

# gestures

# signs

# & marks

In mathematics, logic and computer science, a formal language is a set of finite-length words (i.e. character strings) drawn from some finite alphabet, and the scientific theory that deals with these entities is known as formal language theory. Note that we can talk about formal language in many contexts (scientific, legal, linguistic and so on), meaning a mode of expression more careful and accurate, or more mannered than everyday speech.

*en.wikipedia.org/wiki/Language*

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*en.wikipedia.org/wiki/Language*

# What about…

# Academic Language?

# The

# Language

# of each

# discipline

# to communicate

# about

that discipline.

# To communicate…

# what about the discipline?

# concepts

# ideas

# feelings

# & thoughts…

# sounds

# gestures

# signs

# marks

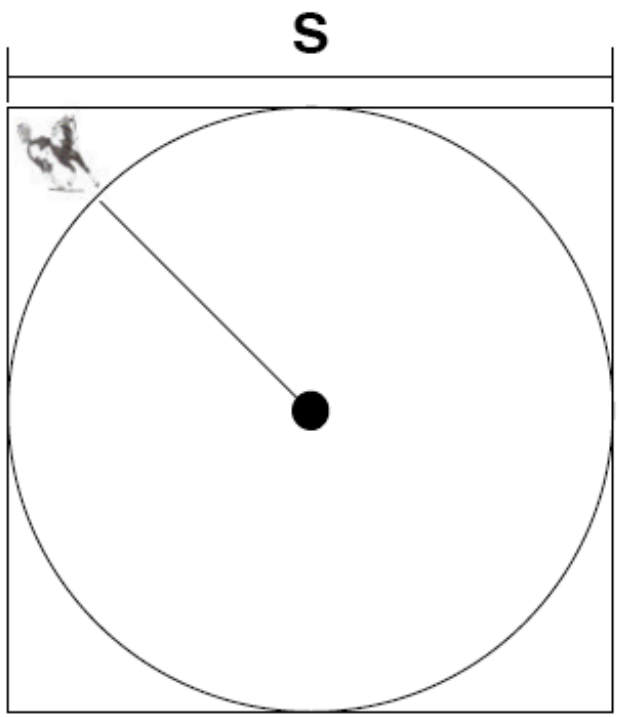
# What do English learners need?

# What is it like to learn mathematics as an English Learner ?

# Travieso

- SOLO
- PARTNER
- TABLE
- WHOLE GROUP

Sa bukid, mayroong isang kayumangging kabayo na ang pangalan ay Travieso. Lumalakad ito sa pinakamalaking pasabilog na daan sa loob ng kuwadradong bakod. Ang sukat ng harapan ay “s” kahaba. Ito ay nakatali sa polo na nasa gitna ng bakod. Magsulat ng algebrang pahayag para mairepresenta kung gaanong kalayo ang nalakad ni Travieso pagkatapos ng tatlong ikot.

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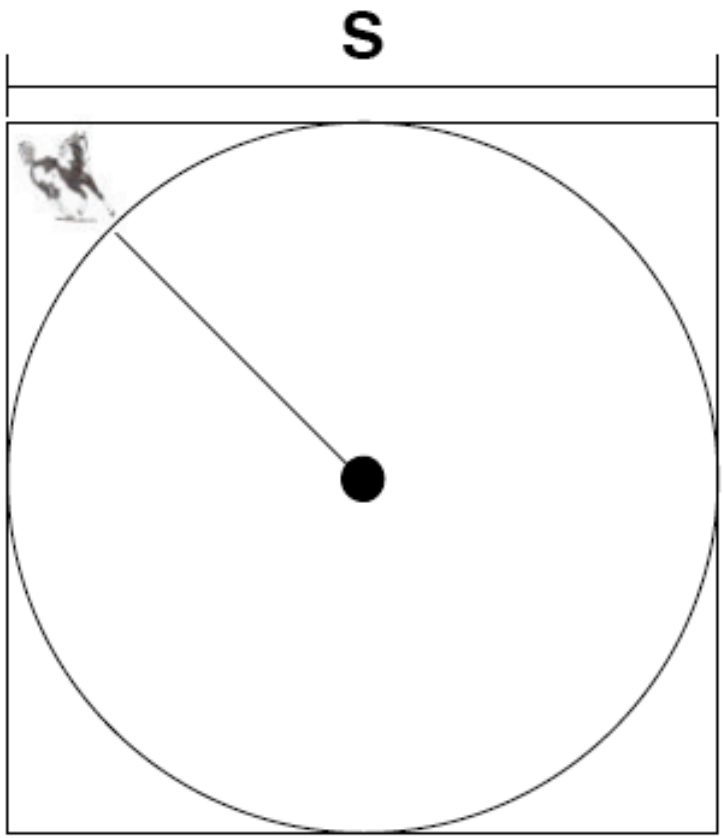



On a farm, there is a brown horse named Travieso. He walks the largest circular path possible inside his square corral. The front side of his corral measures "s" units long. He is tied to the center with a pole. Write an algebraic expression to represent the distance Travieso covers after walking around the corral three times.

- How did it feel to have to solve a problem in language different from yours?
- Did you feel you had access to the problem? …to the language? …to the mathematics?

# What do English learners need?

# VISION

- native-like levels of proficiency in English;
- maintenance and promotion of students' native language;

- everyone in the school responsible for their education;
- to reassurance that knowledge of more than one language and culture is an advantage.

# TESOL: Language Acquisition

- Language is functional.
- Language varies.
- Language learning is cultural learning.

- Language acquisition is a long-term process.
- Language acquisition occurs through meaningful use and interaction.

# Academic Language

- Is not anyone's primary language.
- Does not work well in everyday situations.

- It is an essential part of learning each subject.
- To learn science includes learning the language of science.
- Each discipline has internal ways of using it

- **Logic, analogy, and explanatory narrative dominate the text structures.**

- There are often pictures, demonstrations, diagrams, realia, experiments, and revisitation.

- Many features of the academic language cross linguistic boundaries.

- For example, mathematical equations and graphical displays are like sub-languages shared across languages.

- The diagrams of how DNA works look the same in any language.

# Isn't that just good teaching?

# English learners have a triple challenge…

**For ELs, the ongoing triple challenge of handling "everyday" and [Academic] English, unfamiliar contexts/ cultural norms, and content, all at the same time [particularly] during an on-demand setting can be quite daunting.**

*Carl Lager, UC Santa Barbara*

# All Purpose Academic Words

- Words for thinking: **hypothesize, evidence, criterion**
- Words for classifying: **vehicle, utensil, process**

- Words for communication: **emphasize, affirm, negotiate**
- Words for expressing relationships: **dominate, correspond, locate**

# Why is English so hard?

I could not disagree with you less.

# Free gifts with every purchase.

I personally feel better

advanced planning
never before
past history
tired cliches
sworn affidavit
final ultimatum

# “the whole piece”

# Even
# (a side trip)

# Social Register

- The floor is even (smooth/liso)
- The picture is even with the window (leveled/nivelado)

- Sleep provides even rhythm in our breathing (regular/ uniforme)
- The dog has an even temperament (calm/ calmado)

- If we divide equally…we will be even (balance/igual)
- Looked sick and felt even worse (comparative/aún)

- So simple even a child can do it (comparative/ incluso)

- Got even
- To be even
- Even out
- Break even
- not even
- Even Steven

# Mathematics Register

- **Number: Even numbers (e.g., 2, 4, 6, etc.)**
- **Number: Even amounts (e.g., even amounts of sugar and flour)**

- **Measurement: Exact amount (e.g., an even pound)**

# Everyday English (EE)
# vs.
# Academic English (AE)

# AE requires several proficiencies…

phonological

# lexical

grammatical

discoursal

# strategic

metalinguistic

- sounds
- words
- phrases
- sentences
- function
- discourse
- meta-cognitive
- self-correction

# Phonological

Sounds:

- tens vs. tenths
- sixty vs. sixteen
- sum vs. some
- whole vs. hole
- off vs. of

# Phonological

Sounds:

- T: How many halves do you have?

# Lexical

Three kinds of words:

- meaning in EE only
- meaning in AE only
- meaning in EE and a different meaning in AE

# Meaning in EE only

- cat
- taxi
- because
- climb
- shelf
- dog
- lamp
- etc.

The difficulty these words pose is the same whether we use them in EE or AE.

# Meaning in AE only

- hypotenuse
- parallelogram
- coefficient
- quadratic
- habitat
- erosion
- photosynthesis.

Students encounter these words in school and must learn their meaning from the teacher, the textbook, or someone else who can explain them.

# Specialized meaning in AE

- The scientist needs to stir the solution after adding mold and bark. Then test to see if there is a gas… and test to see if the material sticks.

# Specialized meaning in AE

- The scientist needs to stir the solution after adding mold and bark. Then test to see if there is a gas… and test to see if the material sticks.

# Specialized meaning in AE

Is zero a "number"?

- "I own a number of algebra books."
- "I have a number of friends."
- "I have visited a number of places."

# Specialized meaning in AE

What is a line?

- EE: any line segment
- AE: an infinite line

# Specialized meaning in AE

Is a straight line a curve?

- EE: not a curve
- AE: the simplest example of a curve

# Specialized meaning in AE

"Or"

- Coffee or tea?
- Are you coming or going?
- Was that your husband or your boyfriend?
- Do it now or later?

# Specialized meaning in AE

"Or"

- EE: "or" is exclusive
- AE: (logic) by convention "or" is inclusive. Thus, "A or B" is true if A or B or both.

# Specialized meaning in AE

Multiplying:

- EE: repeating addition, make things bigger
- AE: bigger, smaller, or neither

# Specialized meaning in AE

Dividing:

- EE: cut into pieces, possibly equal pieces
- AE: the same as multiplication (dividing by a non-zero number is multiplying by its reciprocal).

"Amoebas multiply by dividing."

# Grammatical

Rules/syntax of English

- Context is crucial.
- Some words and the mathematical concept they represent differs depending on the context.

# Grammatical

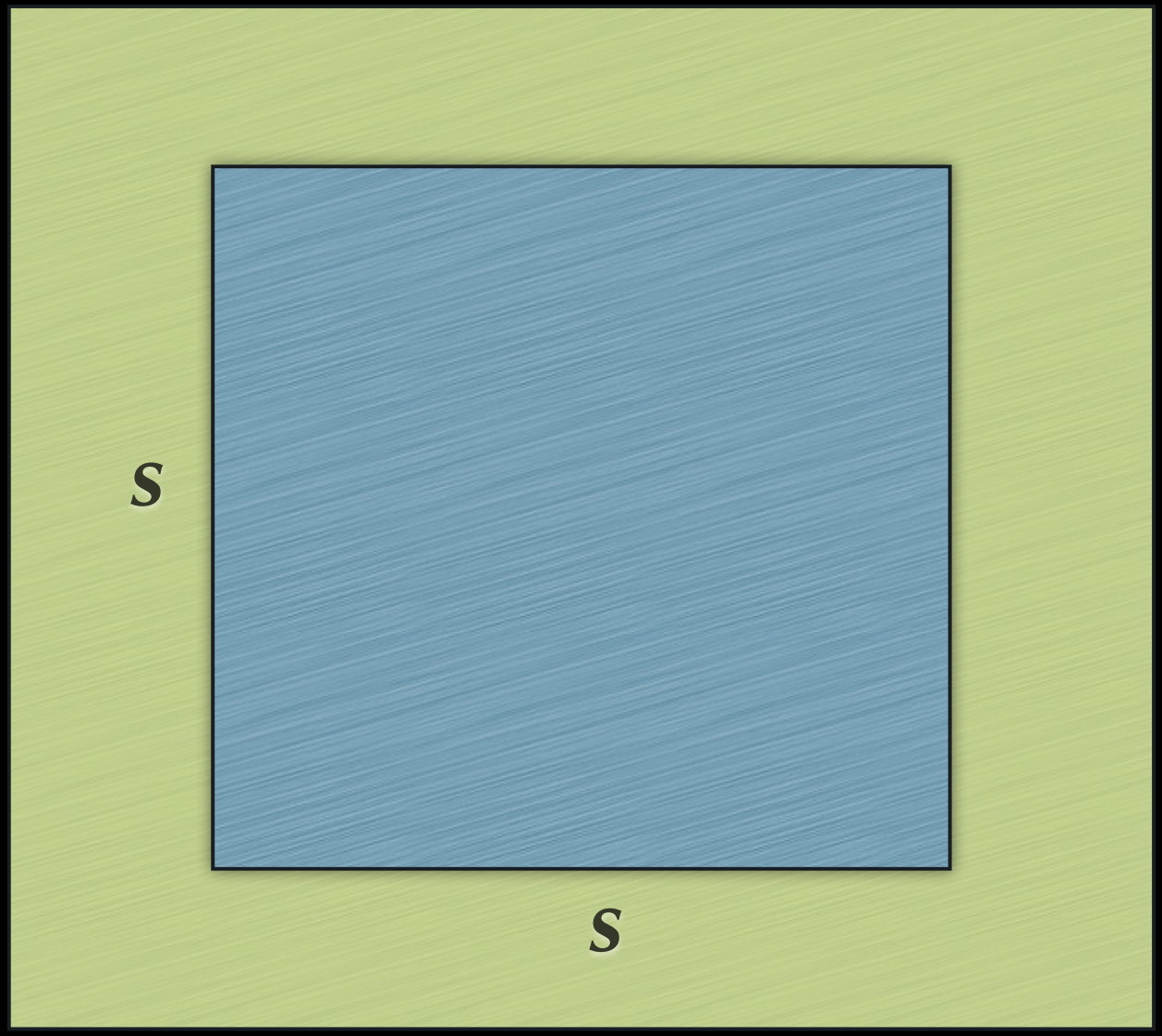
Rules/syntax of English

- For example, base and square will mean different things if we are discussing space or number.

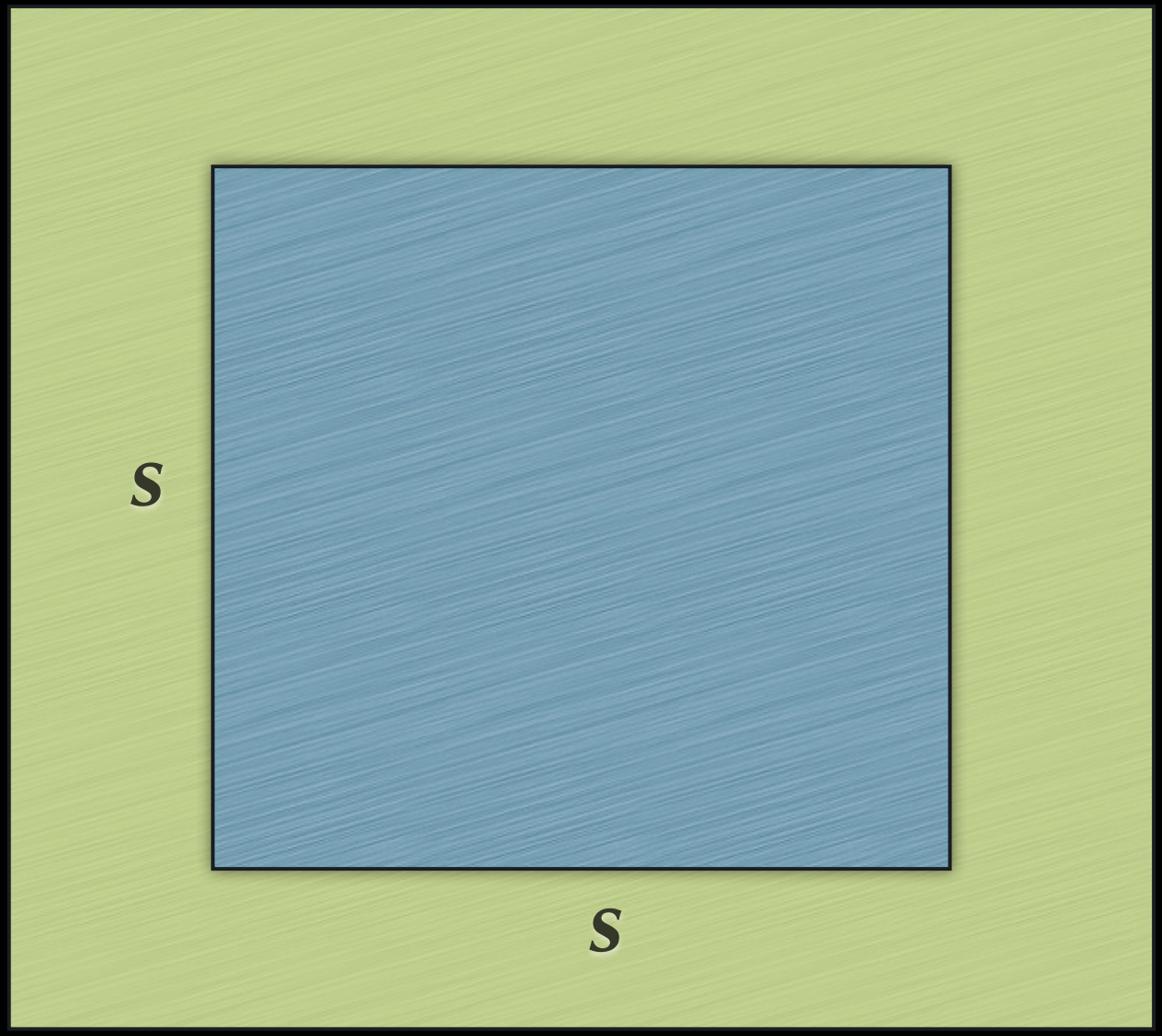
# Grammatical

Rules/syntax of English:

- prepositions
  - The temperature fell…
    - to 10 degrees
    - by 10 degrees
    - from 10 degrees




**Write an expression for the number of tiles needed to surround a pool that is *s* feet on an edge.**

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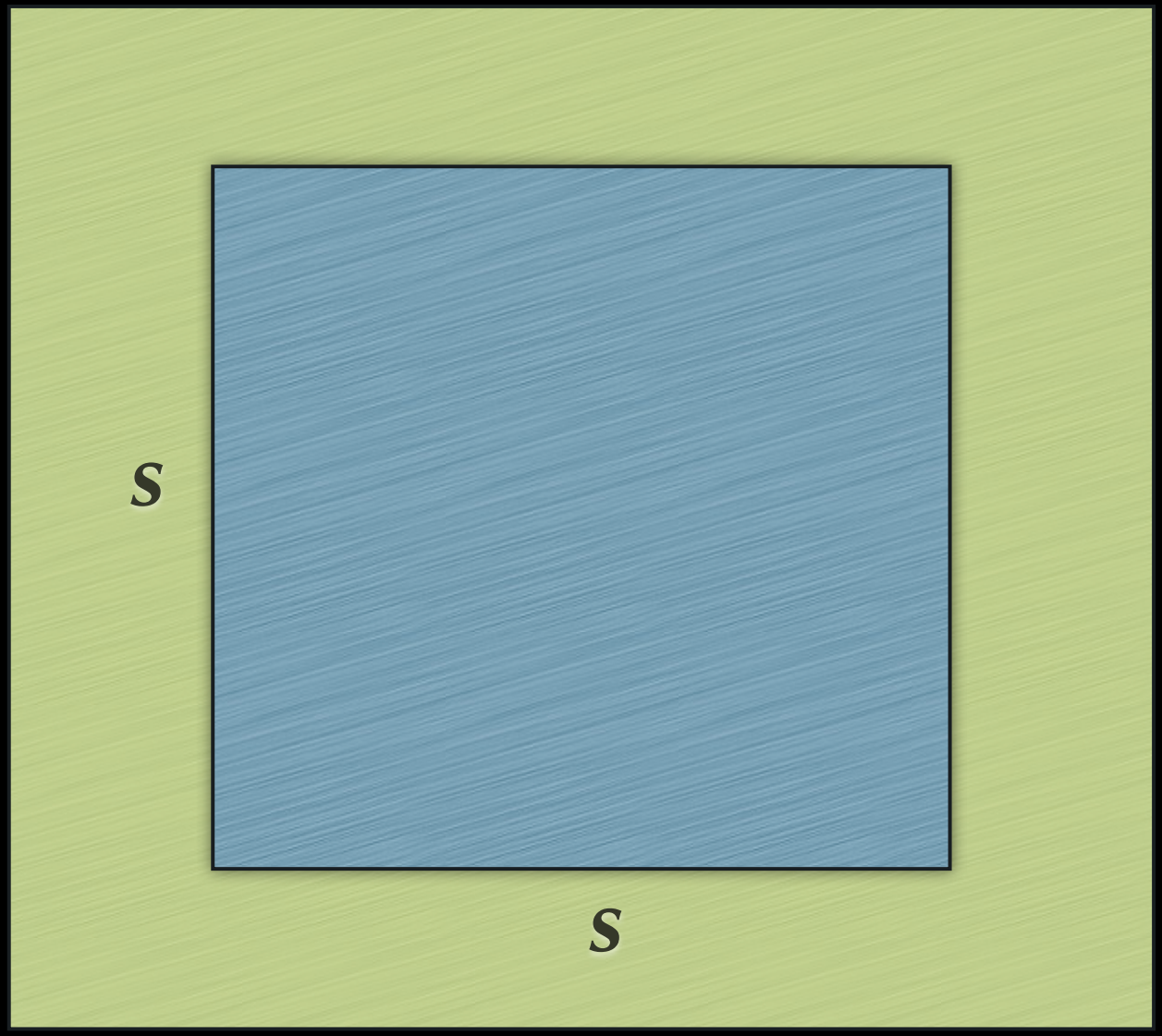


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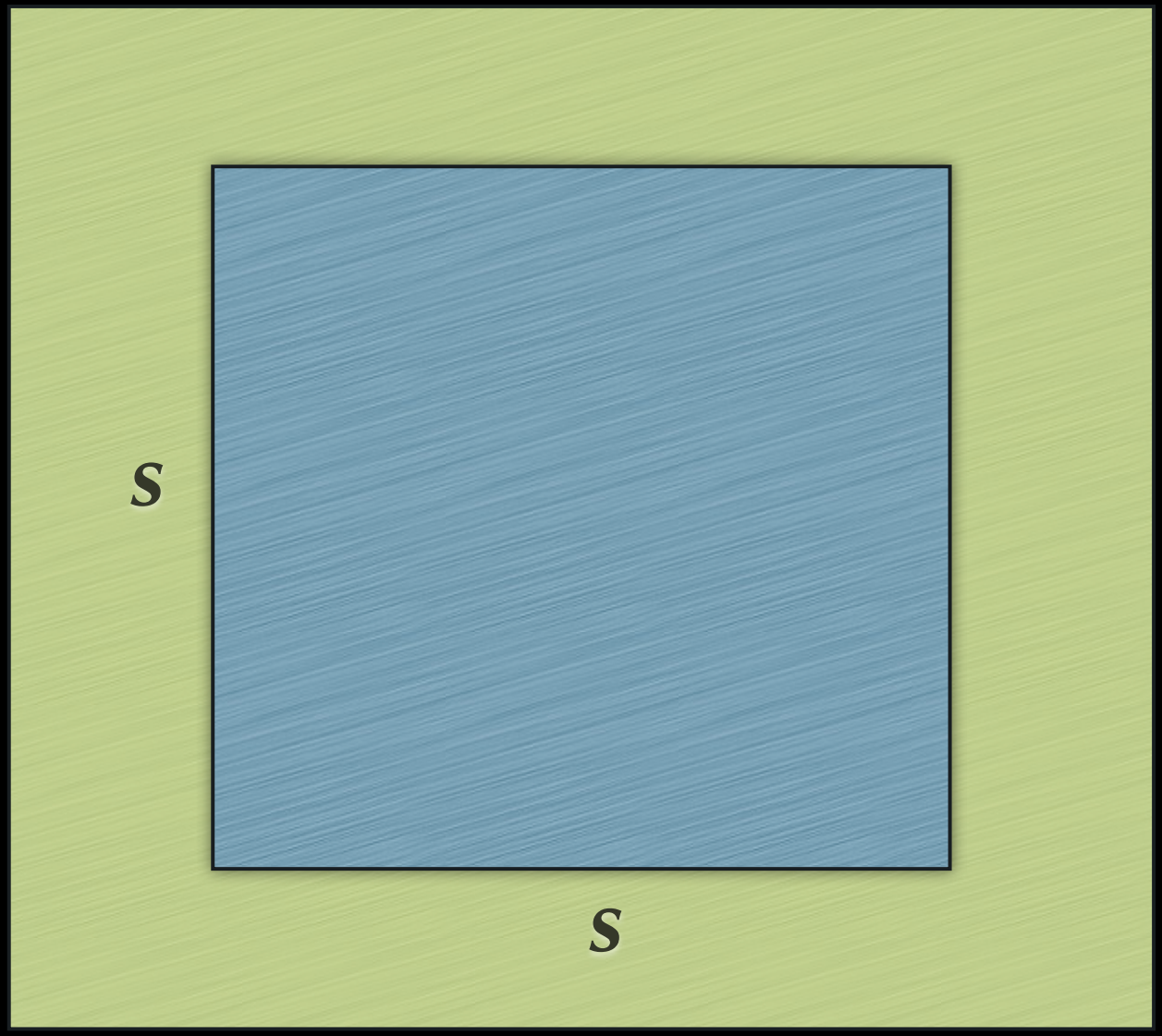


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# Mil Gracias