one stop clil

Conclusions and findings: Science
by Keith Kelly

YOUR CLIL TEACHER'S NOTES

AGE: Teenagers
LEVEL: Intermediate
TIME NEEDED: Approx. 90 minutes
OBJECTIVES: to examine the thermal conductivity of different materials; to practise terms and phrases related to expressing conclusions and findings
KEY SKILLS: reading, speaking, writing, listening
MATERIALS: one copy of the worksheet and piece of graph paper per student; one Chart A and one Chart B per pair of students; one set of glass, aluminum, iron and copper rods (10cm long; equal diameter), ruler, coloured wax, stopwatch, retort stand and source of heat per three students

Content focus
Thermal conductivity

Warm up: 7–8 minutes
Activity 1: 10 minutes
Activity 2: 10 minutes
Activity 3: 20–30 minutes
Activity 4: Homework

WARM-UP

In small groups, give the students a few minutes to discuss what the best materials at conducting heat might be. At this stage, don't give them any examples; they will have plenty of ideas themselves.

As a whole class, gather some of their ideas and create a list of some of the suggestions.

Ask the class to think about the question *What makes these materials good conductors of heat?*. Gather the suggestions as a whole class. It's not important to have a textbook answer at this point; the students will be able to read a definition later.

Ask the students how they could test materials to compare their thermal conductivity. Work the discussion towards using a test to measure and compare heat transfer in each material over a fixed period of time.

ACTIVITY 1

Ask the students to read the text on conduction of heat and check how their ideas about thermal conductivity compare to the text. Get them to answer the two questions, then gather the students' feedback as a whole class.

Key

1. Conduction is the transfer of heat energy, by agitation of the particles within a material, from a warm area (the point where heat is applied) to a colder area.
2. Copper, aluminium and silver are the best conductors.

ACTIVITY 2

In pairs, give one student a copy of Chart A (showing the thermal conductivity of different materials) and the other a copy of Chart B. Ask the students to discuss what the charts show and then complete (***not*** copy!) the unfinished bars on their chart. This involves comparisons, so students might find Your CLIL: Comparisons: Science useful.

Ask the students to compare their completed charts with each other to see how close they were. If necessary, you could show the full chart to the whole class on a screen.

ACTIVITY 3

Working in groups of three, ask the students to carry out the thermal conductivity experiment, following the instructions on their worksheet. Facilitate where necessary.

ACTIVITY 4

After they have completed the investigation, ask the students to discuss their findings as a group but then write up their findings and conclusions individually, using the *Thermal conductivity report sheet*, as a homework task.

Students may also find the following word lists useful:
- Your CLIL: Hypothesis: Science
- Your CLIL: Line graphs: Science

one stop clil

Conclusions and findings: Science
by Keith Kelly

YOUR CLIL TEACHER'S NOTES

THERMAL CONDUCTIVITY OF DIFFERENT MATERIALS: COMPLETE CHART

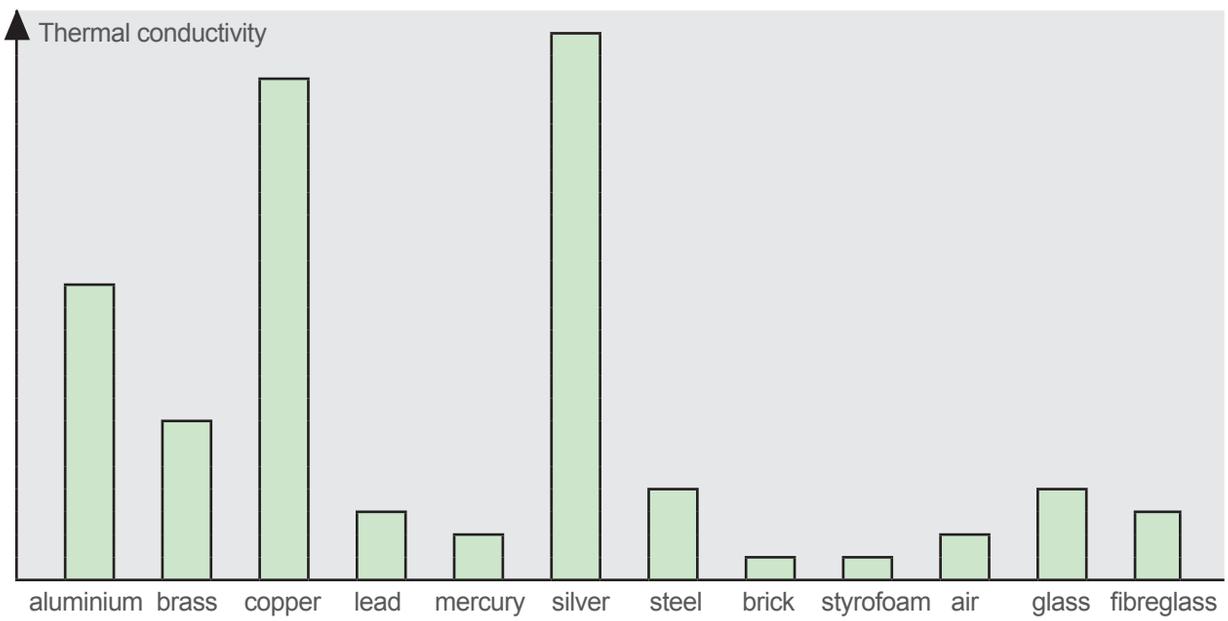


Figure 1 Bar chart showing the thermal conductivity of different materials

Language focus
Conclusions and findings

Warm up: 10 minutes
Activity 2: 10–15 minutes
Activity 3: 15 minutes

Encourage students to practise language related to findings and conclusions and read the Your CLIL: Science: Conclusions and Findings list

ACTIVITY 1

Ask students to choose the correct words to complete the sentences.

Key

1. about; 2. from; 3. about; 4. disputed; 5. present; 6. substantiated; 7. valid; 8. arrived at; 9. for

ACTIVITY 2

Ask students to find the *conclusions and findings* words in the wordsearch.

Key

F	L	R	S	R	Q	R	P	A	T	F	M	T	D	M	E
X	E	A	E	F	E	E	J	Q	E	R	C	E	J	N	X
H	M	S	F	C	C	P	E	P	A	U	O	O	U	C	E
J	E	X	E	Y	O	O	D	I	S	C	U	S	S	E	T
L	E	Z	H	K	O	R	L	A	E	V	N	F	T	E	U
I	A	E	M	C	F	T	D	E	X	P	L	A	I	N	E
N	E	T	D	E	O	M	C	R	C	N	W	E	F	Z	U
Z	Z	S	P	T	L	N	X	O	O	H	Y	N	Y	M	S
Y	S	B	S	A	L	J	F	I	N	A	L	L	Y	I	Y
T	L	I	H	O	O	O	K	I	T	C	A	Z	H	C	O
O	J	X	V	E	W	H	H	G	R	N	L	S	E	O	D
F	T	P	T	I	S	M	X	F	A	M	K	U	N	M	Z
E	N	Q	L	P	R	O	V	I	D	E	M	B	D	M	R
M	M	P	S	E	E	Z	I	C	I	A	E	C	R	E	I
S	H	E	O	I	V	B	F	R	C	N	E	N	A	N	S
M	I	U	O	P	P	B	T	C	T	S	I	S	W	T	E

Ask students to check their work in pairs and share the words they have found with the whole class.

ACTIVITY 3

Ask students to complete the crossword. All the answers are words to do with conclusions and findings.

Key

Across: *2. arguments; 4. deduction; 5. results; 7. observations; 9. survey; 10. fact*
Down: *1. outcome; 3. reasoning; 4. data; 6. evidence; 8. statement; 9. summary*

WORKSHEET

Conclusions and findings: Science by Keith Kelly

YOUR CLIL WORKSHEET

Content focus
Thermal conductivity

WARM-UP

Discuss the questions below in small groups.

- What materials can you think of that conduct heat well?
- Why are these materials good conductors of heat?
- How could you test materials to compare how well they conduct heat?

Share your ideas with the rest of the class.

ACTIVITY 1

Read the text about thermal conduction. Check how close your ideas about heat conduction are to the description in the text.

1. Can you find the definition of conductivity mentioned in the text?
2. What materials are described as being the best conductors of heat?

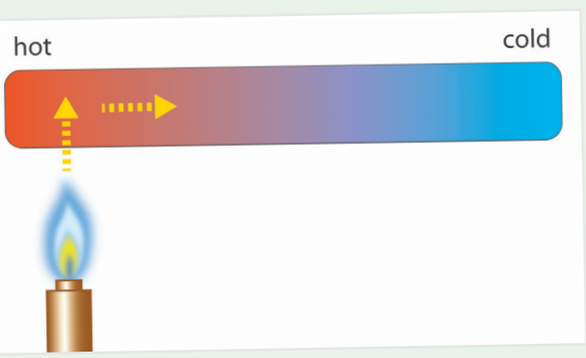
Thermal conduction

Thermal conduction is the transfer of heat energy through a material. If one end of a metal rod is placed in a flame, you will notice after a while that the entire rod becomes hot. This is due to conduction of heat.

In a solid, like the rod, the particles (the atoms) are closely packed together. The atoms at the end of the rod which is being heated gain energy and vibrate more vigorously. As they vibrate, they knock into (collide with) their less energetic neighbours more than they did before. This transfers energy to the neighbouring atoms, so that they also vibrate more vigorously. This process repeats continually along the rod until all the particles have gained heat energy.

Thermal conduction is therefore the transfer of heat energy by agitation of the atoms within a material from a warm area (the point that is heated) to a colder area.

Some solid materials conduct heat energy more rapidly than others. These materials are called **conductors**. Metals are the best conductors of heat. Have you ever wondered why metals feel cold when you touch them? This is due to their excellent conducting properties! The metal is not actually



colder than you but it conducts heat away from your body very quickly so your skin feels colder as it loses heat. Metals such as copper and aluminium are excellent conductors, which is why they are used to make air conditioners, refrigerators and cooking utensils. Iron is also a fairly good conductor and is commonly used to make furnaces and boilers for heating systems. Copper, aluminium and silver are better conductors than other metals.

Some materials do not conduct heat well. These are called **insulators** or non-conductors. Insulators transfer heat very slowly. This property can make them very useful materials.

Adapted from *Macmillan CXC Science Series*, Integrated Science by Tania Chung-Harris pp. 185-96 © Macmillan Caribbean 2005

Conclusions and findings: Science by Keith Kelly

ACTIVITY 2

Work in pairs. Your teacher will give each of you a chart showing the thermal conductivity of different materials. Complete the unfinished bars on your chart. To do this, ask your partner questions about the thermal conductivity of the different materials in the chart. You could ask questions such as:

- Is … a better or worse thermal conductor than … ? (For example, *Is lead a better thermal conductor than mercury?*)
- How does ... compare to ... as a thermal conductor?
- How would you describe the thermal conductivity of ... ?
- What is the thermal conductivity of ... ?

Or you could use statements such as:

- … has the highest thermal conductivity.
- … is twice as thermally conductive as … .
- … is more conductive than … but has slightly lower conductivity than …
- … has the lowest thermal conductivity.

Compare your chart with your partner's. How close are your results?

Conclusions and findings: Science by Keith Kelly

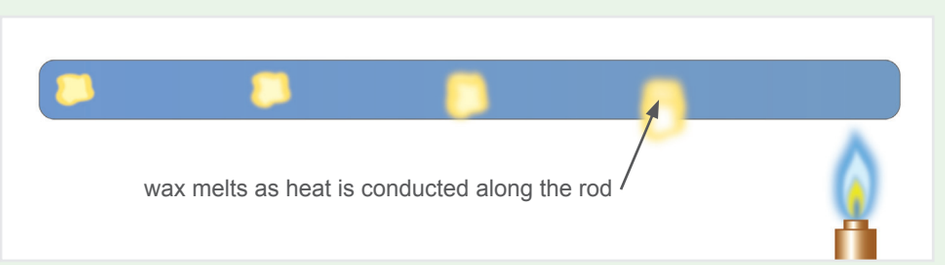
ACTIVITY 3

For this activity, you will work in groups of three.

Thermal conductivity investigation

Procedure

1. Your teacher will give you a glass rod, an iron rod, a copper rod and an aluminium rod. All the rods are the same diameter and are 10cm long.
2. Starting at one end of the rod, use the ruler to make four marks, each 2cm apart. Do this for all four rods. The end without a mark will be called **the zero-end**.
3. Apply a small drop of molten wax on each mark, on every rod, and allow the wax to harden.
4. Clamp one rod in a retort stand and place the zero-end above a flame, as shown below. Start the stopwatch.



5. Record how long it takes for each lump of wax to begin melting along the rod.
6. Repeat for the other three rods.
7. Record your results in the table below.

Distance travelled by heat (cm)	Time taken for heat to travel through material (seconds)			
	glass rod	copper rod	aluminium rod	iron rod
0	0	0	0	0
2				
4				
6				
8				
10				

8. Your teacher will give each of you a piece of graph paper. For each material, plot a graph of time taken for heat transfer against distance travelled by heat.
9. Discuss the findings of your investigation with your group.

Conclusions and findings: Science by Keith Kelly

YOUR CLIL WORKSHEET

ACTIVITY 4

Use the *Thermal conductivity report sheet* below to write a short summary of your findings and conclusions about the thermal conductivity of the four materials.

Hypothesis	A hypothesis can be made up of different kinds of statements.
	You can give a statement of fact (if you're confident!):
	I predict that the outcome of this experiment will be that the wax will ...
	You can make predictions:
	I predict that … • *… the wax will ... melt fastest / slowest on the ... rod.* • *… the second fastest will be the ... rod.* • *… next will be the ... rod.* • *… the least conductive material will be ...*
	If you're not sure, you can use phrases such as *could be* / *might be* ...
	I predict that the … rod might be the best conductor of heat.
	You can state what the outcome will be if your hypothesis is correct:
	With this experiment, I will demonstrate that ...
	You can make comparisons:
	The better / worse the conductivity of the material, the slower / faster the wax will melt.
	You can state what you expect will happen:
	I expect that ... should ... because … will ...

Conclusions	Conclusions say what happened and relate your findings to the hypothesis.
	You can make statements of fact:
	• *My hypothesis was true / false.* • *The ... rod is the best thermal conductor.* • *The least effective heat conductor* (or *The best thermal insulator) is the ... rod is the ... rod.*
	You should relate your conclusions to the data you recorded in the table and graph:
	The data show that … • *… it took ... seconds for all the wax blobs to melt on the … rod.* • *… the heat melted the wax at ... cm on the ... rod in ... seconds.* • *… The findings show that my hypothesis was correct / incorrect.*
	You can also make comparisons based on your findings:
	• *The wax on the ... rod melted in … seconds.* • *This means that the ... rod is ... times more effective as a thermal conductor than the ... rod.*

WORKSHEET

Conclusions and findings: Science
by Keith Kelly

YOUR CLIL WORKSHEET

Language focus
Conclusions and findings

ACTIVITY 1

Circle the correct word to complete the sentences.

1. Scientists are expected to release their findings *in / about* new genetic modification techniques within the next few days.
2. Findings *from / on* recent studies into poverty and disease suggest strategic trade can play a role in reducing poverty.
3. Scientific findings *about / for* the solar system gave insights into the relationship between space and time.
4. The conclusions were *disputed / disrupted* because of a lack of scientific evidence.
5. Gather the data from your group and *populate / present* it as a line graph.
6. The laboratory conclusions were s*ubstantiated / substandard* by good research data.
7. The researchers presented *vivid / valid* conclusions based on findings from their experiments.
8. After considering all the evidence, the scientists *arrived at / aimed* at a conclusion.
9. Conclusions *in / for* group one can be applied to group two.

ACTIVITY 2

Do the wordsearch and find the words to do with *conclusions and findings*. The words appear horizontally, vertically and diagonally.

F	L	R	S	R	Q	R	P	A	T	F	M	T	D	M	E
X	E	A	E	F	E	E	J	Q	E	R	C	E	J	N	X
H	M	S	F	C	C	P	E	P	A	U	O	O	U	C	E
J	E	X	E	Y	O	O	D	I	S	C	U	S	S	E	T
L	E	Z	H	K	O	R	L	A	E	V	N	F	T	E	U
I	A	E	M	C	F	T	D	E	X	P	L	A	I	N	E
N	E	T	D	E	O	M	C	R	C	N	W	E	F	Z	U
Z	Z	S	P	T	L	N	X	O	O	H	Y	N	Y	M	S
Y	S	B	S	A	L	J	F	I	N	A	L	L	Y	I	Y
T	L	I	H	O	O	O	K	I	T	C	A	Z	H	C	O
O	J	X	V	E	W	H	H	G	R	N	L	S	E	O	D
F	T	P	T	I	S	M	X	F	A	M	K	U	N	M	Z
E	N	Q	L	P	R	O	V	I	D	E	M	B	D	M	R
M	M	P	S	E	E	Z	I	C	I	A	E	C	R	E	I
S	H	E	O	I	V	B	F	R	C	N	E	N	A	N	S
M	I	U	O	P	P	B	T	C	T	S	I	S	W	T	E

analyze
comment
conclude
confirm
contradict
discuss
draw
explain
finally
follows
justify
means
provide
record
report
see

Conclusions and findings: Science
by Keith Kelly

YOUR CLIL WORKSHEET

ACTIVITY 3

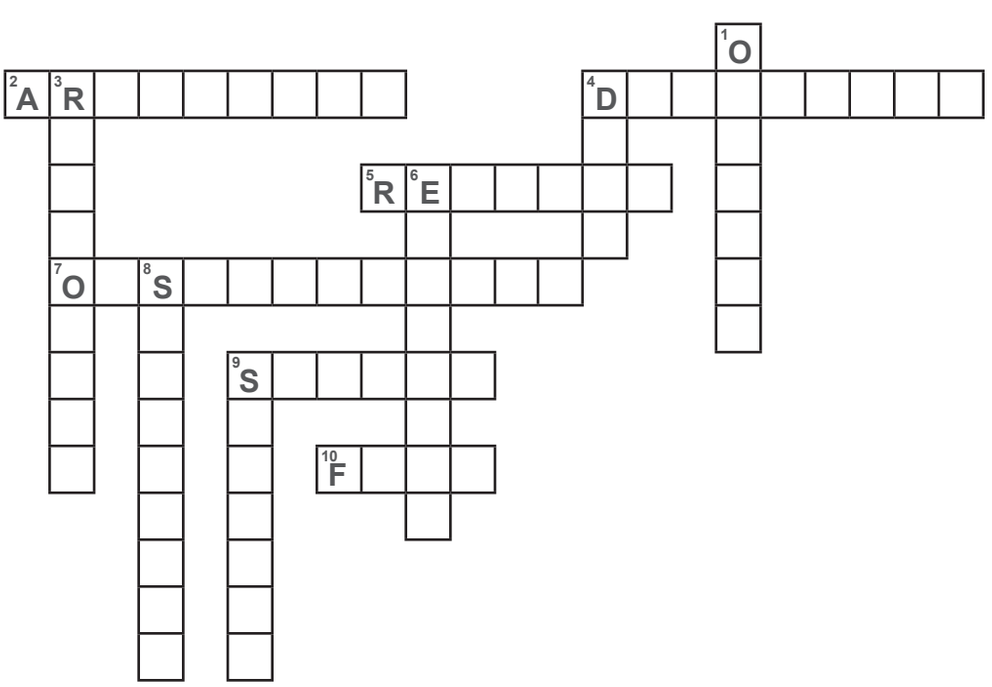
Complete the crossword. The answers are all words to do with conclusions and findings.

Across

2. Study the following statements and give reasons for and against the a_____.
4. What d_____ can you make about one of the components of urine?
5. Exchange your r_____ with four other people in your class and compare the findings.
7. Watch the movement of the colour in the water and record all your o_____.
9. Do a s_____ of your class to find the number of students who have ever had wheezing, allergies, bronchitis, pneumonia or asthma.
10. The f_____ that most animals and plants reproduce sexually suggests that variation in offspring is the most important factor in enabling them to cope with changing conditions.

Down

1. Describe one possible o_____ of this change in farming practice.
3. Give r_____ for your answers.
4. Plot a graph of population growth against years, using the d_____ given in the table.
6. The e_____ for diffusion is that the scent can be smelt everywhere in the room but it is less intense than where it was first sprayed.
8. Make a general s_____ about the conditions the seeds needed for germination.
9. Write a s_____ of characteristics presented in the locations labelled *A*, *B* and *D* on the illustration.



Conclusions and findings: Science by Keith Kelly

CUT-OUTS

CHART A: THERMAL CONDUCTIVITY OF DIFFERENT MATERIALS

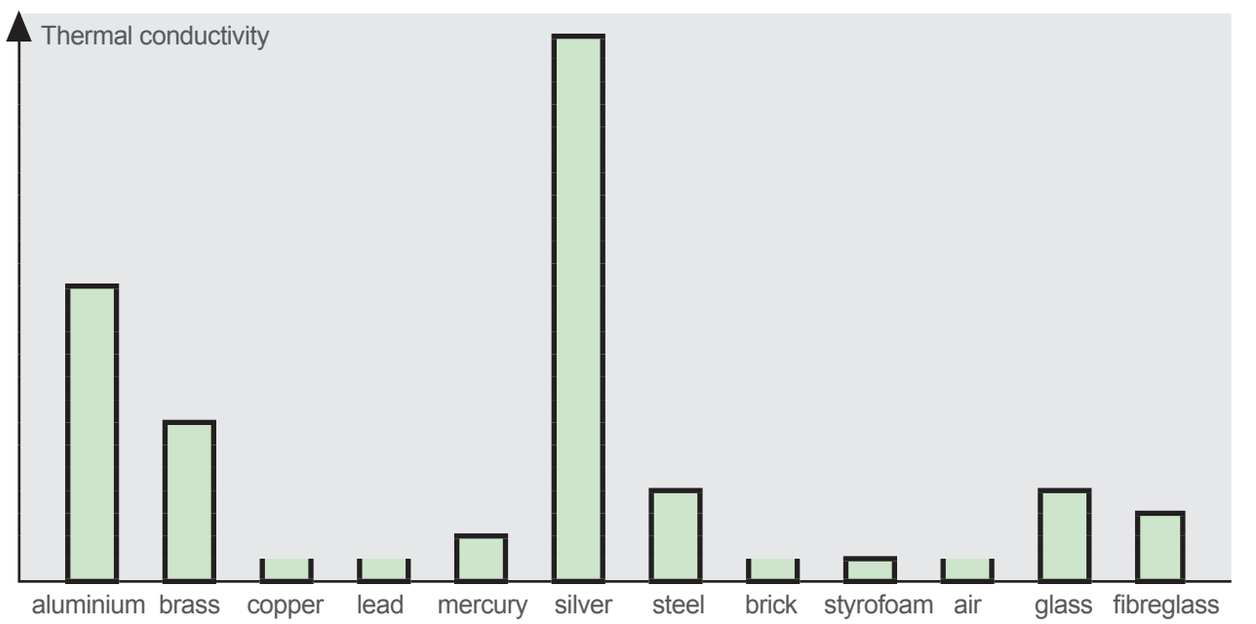


Figure 1 Bar chart showing the thermal conductivity of different materials

CHART B: THERMAL CONDUCTIVITY OF DIFFERENT MATERIALS

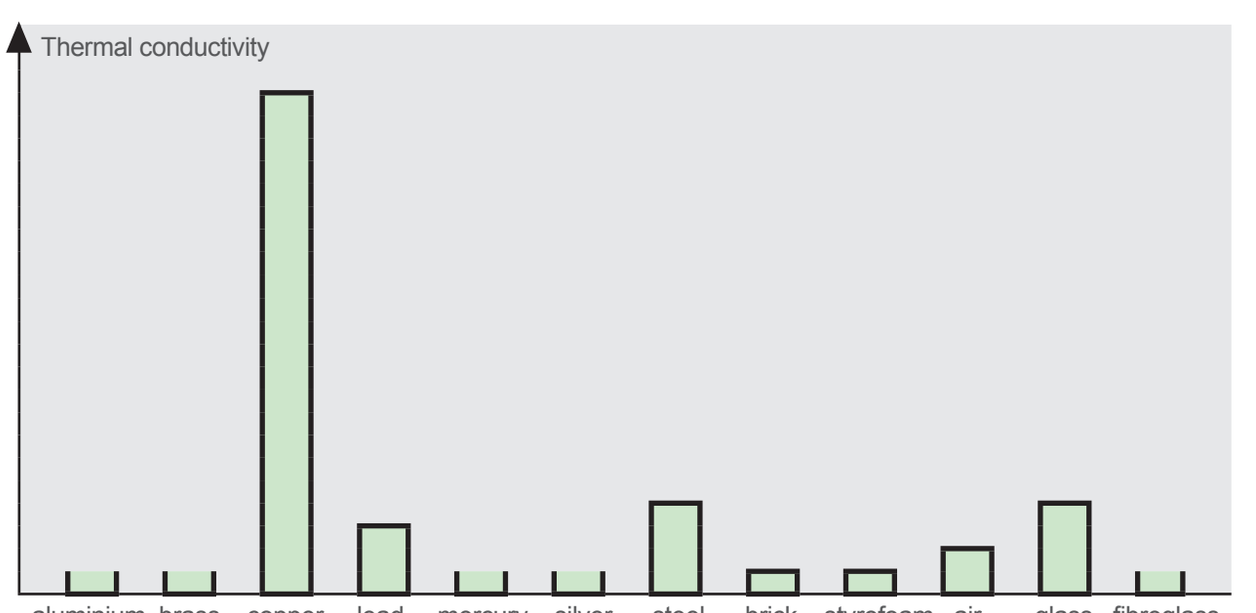


Figure 1 Bar chart showing the thermal conductivity of different materials