



SCHOOL OF CIPHER

A pack of secret writing worksheets for code-breakers ages 7 to 11

- Pigpen — the alphabet in four pens
- Shift ciphers and a cut-out Caesar wheel
- Rail fence and twisted path scrambles
- Key word columns
- Polybius number squares
- Lewis Carroll's table for hard-to-break codes
- Date shift, key word alphabets, answers and a certificate

Free to print, copy and share · no sign-in, no cost · pairs with the animations at schoolofcipher.com

How to use this pack

Running a session

Each cipher sheet works on its own, so pick one and go. A good order is pigpen first (it looks like magic and needs no arithmetic), then shift ciphers, then rail fence, then the harder ones.

1. Show the animation for that cipher on the site. Pause on the step where the trick happens and ask what will come next.
2. Hand out the sheet. Children encode a message of their own first — that is where the rules stick.
3. Swap sheets and decode each other's. Arguments about who made the mistake are part of the lesson.
4. Finish with the puzzle strip at the bottom of the sheet.

What each cipher teaches

Pigpen	one-to-one mapping, symbols as data
Shift	modular counting, wrapping past Z
Rail fence, twisted path	order matters; position as information
Key word columns	sorting, using a key to fix an order
Polybius	coordinates, two numbers for one letter
Carroll's table	many alphabets at once, why frequency counting fails

Recording the animations

The site has a studio mode that hides every control and leaves a large stage and a caption strip, sized for a screen recording.

1. Choose the cipher and type the message before you start recording.
2. Press **Studio mode**, then record the browser window at 1920×1080.
3. Space bar plays and pauses. The arrow keys step one move at a time, which is useful for talking over a tricky step.
4. The caption strip is written to be read aloud, so it doubles as a script.

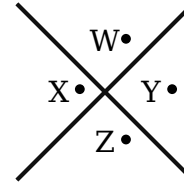
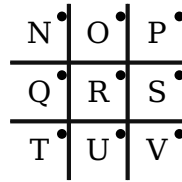
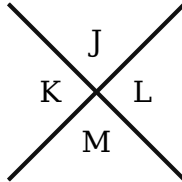
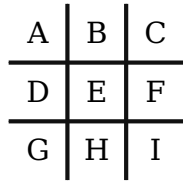
An episode plan that works

1	Pigpen: writing without letters
2	Caesar's shift, and how to break it
3	Rail fence: same letters, new order
4	Twisted paths and spirals
5	Key words that scramble columns
6	Polybius: letters as coordinates
7	Date shift: a moving target
8	Lewis Carroll's unbreakable-ish table

Frequency hint for older children: in English, E is the commonest letter, then T, A, O, N. THE is the commonest three-letter word, and a four-letter word shaped like **XYZX** is very often THAT.

Pigpen: the four pens

Every letter lives in one of these 26 compartments. To write a letter, draw the walls around it — and the dot, if its pen has dots.



Trace these

Copy each shape into the empty box underneath.

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

Now write your own name

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

And a message only your friend can read

Look at the shape, find the matching compartment on Sheet 1, and write the letter underneath.

What is a pirate's favorite letter?

[illegible]

Where do cows go on a Friday night?

[illegible]

Meet me by the oak tree at four

$\wedge \square \square \neg \wedge \square \sqcup \langle \neg \sqcap \square \sqcup \cdot \sqcup \rangle \neg \cdot \square \square \sqcup \neg \sqsubset \sqcup \cdot \cdot \cdot$

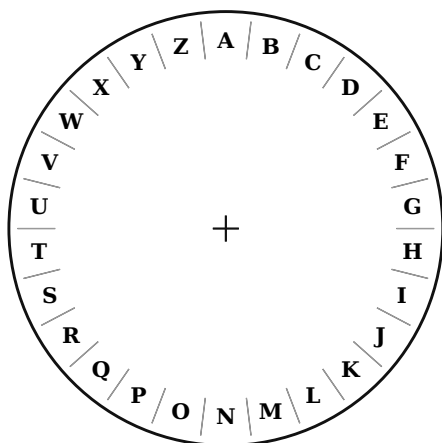
Write a reply

Use the pens to answer one of the jokes above, then pass it to someone else to read.

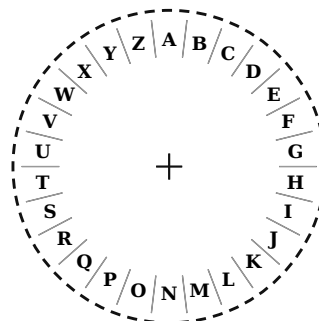
[illegible]

Cut out a Caesar wheel

Cut out both discs. Push a split pin through the middle so the small disc turns inside the big one. Line up A on the small disc with any letter on the big one and you have a shift cipher you can hold.



big disc — cut along the solid circle



small disc — cut it out and pin it on top

How to use it

1. Agree a key letter. Turn the small disc so its A points at that letter.
2. To encode, find your letter on the small disc and write down the letter opposite it on the big one.
3. To decode, do it the other way round.
4. Change the key letter and the whole code changes.

Try it

Set A opposite H, then encode:

GUARD THE BRIDGE AT DAWN

Set A opposite N, then decode:

OE VATGURZNC

--	--	--	--	--	--	--	--	--	--

Write the alphabet again in the empty row, but start it further along. A shift of 3 puts D under A. When you run off the end, go back to A and keep counting.

Build a shift of 3

[illegible]

Build a shift of 11

[illegible]

Encode with a shift of 3 THE PASSWORD IS PENGUIN

[illegible]

Crack these

What do you call a bear caught in the rain?

FIWN EEQD GJFW

shift of 5

Why did the math book look so sad?

PAOH KAVV THUF WYVI SLTZ

shift of 7

What is a scarecrow's favorite fruit?

FGEN JORE EVRF

shift of 13

Code-breaker's trick: there are only 25 shifts to try. Write the first cipher word 25 times, shifting one more letter each time, and one line will be English.



Rail fence

Write your message in a zig-zag down the rails, one letter per box. Then read all of rail 1, then all of rail 2. Add null letters at the end so the message splits into groups of four.

Two rails

cipher text

Three rails

cipher text

Decode: fill the rails first, then zig-zag

MEMT NGTX ETEO IHQZ (two rails, and three of the letters at the end are nulls)

message

Crack these

What has hands but cannot clap?
ALCQ COKX
2 rails

What runs all day but never gets tired?
AIEQ RVRX
2 rails

What has one eye but cannot see?
ADNE LQEE
3 rails



Twisted paths

Write the message into the grid the normal way, left to right, row by row. Then pick the letters up along a secret path and that is your cipher text.

Fill this grid, then read it along a plow path

A plow path goes left to right along the first row, then right to left along the next, like a farmer plowing a field.

cipher text

Now the same message along a spiral

Start in a corner and whirl inward.

cipher text

Decode

MEET MRUH TESD AYQV KJZX (4 by 5 grid, plow path, nulls at the end)

message

Design your own path. Draw arrows on a spare grid, agree it with a friend, and nobody else can read a word of it.



Key word columns

Number the key word letters in alphabet order: the letter nearest A gets 1. Write the message into the grid row by row, then copy out the columns in number order.

Number the key word

F	R	A	N	K

F R A N K → A is first, so A gets 1... **Encode with the key word FRANK**

F	R	A	N	K

cipher text

Encode the same message with the key word JANET

J	A	N	E	T

cipher text

Crack these

Why did the robot go on vacation?

NDCE IDRR EOAX ETHQ TEEG

key word FRANK

What do you call a sleeping bull?

BOLE ADUZ LR

key word JANET



Polybius squares

Every letter becomes two numbers: the row first, then the column. I and J share a cell, and the rest of the word tells you which one is meant.

The square

	1	2	3	4	5
1	A	B	C	D	E
2	F	G	H	I/J	K
3	L	M	N	O	P
4	Q	R	S	T	U
5	V	W	X	Y	Z

Fill in your own copy

	1	2	3	4	5
1					
2					
3					
4					
5					

Encode FIND THE GOLD

--	--	--	--	--	--	--	--	--	--	--	--	--

Decode 44 23 15 25 15 54 24 43 45 33 14 15 42 44 23 15 32 11 44

Crack these

Where do snowmen keep their money?

24 33 11 43 33 34 52 12 11 33 25

What did the big flower say to the little flower?

23 24 12 45 14

Why do bees have sticky hair?

44 23 15 54 45 43 15 23 34 33 15 54 13 34 32 12 43

Harder version: fill the square with a key word first, then the letters you have not used. Now the numbers mean something different and nobody can decode it without the key word.



Two keys to remember

Date shift

Turn a date into digits — October 21, 1973 becomes 102173 — and write them over and over above the message. Each letter shifts forward by the digit above it, so the same letter comes out differently each time.

Top row: key digits. Middle row: your message. Bottom row: the cipher.

Why was the computer cold?

JTNF MWJT UXPQ EOYT VSFN

key 102173

What do you call a dinosaur fast asleep?

CIIR QXNS TJ

key 2504

Key word alphabet

Write the key word with repeated letters removed, then finish the alphabet with every letter you have not used yet. Nothing to carry, nothing to lose — you can rebuild it from memory.

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

Try the key word JUPITER, then try your own name.

What is an astronaut's favorite meal?

FJSH PA

key word JUPITER

What kind of room has no doors?

TGPN YMJJ G

key word THURSDAY

Write the key word over and over above the message. The key letter picks a column, the message letter picks a row, and the letter where they cross is the cipher letter. To decode, find the column headed by the key letter, run down it until you find the cipher letter, and the row label is your answer.

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

[illegible]

key word FISH



Atbash: the alphabet backwards

Write the alphabet forwards along the top row, then backwards along the bottom row. A pairs with Z, B with Y, and so on to the middle. Every letter swaps for the one below it.

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

Fill in the bottom row yourself. Then use it.

Encode

MEET ME AT THE OLD OAK

Decode

GSVIV RH MLGSRMT GL IVNVNYVI

Notice: encoding and decoding are the same job. Doing it twice brings the message straight back, which is why there is no key to forget and no key to steal.



Playfair: letters in pairs

Write the key word into the square, dropping any repeated letter, then fill the rest with the alphabet. I and J share a cell.

Key word: MONARCHY

The three rules

1. **Same row:** each letter steps one to the right.
2. **Same column:** each letter steps one down.
3. **A rectangle:** each letter slides across to the other corner, staying in its own row.

Split into pairs, then encode

MEET ME AT NOON

Watch out: a pair of the same letter needs an X pushed between them, or the rules break.

Tap code: knocking on a wall

The same five by five square as Polybius, but sent by knocking. Count down to the row, pause, then count across to the column. C and K share a cell.

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

Write these as taps

ARE YOU THERE

Read these back

4-4 2-5 4-3 1-1 3-2 1-1 3-2 3-4 4-5 3-5 1-5

Try it for real: tap it on a table with a fingernail while somebody listens from the next room. Slowly. Leave a clear gap between the two counts.



Bacon: five units of two kinds

Every letter becomes five units of two kinds, A and B. Then those units can be carried by anything that comes in two forms: two handwritings, two colours, tall letters and short ones.

A AAAAA · B AAAAB · C AAABA · D AAABB · E AABAA · F AABAB · G AABBA · N ABBAB · O ABBBA · P ABBBB · Q BAAAA · R BAAAB · S BAABA · T BAABB · U
H AABBB · I ABAAA · J ABAAB · K ABABA · L ABABB · M ABBAA BABAA · V BABAB · W BABBA · X BABBB · Y BBAAA · Z BBAAB

Turn this into units

HIDE

Now hide them

Write an ordinary sentence with one word for each unit. Make the B words **bold** or underline them, and leave the A words plain.

Three hundred years later the same idea got two new names: nought and one.

Answers

Sheet 2 — pigpen

- .. THE SEA
- !. THE MOOVIES
- }. MEET ME BY THE OAK TREE AT FOUR

Sheet 3 — Caesar wheel

- .. A opposite H is a shift of 7: NBHY KAOL IYPK NLHA KH DU
- !. A opposite N is a shift of 13: BRING THE MAP

Sheet 4 — shift ciphers

- .. Shift of 3: WKHS DVVZ RUGL VSHQ JXLQ
- !. A DRIZZLY BEAR (shift 5)
- }. IT HAD TOO MANY PROBLEMS (shift 7)
- }. STRAWBERRIES (shift 13)

Sheet 5 — rail fence

- .. MEET ME TONIGHT, with QXZ as nulls
- !. A CLOCK (2 rails)
- }. A RIVER (2 rails)
- }. A NEEDLE (3 rails)

Sheet 6 — twisted paths

- .. MEET ME THURSDAY, with QXZJKV as nulls

Sheet 7 — key word columns

1. FRANK numbers as 2 5 1 4 3; JANET numbers as 3 1 4 5 2
2. IT NEEDED TO RECHARGE (key FRANK)
3. A BULLDOZER (key JANET)

Sheet 8 — Polybius

1. FIND THE GOLD is 21 24 33 14 44 23 15 22 34 31 14
2. THE KEY IS UNDER THE MAT
3. IN A SNOWBANK
4. HI BUD
5. THEY USE HONEYCOMBS

Sheet 9 — date shift and key word alphabet

1. IT LEFT ITS WINDOWS OPEN (key 102173)
2. A DINOSNORE (key 2504)
3. LAUNCH (key word JUPITER)
4. A MUSHROOM (key word THURSDAY)

Sheet 10 — Carroll's table

1. YPWA WMSZ ZZWP XJMY NMV
2. A GUMMY BEAR (key word VIGILANCE)
3. IT WAS TWO TIRED (key word FISH)



Junior Cryptographer

This certificate is awarded to

for encoding, decoding and refusing to give up on

- | | | |
|--|---|---|
| ☐ Pigpen | ☐ Shift ciphers | ☐ Rail fence |
| ☐ Twisted paths | ☐ Key word columns | ☐ Polybius squares |
| ☐ Date shift | ☐ Key word alphabets | ☐ Carroll's table |

signed

date

A message in code is a puzzle waiting for somebody clever.