PIAF – Pedagogical Scenario

(PIAF = Développement de la pensée informatique et algorithmique dans l'enseignement fondamental – **Development of computational and algorithmic thinking in basic education**)

Title

Find your way!

Practical Information

(Ideal) Number of students: 16
Age of the students: 9 – 12 years
Duration of the scenario: 3 sessions of 40 minutes each

Main disciplines of the scenario

C 2.5 Combining action sequences to achieve a goal

Description

Learners perform different types of decoding activities where they acquire an understanding of the specific order of actions needed for decoding. Formal and informal language representations are used for decoding messages into a common, understandable visualization (i.e. Latin characters and numbers on base 10).

PIAF-specific competencies/goals

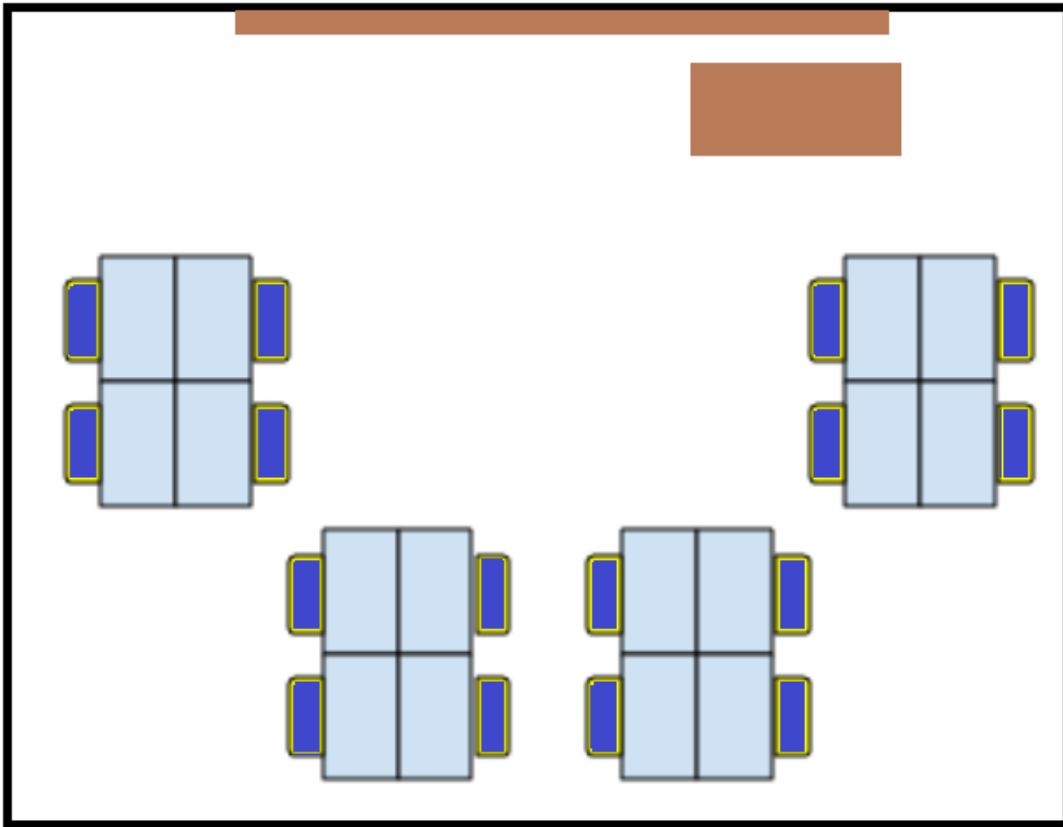| Specific PIAF Competencies:	
C1	Competency 2: Compose/decompose a sequence of actions > C 2.5 Combining action sequences to achieve a goal > Presented with a decoding task, learners identify the correct sequence of steps required to correctly decode a word or number.

Pre-requisite for the activities

- Knowledge of letters and numbers
- Addition of simple numbers

Digital Resources

Technical	Didactic
Not applicable	Course notes and attachments

Organization of the classroom

Scenario (Sequence of the Activities)

Activity 1: Language as codes		
1. Introduction (5')	Group Format: Whole class Instruction: Instructor enters class and knocks three times on the table. Then knocks twice. Then knocks once and claps once. Once the students are too puzzled, start explaining. *"You see. If we had a plan that once I walked in and knocked three times, you would all stand up. Once I knock twice, you line up and as soon as I clap once, you start walking...then we would have a secret code. What is the easier method that we are using in school?"* Students task: Students interact by responding to questions Instructors role: Introduce the task and answer students questions Anticipation of difficulties: If the teacher's question is not well understood by the learners, the teacher can ask "If you want your friend to do something, how do you do that?" -> By telling him/ her -> Telling someone to do something means using words -> Words imply a 'language' and an 'alphabet' Expected response: Language - alphabets as codes	
2. Morse Code (10')	Group Format: Whole class Document: Attachment A for teachers Instruction: *"It is language. The alphabets and the way we put it together help us communicate. We use letters of the alphabet to create words and with those we create phrases and sentences that anyone who knows the same language and alphabet can understand. But what if we want to create a message in a language but that only few people can understand? For that we would need a code. One of the most famous codes is the Morse code. Beware that the Morse code only changes the alphabet used to express the message and doesn't change its language. I will show you an example"* Students task: tries to decode the simple message Instructors role: Gives the simple code	2.5

3. Decode the message (20')	Group Format: Individually Document: Attachment A for teachers; Attachment 1 for students Instruction: *"Now it's your turn to decode some words."* Students task: Solve the Attachment 1 Instructors role: Facilitate the work and answer questions. Students need to first determine the correct order of steps to follow for the decoding and then follow those steps. Expected response: Students understand about coding and decoding and the steps needed for doing so.	2.5
5. End of session: finalize activity and summarize (5')	Group Format: Whole class Instruction: *"What did we learn today?"* Students task: Verbal description of what has been learned during this session Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -Codes can be used as a way of communication - Morse code has been used to transmit messages -Sequence of steps needed for decoding	
Activity 2: Binary Digits		
1. Reminder (5')	Group Format: Whole class Instruction: *"Can someone remind me of what we did last time?"* Students task: Verbal description of the activities done in the previous session Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -Decoded the light message using Morse Code -Decoded using the coding table -Learned some sequences of steps needed for decoding	

2. What are Bits (20')	Group Format: Whole class Document: Attachment B for teacher's Instruction: *"Today we will learn about Binary Digits. If we take the first two letters and last two letters of those words, we get bits. Have you heard of bits? It is the data used in computers. It is the code that the computers can interpret. And it is Binary, as it uses two digits only 0 (which is the OFF state) and 1 (which is the ON state). Let us see what binary numbers are."* Students task: Students interact by responding to question	
3. Bit your Number (10')	Group Format: Dyads Document: Attachment B for teachers; Attachment 2 for students per dyad Instruction: *"Now, Let's practice in dyads. Follow the instructions of the worksheet."* Students task: Code and Decode Instructors role: Facilitate by checking student's work. Expected response: Students are about to code numbers (on base 10) into binary digits (base 2).	2.5
4. End of session (5')	Group Format: Whole class Instruction: *"What did we learn today?"* Students task: Verbal description of what has been learned during this session Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: - Bits and Binary digits	
Activity 3: Find your way out!		
1. Reminder (5')	Group Format: Whole class Instruction: *"Glad you are all here. I have just received a message from the school principal. The key to the activity room is in a vault with a password but the principal forgot the password. We have some clues about who may know the password but the clues may need to be decoded. The director chose you to find where the key is as you will be able to decode the message. All students are depending on you to access their activity items. If this is not solved, we will have no*	

	activities anymore!! Do you remember what you did in the last sessions?" <u>Students task</u>: Verbal description of the activities done in the previous session <u>Instructors role</u>: Guide the students with questions for obtaining the expected answers <u>Covered topics</u>: - Bits and Binary Digits	
2. Decoding the clues (30')	<u>Group Format</u>: Groups of 4 <u>Document</u>: Attachment C for teachers; Attachment 3 for students <u>Instruction</u>: *"Great. Now that you're in groups, I will hand in to each group the first clue. When you're done with it, come to my desk to confirm that you correctly decoded the clue."* <u>Students task</u>: Resolve clues 1 and 2 and obtain the password for the vault. <u>Instructors role</u>: Check that the groups arrive to the correct answers and correctly specify the action sequence required for decoding the clues. Provide support for groups who arrive to incorrect answers. <u>Expected response</u>: Decoding of the clues and obtention of the vault password	*2.5*
3. End of session and summary of activity (5')	<u>Group Format</u>: Whole class <u>Instruction</u>: *"You have done a great job. We can all enjoy activities at school because of you!"* <u>Students task</u>: Give examples of the coding/decoding activity <u>Instructor:</u> Guide the students with questions for obtaining the expected answers <u>Covered topics</u>: - Different coding / decoding activities	

Assessment

Competencies/ PIAF-Goals	Activities for the assessment	Assessment criteria
2.5 Combining action sequences to achieve a goal	Students identify the steps required to decode Morse codes and perform the decoding of 4 words	Being able to combine the different action sequences The learner identifies the correct actions of the action sequence and executes it to decode the words

Received Feedback on the created Scenario

If you have had the opportunity to experiment with the scenario presented here, suggest some feedback on it: what worked well, the obstacles encountered, the learner's feedback, your feelings, possible ways to improve it.

Bibliography

"Binary numbers"
https://csunplugged.org/en/topics/binary-numbers/unit-plan/

"Morse code" To view the terms, visit
https://commons.wikimedia.org/wiki/File:International_Morse_Code.PNG

Attachments

Attachments Overview

Activity	Teacher Attachment	Student Attachment
1.2	A	
1.3	A	1
2.2	B	
2.3	B	2
3.2	C	3

Teacher's Attachments

Teacher's Attachment: A

Used in activity:	1.2: Morse code 1.3: Decode the message
Along with Student's Attachment(s):	1

Morse code

Word to code: HEY
Word in Morse: (dot dot dot dot) (dot) (dash dot dash dash)

Use the reference below to code it. Make a short pause between each letter. Explain to the students that by turning on the flashlight four short-times (**dot dot dot dot**) - you are flashing the letter H. By turning it on one short time (**dot)** - You are flashing the letter E. Lastly, by turning on the flashlight again a long time, then a short time, and two more long times, you are flashing the letter Y.
When done, refer to the table and (optionally) flash other short words.

Once they figure out the word, explain the steps needed to decode the complete word:
(1) Identify the type and amount of flashes for a letter (e.g. short-flash, short-flash, short-flash, short-flash), (2) Translate the amount and type of flashes to Morse (e.g. dot dot dot dot), (3) Search on the table for the letter that has that exact and full combination of dots and dashes that we got from the previous step (e.g. H), (4) Write down the identified letter (e.g. H), (5) Determine if a new letter will be flashed. If yes, go to step (1), if not identify the coded word.

It's important that the students understand each of the steps and that they have a specific order that must be followed

Letter	Code		Letter	Code
A	●▬		U	●●▬
B	▬●●●		V	●●●▬
C	▬●▬●		W	●▬▬
D	▬●●		X	▬●●▬
E	●		Y	▬●▬▬
F	●●▬●		Z	▬▬●●
G	▬▬●			
H	●●●●			
I	●●			
J	●▬▬▬		1	●▬▬▬▬
K	▬●▬		2	●●▬▬▬
L	●▬●●		3	●●●▬▬
M	▬▬		4	●●●●▬
N	▬●		5	●●●●●
O	▬▬▬		6	▬●●●●
P	●▬▬●		7	▬▬●●●
Q	▬▬●▬		8	▬▬▬●●
R	●▬●		9	▬▬▬▬●
S	●●●		0	▬▬▬▬▬
T	▬			

Solution for student's attachment 1

Pick one code.
Pick one cell of the code.
Identify the character(s) in the cell.
Look at the Translation Table to match the identified character(s) with its corresponding letter.
Write the letter directly under the character(s) you decided to decode.

Order	Step
1	Pick one code.
2	Pick one cell of the code.
3	Identify the character(s) in the cell.
4	Look at the Translation Table to match the identified character(s) with its corresponding letter.
5	Write the letter directly under the character(s) you decided to decode.

Code 1:	^°	;	(	""	{	/**			
Word 1:	O	R	A	N	G	E			

Code 2:	;	/**	::	{	(	{}	;	(	""	{
Word 2:	R	E	S	T	A	U	R	A	N	T

Code 3:	{	/**	""	""	--/	::			
Word 3:	T	E	N	N	I	S			

A	(	N	""
B	(*	O	^°
C	(*)	P	°
D	**	Q	,,
E	/**	R	;
F	/*	S	::
G	/	T	{
H	--	U	{}
I	--/	V	~
J	-/	W	[-]
K	%	X	[]
L	§	Y	[\]
M	"	Z	[~]

Teacher's Attachment: B

Used in activity:	2.2: What are Bits 2.3: Bit your Letters
Along with Student's Attachment(s):	2

Instructions to teach binary digits

Activity originally proposed in: https://csunplugged.org/en/topics/binary-numbers/unit-plan/)

Create 6 cards that on one side will have a certain number of dots and on the other the word "OFF"

Card	Side 1 (amount of dots)	Side 2
1	1	
2	2	
3	4	OFF
4	8	
5	16	
6	32	

"I need six volunteers to be bits. Each volunteer is holding a bit Card that contains an amount of dots. Volunteers are ordered from left to right with the card with the most amount of dots on the left and on the right the least.
Remember that each card represents only 1 bit, regardless of the amount of dots it has.

Now, let us choose a number between 0 & 32.
(Allow the students to choose the number. Here is an example for the number 9)
If we want to write 9 in binary digits.

Starting from the left, how many dots does the first bit Card have? 32. This bit has more dots than we need, therefore we flip the card to turn it OFF because we don't need this card.

We now move to the second bit. How many dots? 16. Do we need this bit? No. Why? Because, again, it has more dots than the number we want (in this case, 9). Therefore we also flip this bit to turn it OFF

What about the 3rd bit? This bit has 8 dots, which is lower than our number so then we keep this bit and move on to the next one.

We're now with the 4th bit and we see it has 4 dots. Yes, this is lower than our number but if we add if to our previous bit, 8 dots, it would exceed our number. Based on this we will turn OFF this 4th bit

For the 5th bit, it is similar as with the previous one so we will also turn it OFF

Lastly, the 6th bit has only 1 dot which is exactly what we need to add to our previous bit so we can get our number (i.e. 9)"

If the time allows, repeat the same activity with more examples.

You can prompt students to find the lowest and highest number reached with 6 bits.

"Remember that when deciding which bits to keep, always start with the one with the highest amount of dots, in this case the 6th bit."

Solution for attachment 2

Conversion Table						
Bit position	1	2	3	4	5	6
Value / Dots	32	16	8	4	2	1

Number to convert:	10					
Bit position	1	2	3	4	5	6
Keep Bit?	no	no	yes	no	yes	no
Converted number:	0	0	1	0	1	0

Identify number to convert
Start with the bit position in the left
Check value/dots of chosen bit position
Decide to keep (no / yes) chosen bit position indicating it in the "Keep Bit?" row
Move to the next bit position and go to the 3rd step. Repeat until reaching Bit position 7
Fill the "Converted number" row based on "Keep Bit?" row

Order	Step
1	Identify number to convert
2	Start with the bit position in the left

3	Check value/dots of chosen bit position	
4	Decide to keep (no / yes) chosen bit position indicating it in the "Keep Bit?" row	
5	Move to the next bit position and go to the 3rd step. Repeat until reaching Bit position 7	
6	Fill the "Converted number" row based on "Keep Bit?" row	

Number to convert:	7					
Bit position	1	2	3	4	5	6
Keep Bit?	no	no	no	yes	yes	yes
Converted number:	0	0	0	1	1	1

Number to convert:	30					
Bit position	1	2	3	4	5	6
Keep Bit?	no	yes	yes	yes	yes	yes
Converted number:	0	1	1	1	1	1

Number to convert:	25					
Bit position	1	2	3	4	5	6
Keep Bit?	no	yes	yes	no	no	yes
Converted number:	0	1	1	0	0	1

Print numbers for students to randomly pick up and code. Then direct them to switch their sheet (Attachment 2) with the other pair to decode back into the number picked.

1	**17**
2	**18**
3	**19**
4	**20**
5	**21**
6	**22**
7	**23**
8	**24**
9	**25**
10	**26**
11	**27**
12	**28**
13	**29**
14	**30**
15	**31**
16	

Used in activity:	3.2 Decoding the clues
Along with Student's Attachment(s):	3

Introduction

"As explained in the previous activity, there are a series of clues for retrieving the password that opens the vault. When decoded, the clues indicate the name of a person from the school that has a part of the password for the vault. These people rarely talk about the password therefore you also need a talk code so these people know that you are trustworthy."

"Now that all groups are formed, I will give each group a sheet with the first clue. Once you decode the name and talk code, come to my desk and I will confirm to you if the name are talk code are correct"

Advice for the teacher

For this activity, each group will start by receiving the first clue from which they need to decode the name of the person as well as a talk code. The name of the person is obtained by translating the characters into letters and the talk code is obtained by correctly ordering the steps needed to decode the clue.

Once a group is done with the first clue, check that the name and talk code are correct, then briefly talk about the person, and only after that provide the group with the first vault password part as well as the second clue.

The second clue has the same structure as the first one but uses a different translation table. After a group obtains the name and talk code, check their answers and if correct, talk about the person, give them the second part of the vault password, and give them the final sheet where they need to write the password according to the instructions.

Check the final password, and if correct, tell the students that they were able to open the vault and recover the key"

Below is an overview of all the clues, names, talk codes, password parts and final vault password:

	Clue	Name	Talk Code	Profession	Password part
Clue 1	-- ("" ::	Hans	(92) (45) (51) (33)	Janitor	{7392}
Clue 2	" (; --/ ("" "" /**	Marianne	(46) (83) (12) (67)	Librarian	{0026}
Final password		{7392}{0026} = 73920026			

Clue 1

Task: Decode the first clue that contains the name of a person and discover the number code needed to talk with the person. Once you have the "Name" and "Talk code", go with the teacher and to share this information. If correct, the teacher will give you the second clue.

First, look at the following steps that describe how to decode the clue in the box below and place them in the correct order. Remember to include the number at the end of each step.

Write the corresponding letter in the "Name" row : (45)
In the translation table, identify the letter that corresponds to the character : (92)
Moving from left to right, identify a character (in the "clue" row) that doesn't have its letter (in the "name" row) : (33)
Look at the translation table to search the character : (51)

Order	Step
1	Moving from left to right, identify a character (in the "clue" row) that doesn't have its letter (in the "name" row) : (33)
2	Look at the translation table to search the character : (51)
3	In the translation table, identify the letter that corresponds to the character : (92)
4	Write the corresponding letter in the "Name" row : (45)

Now that you have the steps ordered, locate the number

Order	3	4	2	1
Talk code	(92)	(45)	(51)	(33)

Now that you have the correct order of steps, decode the clue using the Translation Table

Clue	--	(	""	::		
Name	H	A	N	S		

Translation Table (Use it for decoding clues 1 and 2)

A	(		N	""
B	(*		O	∧º
C	(*)		P	º
D	**		Q	,,
E	/**		R	;
F	/*		S	∷
G	/		T	{
H	--		U	{}
I	--/		V	~
J	-/		W	[-]
K	%		X	[]
L	§		Y	[\]
M	"		Z	[~]

First part of the vault password

Only provide it to the groups after correct submission of clue 1:

Vault password part 1:
{7392}

Clue 2

Task: Decode the second clue that contains the name of a person and discover the number code needed to talk with the person. Once you have the "Name" and "Talk code", go with the teacher and to share this information.

First, look at the following steps that describe how to decode the clue in the box below and place them in the correct order. Remember to include the number at the end of each step.

Search the character: (46)

Write the corresponding letter in the "Name" row : (67)

Identify a character that doesn't have its letter: (12)

Identify the letter that corresponds to the character: (83)

Order	Step
1	Identify a character that doesn't have its letter: (12)
2	Search the character: (46)
3	Identify the letter that corresponds to the character: (83)
4	Write the corresponding letter in the "Name" row : (67)

Now that you have the steps ordered, locate the number

Order	2	3	1	4
Talk code	(46)	(83)	(12)	(67)

Now that you have the correct order of steps, decode the clue using the Translation Table

Clue	"	(	;	--/	(	""	""	/**
Name	M	A	R	I	A	N	N	E

Second part of the vault password

Only provide it to the groups after correct submission of clue 2:

Vault password part 2:
{0026}

Vault password

Part 1	Part 2
{7392}	{0026}

Student's Attachments

Attachment 1: Decoding words

Below, you will find a list of steps to follow for decoding each word. Two of the steps are already shown in the correct order. Place the other steps in the correct order, and after that proceed to decode each word.

Pick one code.

Write the letter directly under the character(s) you decided to decode.

Look at the Translation Table to match the identified character(s) with its corresponding letter.

Identify the character(s) in the cell.

Pick one cell of the code.

Order	Step
1	Pick one code.
2	
3	
4	
5	Write the letter directly under the character(s) you decided to decode.

Code 1:	^°	;	(	""	{	/**			
Word 1:									

Code 2:	;	/**	::	{	(	{}	;	(	""	{
Word 2:										

Code 3:	{	/**	""	""	--/	::			
Word 3:									

Translation Table

A	(	N	""
B	(*	O	^°
C	(*)	P	°
D	**	Q	,,
E	/**	R	;
F	/*	S	::
G	/	T	{
H	--	U	{}
I	--/	V	~
J	-/	W	[-]
K	%	X	[]
L	§	Y	[\]
M	"	Z	[~]

Attachment 2: Work with your classmate.

First, have a look at the conversion table below and the next table which contains a converted number.

Conversion Table						
Bit position	1	2	3	4	5	6
Value / Dots	32	16	8	4	2	1

Number to convert:	10					
Bit position	1	2	3	4	5	6
Keep Bit?	no	no	yes	no	yes	no
Converted number:	0	0	1	0	1	0

Based on the 2 tables above, read the steps described below and place them in the correct order

Move to the next bit position and go to the 3rd step. Repeat until reaching Bit position 7

~~Identify number to convert~~

Decide to keep (no / yes) chosen bit position indicating it in the "Keep Bit?" row

Start with the bit position in the left

Fill the "Converted number" row based on "Keep Bit?" row

Check value/dots of chosen bit position

Order	Step
1	Identify number to convert
2	
3	
4	
5	
6	

Now that you have the steps in the correct order, convert the following 3 numbers. Don't forget to use the Conversion Table!:

Number to convert:	7					
Bit position	1	2	3	4	5	6
Keep Bit?						
Converted number:						

Number to convert:	30					
Bit position	1	2	3	4	5	6
Keep Bit?						
Converted number:						

Number to convert:	25					
Bit position	1	2	3	4	5	6
Keep Bit?						
Converted number:						

Clue 1

Task: Decode the first clue that contains the name of a person and discover the number code needed to talk with the person. Once you have the "Name" and "Talk code", go with the teacher and to share this information. If correct, the teacher will give you the second clue.

First, look at the following steps that describe how to decode the clue in the box below and place them in the correct order. Remember to include the number at the end of each step.

Write the corresponding letter in the "Name" row : (45)

In the translation table, identify the letter that corresponds to the character : (92)

Moving from left to right, identify a character (in the "clue" row) that doesn't have its letter (in the "name" row) : (33)

Look at the translation table to search the character : (51)

Order	Step
1	
2	
3	
4	

Now that you have the steps ordered, locate the number

Order	3	4	2	1
Talk code				

Now that you have the correct order of steps, decode the clue using the Translation Table

Clue	--	(	""	::		
Name						

Translation Table (Use it for decoding clues 1 and 2)

A	(	N	""
B	(*	O	∧°
C	(*)	P	°
D	**	Q	,,
E	/**	R	;
F	/*	S	::
G	/	T	{
H	--	U	{}
I	--/	V	~
J	-/	W	[-]
K	%	X	[]
L	§	Y	[\]
M	"	Z	[~]

Vault password part 1:
{7392}

Clue 2

Task: Decode the second clue that contains the name of a person and discover the number code needed to talk with the person. Once you have the "Name" and "Talk code", go with the teacher and to share this information.

First, look at the following steps that describe how to decode the clue in the box below and place them in the correct order. Remember to include the number at the end of each step.

Search the character: (46)

Write the corresponding letter in the "Name" row : (67)

Identify a character that doesn't have its letter: (12)

Identify the letter that corresponds to the character: (83)

Order	Step
1	
2	
3	
4	

Now that you have the steps ordered, locate the number

Order	2	3	1	4
Talk code				

Now that you have the correct order of steps, decode the clue using the Translation Table

Clue	"	(	;	--/	(	""	""	/**
Name								

Second part of the vault password

Vault password part 2:
{0026}

Vault password

Part 1	Part 2

Evaluation

Destination… Morse? (SOLUTIONS)

We want to travel to 4 cities, but we only have their names in Morse code.

First, read the steps below and place 5 of them in the correct order. This time we will try to decode the 4 cities at the same time.

Identify an uncoded Morse code column

Check on all other columns and circle the columns that have the same uncoded Morse code

Write down in a piece of paper the identified uncoded Morse code

Look at the Morse code table and find the letter that corresponds to that Morse code

Write in all circled columns the letter that corresponds to that Morse code

(false) Count the amount of dots of the uncoded Morse code

(false) Count the amount of dashes of the uncoded Morse code

(false) Reorganize the Morse code table

Order	Step
1	Identify an uncoded Morse code column
2	Check on all other columns and circle the columns that have the same uncoded Morse code
3	Write down in a piece of paper the identified uncoded Morse code
4	Look at the Morse code table and find the letter that corresponds to that Morse code
5	Write in all circled columns the letter that corresponds to that Morse code

Morse	– • • •	•	• – •	• – • •	• •	– •		
City	B	E	R	L	I	N		

Morse	• – – •	• –	• – •	• •	• • •			
City	P	A	R	I	S			

Morse	• – • •	– • – –	– – –	– •				
City	L	Y	O	N				

Morse	• • •	–	• • –	–	–	– – •	• –	• – •
City	S	T	U	T	T	G	A	R	T

Print the following Morse code table and distribute to the whole class.

Morse code table

Destination… Morse?

We want to travel to 4 cities, but we only have their names in Morse code.

First, read the steps below and place 5 of them in the correct order. This time we will try to decode the 4 cities at the same time.

Reorganize the Morse code table

Count the amount of dots of the uncoded Morse code

Reorganize the Morse code table

Write in all circled columns the letter that corresponds to that Morse code

Check on all other columns and circle the columns that have the same uncoded Morse code

Identify an uncoded Morse code column

Count the amount of dashes of the uncoded Morse code

Look at the Morse code table and find the letter that corresponds to that Morse code

Write down in a piece of paper the identified uncoded Morse code

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Order	Step
1	
2	
3	
4	
5	

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