

Science Olympiad — Stuyvesant

Exam Preparation

You will need:

1. Folders for each of the teams to hold the tests
2. Sufficient copies of the test for all teams. They don't need to be stapled.
3. Multiple timers which have a lap function on them - ideally one per volunteer. The timer app on an iPhone or Android Phone that has a stopwatch function with lap function is sufficient.

Before the event begins:

1. Practice starting the timers and using the lap function to record the times. Make sure volunteers understand how to use the lap function and are not accidentally stopping the timer completely.
2. Memorize the answer to the timed question.
3. Check to make sure that this key matches the test you are proctoring.
4. Place one copy of the test for each team in the provided folders with the first page outside the folder.
5. Adjust desks and chairs – teams may have up to 3 students for this event.

Running the Event

1. When the students enter the room, instruct them to sit down, DO NOT OPEN THE FOLDER, and put their names, school name and school number on the first page.
2. Encourage them to write their team number on all the other pages AFTER they begin the test. This way if their papers gets separated from each other we can make sure to give them credit.
3. **CRITICAL:** Check to see that students have ONLY brought
 - i. Something to write with (pencils, pens, erasers)
 - ii. Five function calculators (addition, subtraction, multiplication, division, and usually square root). The calculator can have a simple memory store/recall function but must not have a modulus or other scientific and programmable functions. If their calculator doesn't meet these requirements, they may not use it.
 - iii. If there are spare calculators in the kit, you may loan up to one per team to use for the test.
 - iv. If the student has a smart watch (Apple watch, Samsung Gear, etc.) they will need to put it away.
4. Instruct the students that if they answer the timed question within 10 minutes, they can be awarded a bonus if they solve the timed question with no more than 2 letters incorrect.
 - i. When they have a solution for the cryptogram they should raise their hand.
 - ii. Let them know that you will announce when the 10-minute time is up. After the first 10 minutes, no additional bonus points will be awarded.
 - iii. When you see a team raise their hand, hit the LAP function and head to the team.
 - iv. Determine if their answer is correct (see next page for grading), If so, write the time on their score sheet.
 - v. If their score is incorrect (more than 2 letters incorrect), tell the team that the answer is wrong, but DO NOT tell them what is wrong. They can continue to work on the question and raise their hand again to be checked. A team has an unlimited number of attempts during the 10-minute bonus.
5. Tell the teams that they do not have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It will not be graded.
6. Some students may never have used a non-scientific calculator. You should have them enter a simple formula on their calculator: $1 / 26 = * 26 = ..$ Most will be surprised to see that the answer is not rounded to 1 as they expected but .9999999999
7. When the timers hit the 10-minute point, announce that no bonus points will be awarded and put away the timers. The students may continue to work on the question, but they may not receive any extra points.

8. A team is not restricted to only the timed question during the 10 minutes. They can move on or split up the work if they would like, but it is in their best interest to try for the bonus.
9. When time is up, have the students put writing instruments down and put their answer pages back into the folder in the correct order.

How to grade

1. Teams can have up to two incorrect letters total on their cryptogram and still be correct. The frequency of the incorrect letter is irrelevant. See the example below.

If the cryptogram was as shown:

KZBAOF KFXMFXYP
SAMPLE SENTENCE

and the students answered (underlined letters indicate mistakes)

SAMPLE SENTENCE

then it counts as four mistakes (even though the mistake was only in the letter E) and the answer DOES NOT count. However, if they put

SAMPLE SENTENCE

It is considered correct with two letter mistakes.

2. For questions which have a numeric answer (such as determining the a= and b= values), no mistakes are allowed.
3. Teams do NOT have to fill in the frequency table. It is simply there as an aid to them solving the cryptogram. It WILL NOT be graded. It is included in the answer key as an aid to the grader.
4. When scoring the Baconian ciphers (with strange text or symbols), they can write the answer under the Baconian symbols or on the line provided. Note that you will see lots of As and Bs, but they are not graded as the answer, only what they put on the answer line.
5. As you score each question, if correct, put the number of incorrect letters (0, 1, or 2) next to the question number on the scoring page. Also, put the value for the question into the score column. If they get more than 2 letters wrong, subtract 100 points from the score until it would be zero. If a question is worth 240 points and they get 4 letters wrong, you would start with 240 points (for up to 2 letters wrong) and then subtract 100 points for the next two letters wrong ending up with a final score of 40 points for that question. If they had gotten 5 or more letters wrong on a 240 point question, they would receive 0 points for that question. With a 650 point question, they could get 8 letters wrong and receive 50 points (2 free letters then $6 \times 100 = 600$ points off). Just put the incorrect cost deduction on the score sheet and subtract it from the value for the question. Under no circumstance should the score for any question be less than zero. Note that while the timed question must have 2 or fewer letters incorrect in order to get the timing bonus, a team solving the timed question after the 10 minutes passed would be accepted as correct with 3 incorrect letters receiving 100 points for the timed question.
6. If they correctly answered the timed question in 10-minutes or less with 2 or fewer letters incorrect, you need to compute the bonus time. Take the value for the minute from this first table below

0:xx	2,160	1:xx	1,920	2:xx	1,680	3:xx	1,440	4:xx	1,200
5:xx	960	6:xx	720	7:xx	480	8:xx	240	9:xx	0

and then add the seconds value from this table:

X:00	240	X:01	236	X:02	232	X:03	228	X:04	224	X:05	220
X:06	216	X:07	212	X:08	208	X:09	204	X:10	200	X:11	196
X:12	192	X:13	188	X:14	184	X:15	180	X:16	176	X:17	172
X:18	168	X:19	164	X:20	160	X:21	156	X:22	152	X:23	148
X:24	144	X:25	140	X:26	136	X:27	132	X:28	128	X:29	124
X:30	120	X:31	116	X:32	112	X:33	108	X:34	104	X:35	100

X:36	96
X:42	72
X:48	48
X:54	24

X:37	92
X:43	68
X:49	44
X:55	20

X:38	88
X:44	64
X:50	40
X:56	16

X:39	84
X:45	60
X:51	36
X:57	12

X:40	80
X:46	56
X:52	32
X:58	8

X:41	76
X:47	52
X:53	28
X:59	4

For example if they solved the time question at the 6:46 mark, you would add 720 (from the 6:xx entry in the first table) to 56 (from the X:46 entry in the second table) to get a bonus of 776. If they had solved it in exactly 4:00 minutes, you would add 1200 and 240 to get a bonus of 1440.

7. Add up all the scores and put the total on the bottom of score sheet.
8. You must break all ties. Indicate the tie breaker by adding .1 to the score of the team ahead. With multiple teams tied, you will add more. I.e. if five teams all scored 200 points, the final scores that you would enter on the score sheet would be 200.4, 200.3, 200.2, 200.1 and 200.
9. To determine how to break the tie, you need to look at the correctly answered questions in the order from the table below. If both teams answered the same (i.e. they answered the question with zero mistakes) then you go on to the next question. If one team had no mistakes and the other team had one mistake, then the team with no mistakes is ahead. For example, if one team answered question #8 (which is the highest value question) and another team didn't, the first team will be ahead.

Tie Breaker Order	Question #
1	6
2	15
3	12
4	16
5	4
6	14
7	10
8	3
9	17
10	11
11	7
12	5
13	2
14	Timed
15	18
16	13
17	9
18	8
19	1

0. If there is still a tie (typically when you have teams which answered either zero, one or two questions) then you will need to look at the tie breaker questions again and count the number of correctly answered letters. The team with the most correctly matched letters is to be ahead.

Timed Question **[300 points]** Below is a passage by American writer Jodi Picoult that has been encoded with a random alphabet Aristocrat cipher. What did it say? When you have solved it, raise your hand so that the time can be recorded and the solution checked.

**EA EY X MUERF LBFJ NQO SQDF AQRFOJF AQ ROMB YBXY NQO
IS IT A CRIME WHEN YOU LOVE SOMEONE SO MUCH THAT YOU**

**MXJ'Y AFF MSFXUSN?
CAN'T SEE CLEARLY?**

	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
Frequency	4	3		1	3	8				3		1	4	3	3		6	3	3		2			4	4	
Replacement	S	H	Z	V	I	E	X	K	J	N	D	W	C	Y	U	G	O	M	L	P	R	F	B	A	T	Q

1) **[200 points]** What did this quote from American author Robert Anton Wilson encrypted with the Caesar cipher say?

I	P	M	P	I	X	D	C	X	H	G	D	Q	Q	T	G	N	Q	P	H	T	S	D	C	B	D	C	D	E	D	A	N
T	A	X	A	T	I	O	N	I	S	R	O	B	B	E	R	Y	B	A	S	E	D	O	N	M	O	N	O	P	O	L	Y

D	U	L	T	P	E	D	C	H
O	F	W	E	A	P	O	N	S

2) **[300 points]** Don Cheadle, Actor & UN Environment Goodwill Ambassador once said this, encrypted with the Vigenère cipher using the key "TREES". What did he say?

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

E	E	S	T	R	E
I	E	F	T	Z	V
E	A	N	A	I	R

3) [350 points] Solve this Morbit cipher that encrypts a quote from Mary Frances Berry, an American historian and lawyer, concerning justice. You are given that 2=-●, 4=-●-, 7=●●, 8=-, 9=●x. What does it say?

4 6 7 7 3 1 9 3 9 6 1 4 9 8 6 8 3 3 7 5 6 8 6 1 3 7 9
 ●--x●●●●x●x-●xx●●x-xx-●-●x---x---x●x●●●xx-x---xx-x●●●x
 W H E N / I T / C O M E S / T O / T H

9 1 4 9 4 3 4 3 7 3 5 8 6 7 2 5 4 8 3 4 3 7 1 3 9
 ●xx-●-●x●-x●●-x●●●x●xx---x●●-●xx●---x●●-x●●●x-x●●x
 E / C A U S E / O F / J U S T I

2 2 3 5 7 5 6 4 1 4 3 5 2 1 8 5 4 2 3 2 3 9 7 9 8 6
 -●-●x●xx●●xx-x●-x-●-x●xx-●x---xx●---●x●-●x●●x●●●x---x
 C E / I / T A K E / N O / P R I S O

2 3 3 2 3 7 5 4 1 9 2 9 3 9 1 7 1 8 1 9 1 5 2 7 3
 -●x●x●-●x●●●xx●-x-●x-●●xx●●xx-●●x---x-●xx-xx-●●●x●
 N E R S / A N D / I / D O N / T / B E

3 2 9 7 3 3 7 6 9 3 9 2 5 2 2 1 8 1 6 4 2 3 2 1 8
 x●-●●x●●x●x●●●-x●xx●●x-●xx-●-●x---x---x●-●x●-●x---
 L I E V E / I N / C O M P R O

1 6 7 3 7 3
 x--x●●x●●●x●
 M I S E

4) [400 points] The following quote by Civil Rights activist Rosa Parks is encrypted using the Pollux cipher given that 1=●, 3=x, 4=x, 6=-, 7=●. What does it say?

92556458047649195441883395288396121700452986623999405
 -x---x-●●x●-x-●---xx●●●xx--x●●x--●x●●●x-x-●---xx---x●-
 T O D A Y S M I G H T Y O A

49093300478734679520211129383197491037945069348703358
 x-●-xx●●x●●●xx-●---x●x●●●x-x●x●-●x-●●x●-x-●---xx●●●xx-●
 K I S Y E S T E R D A Y S N

3109292263110721546430787214767046002300252017339974751
 x●●-x-xx-x●●●●x●-x-xx●●●●x●x●-●●x-●●xx●●x-x●●●xx--●x●-●
 U T T H A T H E L D I T S G R

269938764504518
 x---x●●-x-●x-●●
 O U N D

5) [300 points] Below is a quote said by G-Man from the game *Half-Life 2* encoded with a Baconian cipher. You know that the last word spells "WORLD". What does it say?

42365728943567283572395723546723894657823954672357289
 BAABAAABBBAABAABAAAAABAAAAABBAAABBBBAABAABABBAAAAAABB
 T H E R I G H T M A N

35742357682395742356897243567823957235467829435726835
 AAABAAAABBAABAABAAABBBAABAABABAABAAAAABBABABBAAAABBAA
 I N T H E W R O N G

94672839572357235472365723587235723945726389572357423
 BBBAABABAAAAAAAABAAAABAAAAABAAAAABBAAABABBAAAAAABAA
 P L A C E C A N M A K

65782357235792435678293547236895742357268395723547623
 BAABAAAAAABABABAABABAABAAABBBAABAAAAABBABAAAAABABAA
 E A L L T H E D I F

85972435672357283579423572635782359723546728359723468
 BABAABAABAAAAABAAABBAAAAABAAABAAAABBAABAABAABBB
 F E R E N C E I N T H

579234567238954672357829357246
 AABAABABAAABBABBAAAAABABAAAABB
 E W O R L D

The right man in the wrong place can make all the difference in the world.

6) [650 points] Emiliano Zapata, a leading figure in the Mexican Revolution, said this, encrypted with a Spanish Xenocrypt cipher. What does it say?

CG PZ YXH SQCEGTGX VXIX WÑ VQWKÑZ, NQW PZ YXHX VXD
 SI NO HAY JUSTICIA PARA EL PUEBLO, QUE NO HAYA PAZ

VXIX WÑ OZKGWIPZ.
 PARA EL GOBIERNO.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Ñ	O	P	Q	R	S	T	U	V	W	X	Y	Z
Frequency			2	1	1		4	2	3		2			1	3	1	3	3		1	1		4	5	9	2	5
Replacement	K	M	S	Z	T	V	I	Y	R	Ñ	B	W	D	Q	L	G	N	U	F	J	C	X	P	E	A	H	O

7) **[300 points]** Cris Cyborg, a Brazilian-American mixed martial artist, once said this about her fights. It has been encrypted with a random alphabet Aristocrat cipher. What does it say?

S PNQL LU DNEA KJANL TSKRLO, ADULSUQNV TSKRLO, TUJ
 I WANT TO MAKE GREAT FIGHTS, EMOTIONAL FIGHTS, FOR
 NVV DZ TNQO NQH AWAJZUQA PNLERSQK.
 ALL MY FANS AND EVERYONE WATCHING.

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

8) **[250 points]** Helen Keller, American author and political activist, once said this to *inspire* you. It has been encrypted with a K2 Aristocrat cipher. What does it say?

JKQBGBOG BO QAP RZBQA QAZQ FPZSO QJ ZNABPUPGPHQ.
 OPTIMISM IS THE FAITH THAT LEADS TO ACHIEVEMENT.
 HJQABHE NZH IP SJHP VBQAJTQ AJKP ZHS NJHRBSPHNP.
 NOTHING CAN BE DONE WITHOUT HOPE AND CONFIDENCE.

Replacement	Z	I	N	S	P	R	E	A	B	C	D	F	G	H	J	K	L	M	O	Q	T	U	V	W	X	Y
K2	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
Frequency	7	8			1	1	3	8	1	7	2			4	3	10	10	2	4	1	1	1				6

9) **[250 points]** Stevie Wonder once we should stop doing this, encrypted using the Affine cipher which was encoded using the Affine Cipher with $a=7$ and $b=11$. What does it say?

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

10) **[350 points]** You are given the message PENNSYLVANIA to be encrypted using the Hill cipher. Use the following encryption matrix to do so:

$$\begin{pmatrix} J & A \\ Z & Z \end{pmatrix} \equiv \begin{pmatrix} 9 & 0 \\ 25 & 25 \end{pmatrix}$$

P	E	N	N	S	Y	L	V	A	N	I	A
F	H	N	A	G	K	V	U	A	N	U	S

11) **[300 points]** Willy Wonka once said "We are the music makers, and we are the dreamers of dreams". Encrypt it using the Vigenère cipher using the key "CANDY".

C A N D Y C A N D Y C A N D Y C A N D Y C A N D Y C A N D Y C A N D Y , Y C A N D Y C A N D Y C A N D Y

W	E
Y	E

A	R	E
N	U	C

T	H	E
V	H	R

M	U	S	I	C
P	S	U	I	P

M	A	K	E	R	S
P	Y	M	E	E	V

A	N	D
Y	P	D

W	E
J	H

A	R	E
Y	T	E

T	H	E
G	K	C

C A N D Y C A N D Y C A N D Y C .

D	R	E	A	M	E	R	S
F	R	R	D	K	G	R	F

O	F
R	D

D	R	E	A	M	S
F	R	R	D	K	U

12) **[600 points]** Special Agent, Benjamin, has the following RSA public key:

$$n = 145801 \quad e = 79229$$

Unfortunately for them, A quantum computer has successfully factored their n

$$145801 = 691 * 211$$

Compute the value of their private key.

Enter the computed private key:

8069

13) [250 points] South African political leader and revolutionary Nelson Mandela once said these words encrypted with a Baconian cipher. You are told that the first word is "ANY". What did he say?

+--+--/*+--/*+/-+*-/*+--+--/*+--+/*-/*+--+--/-+--+*/*+--+/*+--
 AAAAAABBAABABBAABABBAAAAAABBAABBABBAAAAAABAAAABBAABAAABBA
 A N Y M A N O R I N S T

 /+-*+--+/-+*-/+-*/*+--+--/*+/-*/*+--+--/+--+*/*+--+--/+--+*/*+--
 BAABAAABAABABAABBBAAABAABAAAABBBABABBAABAABAABBBBAAAAABAABAB
 I T U T I O N T H A T

 -+*-/+--+--*+--+--/+--+--/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--
 AABABAAAABAABAAAABAABAAABBAABAABBBABBAAAAABBABAAAABABABBAABA
 T R I E S T O R O B M E

 -+*/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--
 AABBABAABABABABBBABBAAAAABBABAAAABBAABBAABAABAABAABABABBABA
 O F M Y D I G N I T Y

 /+--+--*+--+--/*+--+--/*+--+--/*+--+--/*+--+--/*+--+--
 BAAABAAAABABAABABAABABAABBBABBAABAABAABA
 W I L L O S E

Any man or institution that tries to rob me of my dignity will lose.

14) [350 points] The following text is taken from William Faulkner's *The Sound and the Fury* and has been encrypted with a random alphabet Aristocrat cipher. What did it say?

OC'F VUC ETRV PUG JRMSOFR CTMC VUCTOVD NMV TRSH PUG -
 IT'S NOT WHEN YOU REALISE THAT NOTHING CAN HELP YOU -

JRSODOUV, HJOIR, MVPCTOVD - OC'F ETRV PUG JRMSOFR
 RELIGION, PRIDE, ANYTHING - IT'S WHEN YOU REALISE

CTMC PUG IUV'C VRRI MVP MOI.
 THAT YOU DON'T NEED ANY AID.

	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
Frequency			10	3	2	4	4	2	4	4			8	1	10	6		11	4	7	8	12				
Replacement	Q	F	T	G	W	S	U	P	D	R	Z	B	A	C	I	Y	V	E	L	H	O	N	X	K	J	M

15) [600 points] Mother Abbess said this to Maria about facing her problems in the movie *The Sound of Music*. It has been encrypted with the Patristocrat cipher. What did it say?

HCZBC MDUNU TCEEN TUZUY JMHUC YMMJN DKMJK MVZJF
 MARIA THESE WALLS WEREN OTMEA NTTOS HUTOU TPROB

EUHNI JKDCS UMJWC OUMDU HIJKD CSUMJ EBSUM DUEBW
 LEMSY OUHAV ETOFA CETHE MYOUH AVETO LIVET HELIF

UIJKT UZUFJ ZYMJE BSU
 EYOUW EREBO RNTOL IVE

Maria, these walls were not meant to shut out problems. You have to face them. You have to live the life you were born to live.

	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
Frequency		4	7	6	6	2		4	3	11	5		11	4	1				4	3	16	1	2		3	5
Replacement	J	I	A	H	L	B	Q	M	Y	O	U	G	T	S	C	D	X	Z	V	W	E	P	F	K	N	R

16) [550 points] Alfred in the movie *The Dark Knight* said this to Bruce Wayne about the choices Batman can make. It has been encrypted with the Patristocrat cipher. What did Alfred say?

FNRPV QPGNJ FNRFH TRNJF PJVHH VNNIZ NRPVQ PGNJF
 HECAN MAKET HECHO ICETH ATNOO NEELS ECANM AKETH

NWTMF JRFHT RN
 ERIGH TCHOI CE

He can make the choice that no one else can make, the right choice.

	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
Frequency						7	2	4	1	5			1	10		5	2	6		3		4	1			1
Replacement	Q	X	V	J	P	H	K	O	L	T	U	F	G	E	B	A	M	C	Y	I	Z	N	R	W	D	S

17) **[300 points]** The following was said by author Shannon L. Alder, but was encrypted using an Aristocrat cipher. What did it originally say?

SIWR UX VTIWRO MYR FIFRKM PIZ SRM JI ID XIFRIKR
 LOVE IS PROVED THE MOMENT YOU LET GO OF SOMEONE

LRHBZXR MYRP KRRO PIZ MI.
 BECAUSE THEY NEED YOU TO.

	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
Frequency		1		1		3		1	10	1	3	1	5		2	3		12	2	1	1	1	2	3	2	3
Replacement	Z	A	X	F	J	M	K	C	O	G	N	B	T	Q	D	Y	W	E	L	R	I	P	V	S	H	U

18) **[250 points]** John Cena once said the following about his attire. It has been encoded with an Aristocrat cipher. What did the message originally say?

R	W	L	M	'	G	S	Z	E	V	Z	M	B	V	O	Z	Y	L	I	Z	G	V	F	M	R	U	L	I	N	H	;	R
I	D	O	N	'	T	H	A	V	E	A	N	Y	E	L	A	B	O	R	A	T	E	U	N	I	F	O	R	M	S	;	I
X	L	N	V	G	L	G	S	V	I	R	M	T	R	M	Z	G	-	H	S	R	I	G	,	Z	K	Z	R	I			
C	O	M	E	T	O	T	H	E	R	I	N	G	I	N	A	T	-	S	H	I	R	T	,	A	P	A	I	R			
L	U	H	M	V	Z	P	V	I	H	Z	M	W	H	L	N	V	H	S	L	I	G	H	.								
O	F	S	N	E	A	K	E	R	S	A	N	D	S	O	M	E	S	H	O	R	T	S	.								