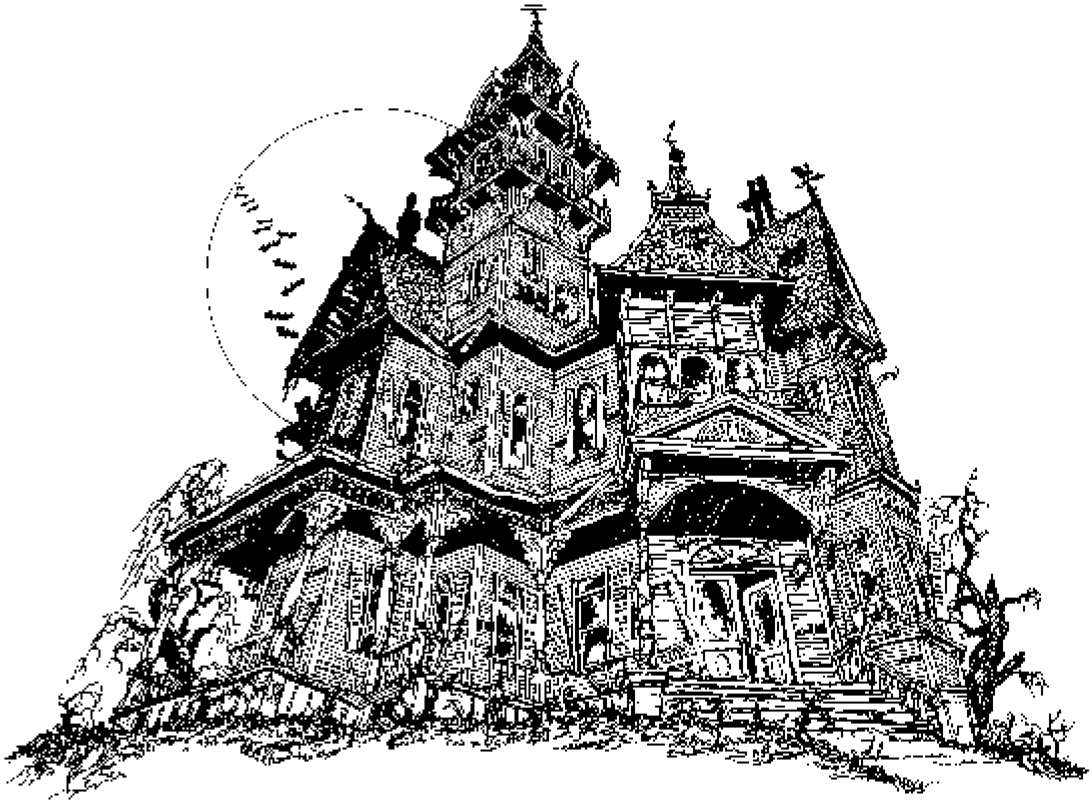
Tran Towers



A resource pack for the mathematics teacher

The Tran Towers adventure game can be found at www.Transum.org/go/?Num=191

Tran Towers is a mathematical adventure game, a quest or challenge to find the hidden treasure room. The original version I had written many years ago in Flash so it was long overdue for an upgrade so that it will work on newer devices and provide more functionality for the teacher.

The initial concept was based on Martello Tower, written by Anita Straker back in the eighties. I can distinctly remember how pupils would eagerly book the one computer (RM Nimbus) I had in my classroom for break time use. They worked in pairs and were totally hooked on the quest to find the treasure.

Even though there is an ultimate objective to find the treasure room there are nice puzzles and challenges to do on the way and many of the rooms have nice mathematical things to look at and talk about.

This resource pack contains ideas for using Tran Towers in the classroom. Many of the activities can be done away from the computer and make perfect pairs or small group tasks.

Give it a go yourself and let me know what you think.

John Tranter

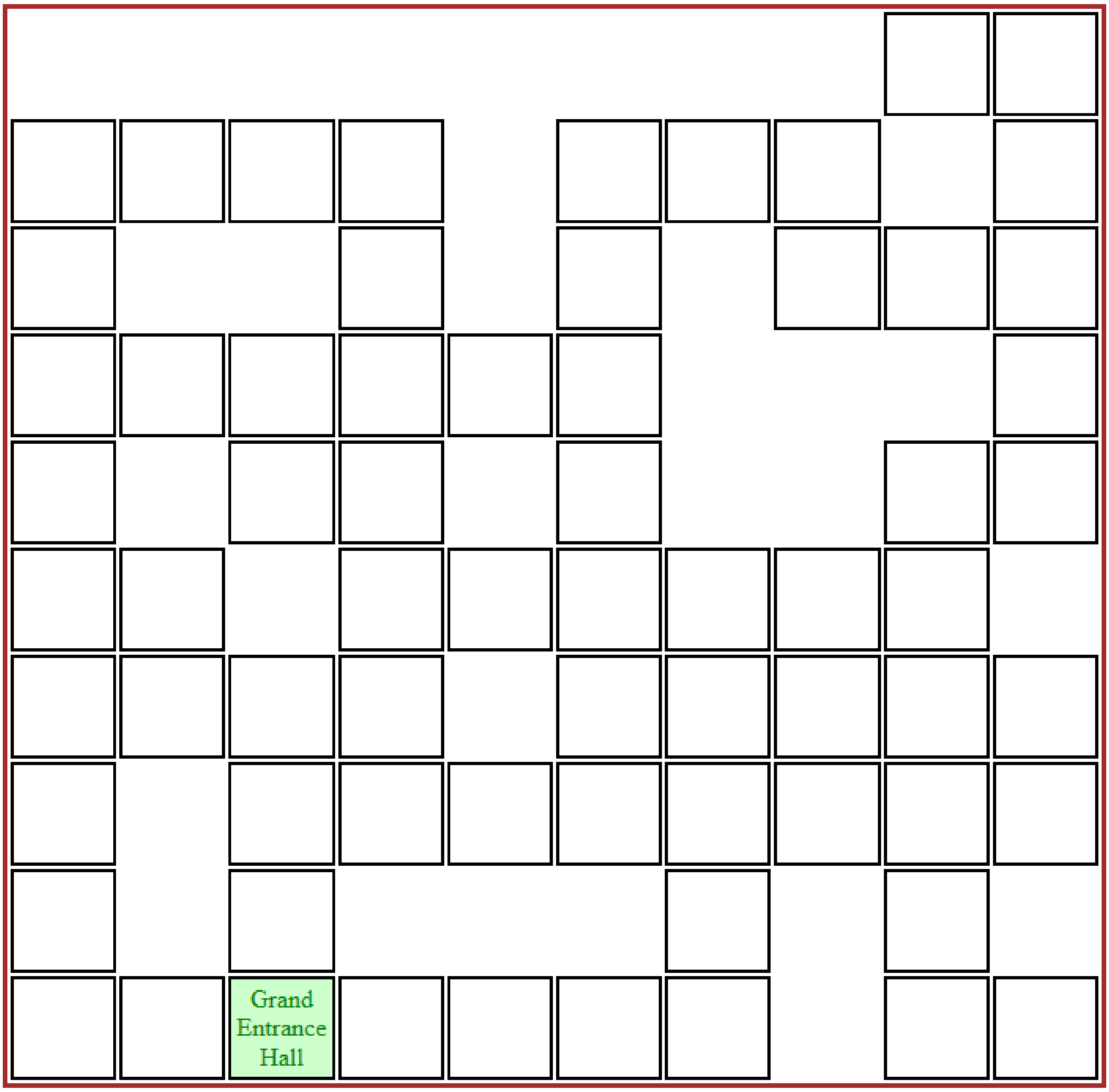
May 2020

Map of Tran Towers

								Treasure Room	Last Chance Chamber
North West View	Library	Chapel	Store		Infin-Eight Room	Parallel Place	Binary Room		Penultimate Place
Butler's Room			Old Room		Decagon Room		Trig Room	Factor Room	Constant Corner
Corridor	Prison	Semicircle Room	Radius Room	Morphing Lab	Aquarium				Map Room
Passage		Abacus Attic	Rectangles Room		Octagon Room			Prime Room	Unity Room
Triangular Room	Dead End		Rhombus Room	Pantry	Heptagonal Tiling Room	Hexagon Room	Pentagon Room	Pythagaroom	
Conic Section	The Pin Room	Polygon Memory Room	Kitchen		Ballroom West	Ballroom Central	Ballroom East	Circular Square	Kite Room
Lounge		The Pyramid Room	Dining Room	Drawing Room	Fibonacci Room	Mystic Rose Room	Pascal's Place	Area Atrium	Tessellating Terrace
Conservatory		The Spherical Room				Password Room		Icosahedron Room	
Vertex Room	Lobby	Grand Entrance Hall	Cloak Room	Short Hall	Long Hall	Orthogonal Room		Cube Chamber	Scalene Room

The following page contains a blank map that could be printed and given to pupils to fill in as they find their way around the Towers.

Tran Towers



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Tran Towers Quiz

1. How many cloaks are hanging in the cloak room?
2. How many places have been set in the dining room?
3. What number is being shown on the abacus?
4. What did the Romans call the spoke of a chariot wheel?
5. How many triangular faces does a pyramid have?
6. How many rectangles are in the rectangles room?
7. How many lines of symmetry does a rhombus have?
8. What is the order of rotational symmetry of the design in the semicircle room?
9. Write down the first 20 terms of the Fibonacci sequence.
10. What number lies between 924 and 495 in Pascal's Triangle?

Challenge in the Lobby:

The Vertex Room is through the door to the left. The door has a three digit combination lock. You have 10 attempts to guess the combination. After each guess you will be told whether your number is too high or too low. Good luck

The combination must lie between 100 and 999. The most efficient method of guessing the combination is to choose a number near the middle of the range of possibilities.

Here is an example:

Number	Feedback
550	Too high
325	Too high
212	Too low
...	

If you don't get the correct combination within the ten guesses you will be transported back to the entrance hall.

Each time you visit the lobby the combination changes.

Challenge in the Long Hall:

Tran Towers Farm has cows and hens. Altogether they have 73 heads and 210 legs. The door to the Orthogonal Room to the right will only open if you type in the correct number of cows at Tran Towers Farm. If you get the answer wrong you will be sent back to where you started. Good luck.

The solution can be found either by trial and improvement or older pupils might have experience of solving simultaneous equations.

Each time you enter this room the numbers given in this puzzle change. The following example solution describes a method:

Let the number of cows be **c**.

Let the number of hens be **h**.

$$c + h = 73$$

$$4c + 2h = 210$$

Subtract twice the first equation from the second:

$$2c = 64$$

$$c = 32$$

i.e. there are 32 cows at Tran Towers Farm.

Challenge in the Polygon Memory Room:

If you want to open the door on the left you will need to remember the order in which you see six polygons appear. If you get the answer wrong you will be sent back to where you started. Good luck.

The trick here is to find an efficient way of remembering the order in which the polygons appear. There is nothing to stop you writing down the names of the polygons though they appear a little faster than most people can write. One strategy would be to reduce the description of each polygon to a letter, acronym or number which can be remembered or quickly scribbled down.

For example K for kite and 6 for hexagon.

Alternatively, as each shape is a different colour so you might find that an easier attribute to remember.

This room is quite close to the Entrance Hall so even if you get the sequence wrong on the first attempt it is easy to get back into this room and try again.

The sequence of polygons is randomly generated so will be different each time you attempt the challenge.

Challenge in Cube Chamber:

If you want to open the door to the east you will need to work out the volume of a cubical box that has a surface area of 726 cm^2. If you get the answer wrong you will be sent back to where you started. Good luck.

Each time you enter Cube Chamber the value for the surface area of the cube changes so the following example is to demonstrate the method only.

The method of finding the volume of a cube given its surface area is to first find the length of each of its edges.

A cube has six identical faces so the area of each face is:

$$726 \div 6 = 121 \text{ cm}^2$$

As each face is a square the length of an edge is the square root of its area:

$$\sqrt{121} = 11cm$$

The volume of a cube is the length of its edges cubed

$$11^3 = 1331cm^3$$

Challenge in the Triangular Room:

If you want to open the door to the right you will need to enter a particular two-digit number. When the digits of this number swap places the result is a number which is one less than half of the original two-digit number.

The name of the room is a 'red herring'! The answer is not a triangular number. This puzzle can be solved by trial and improvement supported with a few insights.

- The second digit must be less than the first digit otherwise the process of swapping the digits produce a larger number.
- If the first digit is even the second digit will be half of it.
- If the first digit is odd the second digit will be half of it rounded down.
- The number must be even as half of it is an integer.

This narrows the search down to the following possibilities which can easily be checked:

N	N ÷2	N reversed	Result
10	5	1	False
42	21	24	False
52	26	25	True
84	42	48	False
94	47	49	False

Challenge in the Butler's Room:

If you want to open the door above you will need to think about this: The sum of four consecutive odd numbers adds up to 368. What is the smallest of these four numbers? If you get the answer wrong you will be sent back to where you started. Good luck.

Each time you enter the Butler's Room the numbers involved are randomly generated so the following is just an example solution.

The average (mean) of the four odd numbers is one quarter of the given sum.

$$368 \div 4 = 92$$

The four odd numbers are situated either side of 92 and are consecutive. They are:

74	75	76	77	78	79	80	81	82
88	89	90	91	92	93	94	95	96
102	103	104	105	106	107	108	109	110

$$89{,}91{,}93 \; and \; 95$$

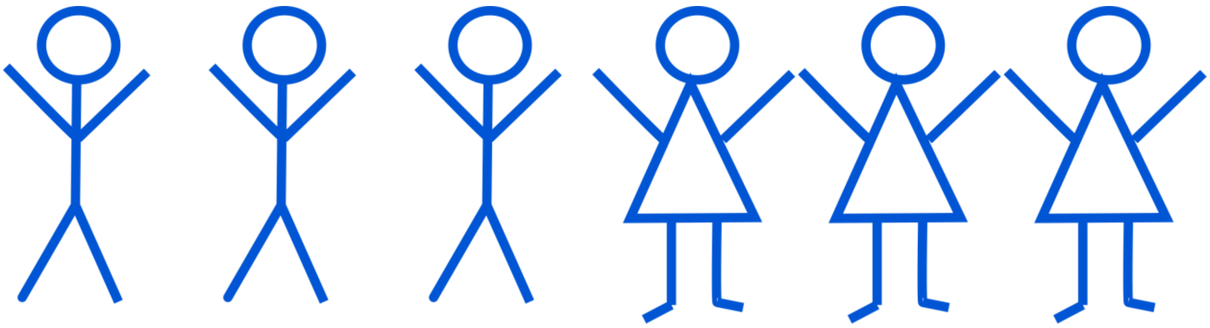
The smallest of these four numbers is 89.

Challenge in the Corridor:

The door on the right is very secure. You can only open it if you can work out the solution to the following: In a family each child has at least two brothers and two sisters. What is the smallest number of children in the family?

One of my pupils attempting to find a solution to this puzzle drew stick people to represent the children in the family. She began with one boy and one girl then continued to add children until the criteria were true for each child.

This is her solution:



Challenge in the Fibonacci Room:

One of two ways of getting into the room on the other side of the door to the right is by knowing the 17th term of the Fibonacci sequence. Get it wrong and you will find yourself back where you started.

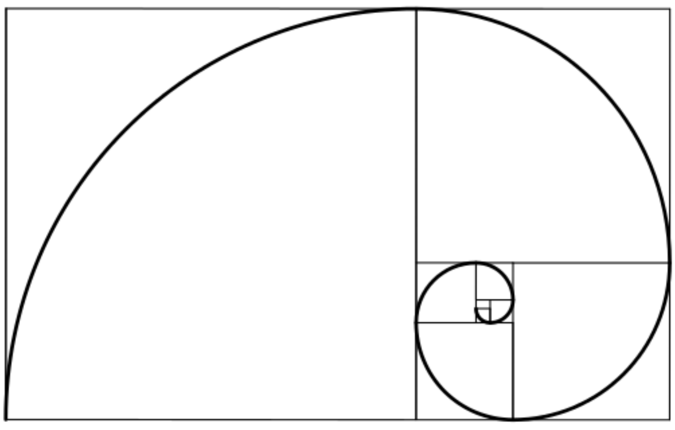
The Fibonacci sequence is absolutely fascinating. If a pupil attempts to find out more about this number pattern as a result of visiting Tran Towers I will be very happy.

For your information each term of the sequence is the sum of the preceding two terms thus:

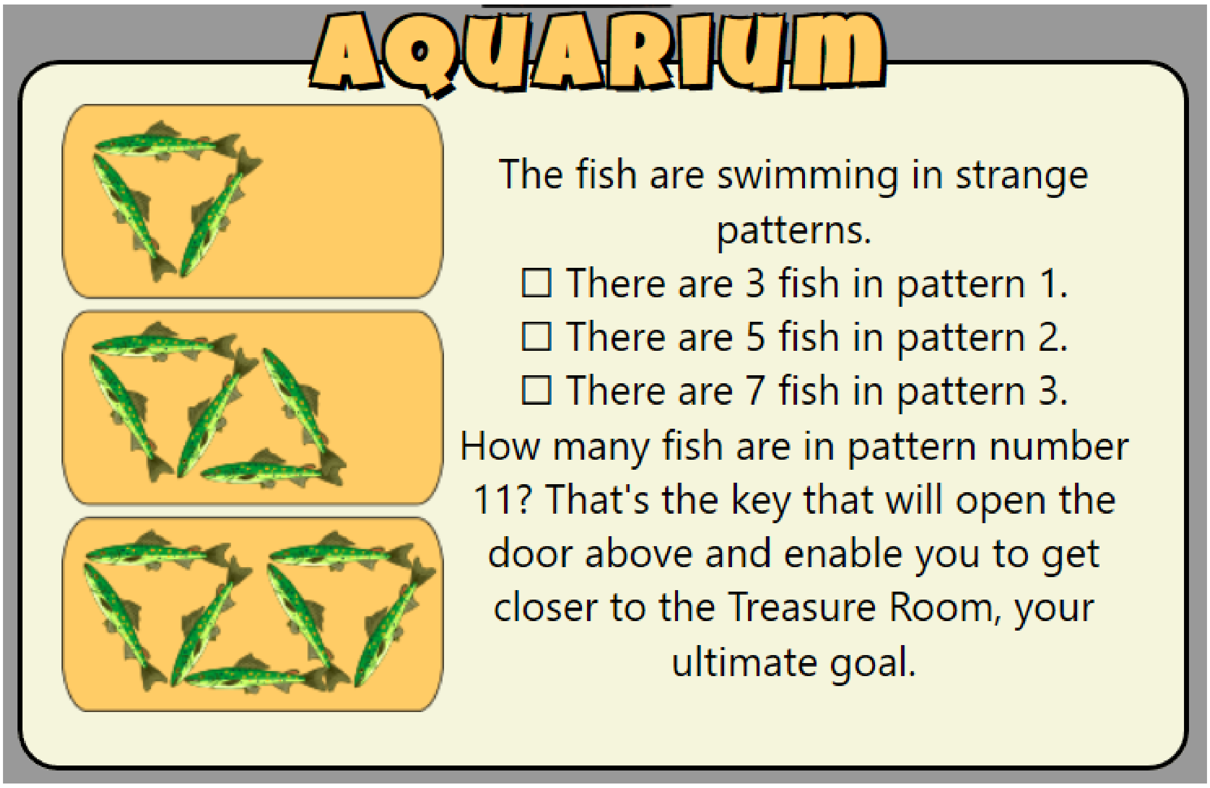
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765, 10946, 17711, 28657, 46368, 75025, 121393 ...

Pupils can learn more about the Fibonacci sequence by doing the activities here:

`www.Transum.org/go/?Num=498`



Challenge in the Aquarium:



This puzzle can be solved by drawing lots of fish! However it is much easier to consider the growing number of fish as a number sequence which can be continued.

As can be seen in the diagram, each pattern has two more fish than the pattern above. The number of fish in each pattern forms an arithmetic sequence with a first term of 3 and a common difference of 2. The formula for the nth term of this sequence is:

$$U_n = 2n + 1$$

So the number of fish in the 11th pattern is:

$$2 \times 11 + 1 = 23$$

Challenge in the Factor Room:

A knife and a fork together cost £48. If the knife costs £10 more than the fork, how much does the knife cost?

Again, this puzzle is generated with a random element but for this version of the puzzle here is a method.

Subtract £10 from £48 then divide the result by two. This gives the cost of the fork as £19 and the knife £29.

This puzzle can also be solved using simultaneous equations.

Challenge in the Area Atrium:

This puzzle is an area maze. The answer is 4. There are instructions for solving area mazes here:

`www.Transum.org/go/?Num=696`

Challenge in the Unity Room:

The number is at the very top of Pascal's triangle is 1

Last Chance Chamber Challenge:

Password: Euler (a famous mathematician)

PIN number: 1707 (his year of birth)

Quiz Answers:

1. 13 cloaks

2. 10 place settings

3. 1707 (Euler's year of birth)

4. Radius

5. 4 faces

6. 21 rectangles

7. 2 lines of symmetry

8. None

9. 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765

10. 792