Cubic Calculators: The Magic Dice

This idea comes from Martin Gardner. He wrote a math and puzzle article each month for over 25 years for Scientific American. A CD of all his articles can be purchased from many internet sites.

Select any one number from Die 1 and then one number from Die 2 and then Die 3 , 4 and 5.
You can state the total at once.

Die 1	Die 2	Die 3	Die 4	Die 5
545	756	766	874	881
644	855	865	676	584
743	459	667	577	287
347	657	964	775	188
446	558	469	478	386
248	954	865	973	485

The sum of the 5 selected numbers will be a 4 digit number

1. The tens and ones digits of the answer will be the sum of the ones digits on the 5 faces of the dice.

2. The thousands and hundreds digits of the answer will be 60 minus the sum of the ones digits

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Example 1

6 4 4	from die 1
7 5 6	from die 2
4 6 9	from die 3
5 7 7	from die 4
+ 1 8 8	from die 5
2634	Total of the 5 faces of the dice

the 34 came from the sum
of the ones digits
$4 + 6 + 9 + 7 + 8 = 34$

the 26 came from subtracting
the ones total from 60
$60 - 34 = 26$

Example 2

3 4 7	from die 1
9 5 4	from die 2
6 6 7	from die 3
8 7 4	from die 4
+ 3 8 6	from die 5
3228	The total of the 5 faces of the dice

the 28 came from the sum
of the ones digits
$7 + 4 + 7 + 4 + 6 = 28$

The 32 came from subtracting
the ones total from 60
$60 - 28 = 22$

Example 3

5 4 5	from die 1
6 4 7	from die 2
9 6 4	from die 3
9 7 3	from die 4
+ 1 8 8	from die 5
3 3 2 7	Total of the 5 faces of the dice

the 27 came from the sum
of the ones digits
$5 + 7 + 4 + 3 + 8 = 27$

the 23 came from subtracting
the ones total from 60
$60 - 27 = 33$

Example 4

2 4 8	from die 1
4 5 9	from die 2
4 6 9	from die 3
6 7 6	from die 4
+ 1 8 8	from die 5
2040	The total of the 5 faces of the dice

the 40 came from the sum
of the ones digits
$8 + 9 + 9 + 6 + 8 = 40$

The 20 came from subtracting
the ones total from 60
$60 - 40 = 20$

Classroom Suggestions

You may want to have each group of students cut out and make one set of 5 dice for the group to use.   Be sure that each student gets to make at least one die. I like to have students do the construction work using the net but this takes up some class time. It you are not working on making 3 dimensional objects from nets then you may use die that have been made in advance. I use a set of blank die (or wooden cubes) and then use sticky dots from an office supply store. I write the numbers on the dots and then stick them to dice and hand out these dice. The use of dice allow students to roll the dice and get 5 random numbers. Another technique is to give each group a list showing the 6 numbers on each die and have them select 1 number from each of the 5 lists.

Stand by a group and have them get the 5 numbers using any method you like. Ask them to write down the 5 numbers they see on the tops of the 5 die and add up the 5 numbers. This allows you to see they have one number from each dice and to see that the numbers are written correctly. Have them write the 5 numbers below each other and add the numbers. You could have them place the die one below another and add the numbers from the dice without recording the numbers if you like. As they are adding the numbers write the answer on a piece of paper and put in upside down on their table. Tell them not to look at the paper.   Go from group to group watching them roll the dice and giving them a piece of paper with their answer on it.
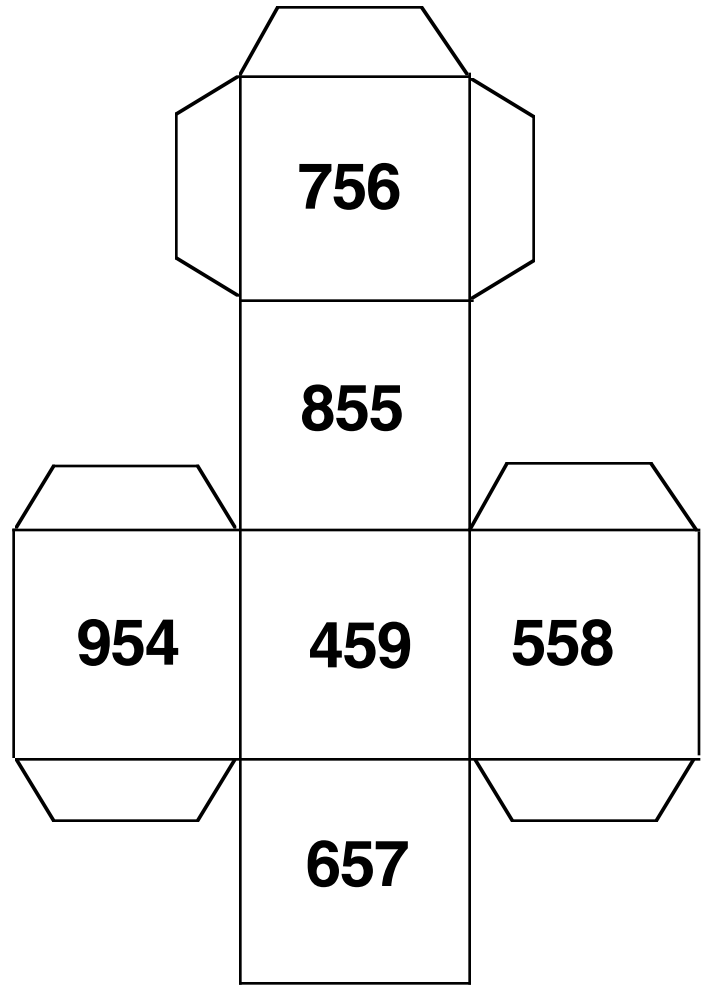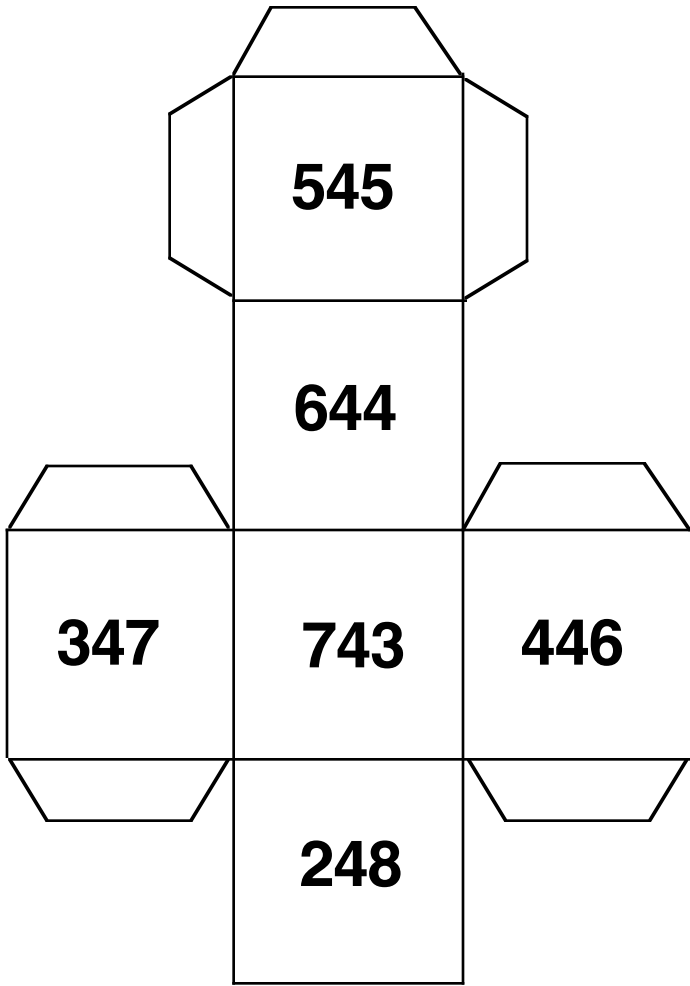
When each group is finished call on each group and them to read their numbers and the sum they found.   Have them compare their answer to the one you gave them. They will see that you added their numbers much faster then they did. If any group has an incorrect answer ask them to check their work.   Be sure to watch them to ensure they are correct this time.
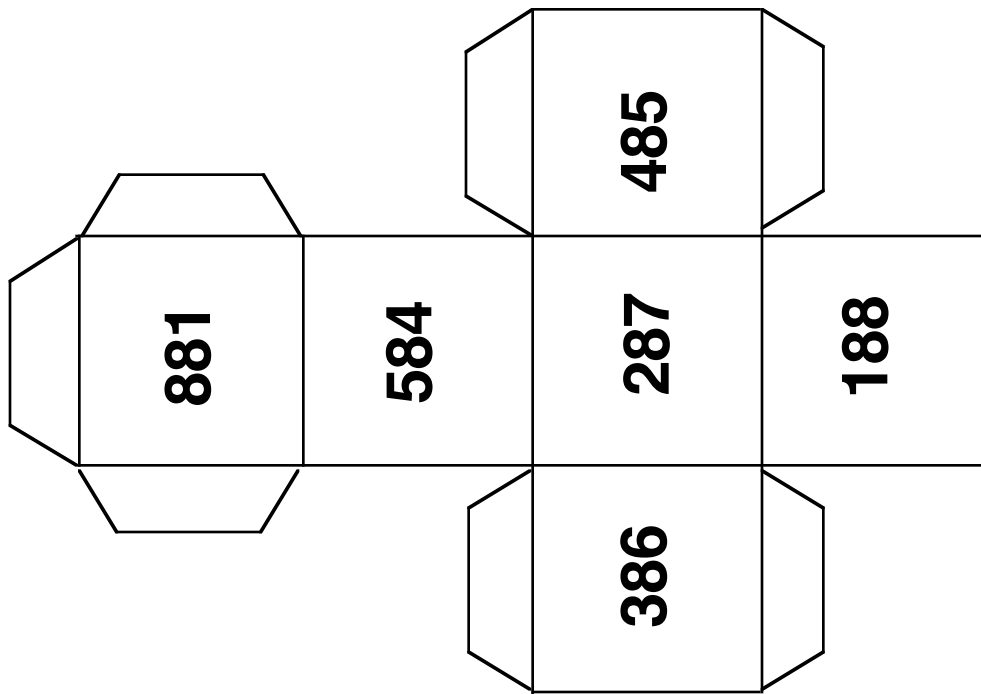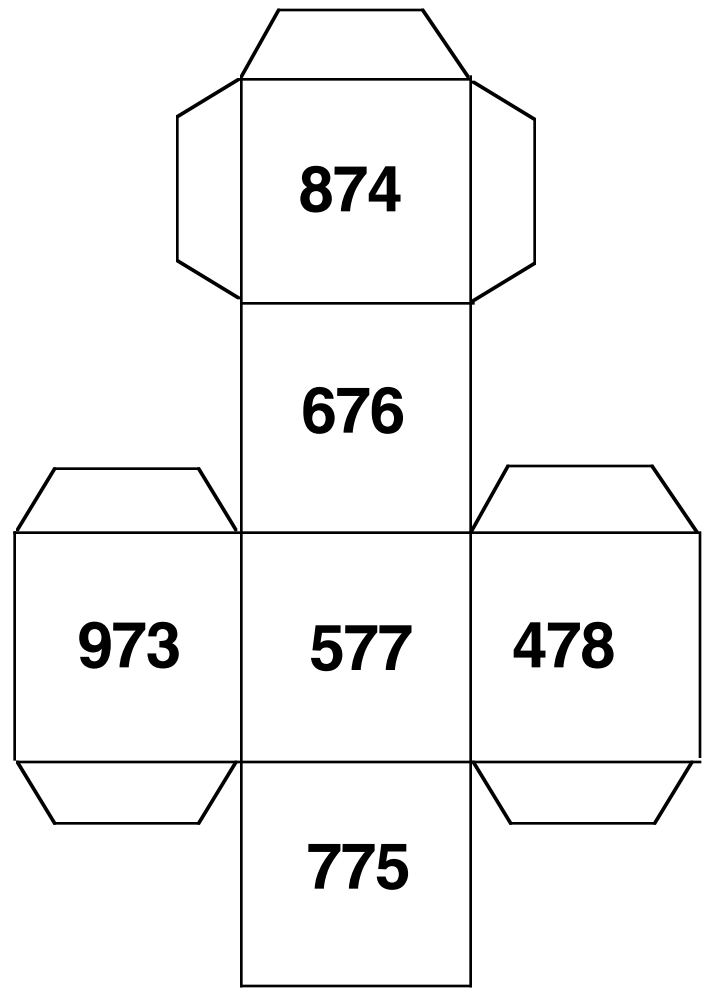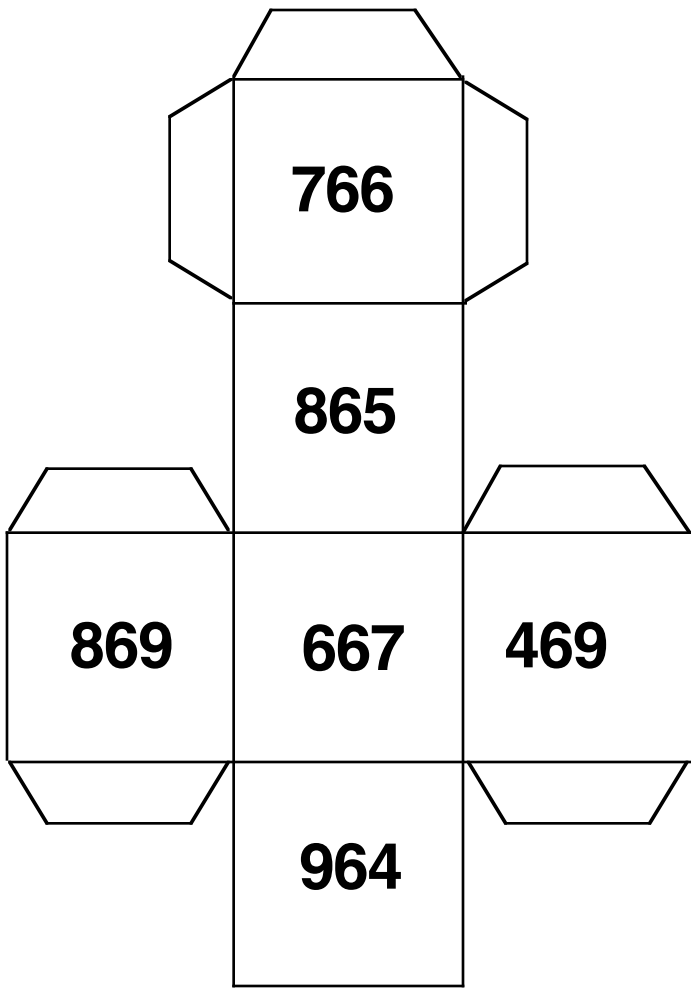
Each group can see that all the numbers they used were different and the totals they got were different from other groups.   They will wonder how you could add the numbers so much faster then they did. If they ask "how did you do it" you will need to decide how to proceed. You can have them put all the numbers and the sums on the board and start to look for a pattern. All answers are 4 digits, etc. Many times they will see the sum of the one's digit form the last part of the answer. This may lead them to look for a similar pattern for the other part of the answer. If they have all the numbers and answers to look at they may make the jump to see the first 2 digits of the answer and the last 2 digits of the answer add to 60. The solution to the problems is as follows. You add the ones digits and write down that number. Subtract that number form 60 and write it to the left of the first answer At this point they can test their solution by trying different numbers and see if their solution works.

If you do not have the time for finding a solution to how the adding works then have each group write down their 5 numbers and the total and post the papers on a wall.   Encourage the students to look at the papers in their free time and see if they can find a solution. You may drop a hint to a student who seems interested in the solution to help them along. If someone does find a solution have them present it to the class. They will be a star.

Magic Dice with tabs

Use glue sticks to adhere the tab inside the cube or use tape to adhere the tabs outside. I put the face that is at the intersection of rows and columns (743 on the die below left) facing down and fold the 4 faces up. I then glue these tabs and use my fingers to press each tab inside the box to get them to stick. I then use the 3 tabs on the top face (545 on the cube below left) to complete the cube. You can glue stick the last tabs, fold the top over and put the tabs inside and then "pinch each top edge to get the tabs to stick.   Its easier to tape the last tabs outside.

	545		
	644		
347	743	446	
	248		

	756		
	855		
954	459	558	
	657		

766

865

869 **667** **469**

964

874

676

973 **577** **478**

775

485

881 **584** **287** **188**

386

Nets for the cubes with tabs. There are blank so you can write your own numbers on the faces after you discover how the numbers are produced. This lets you have a set different then the ones shown here.
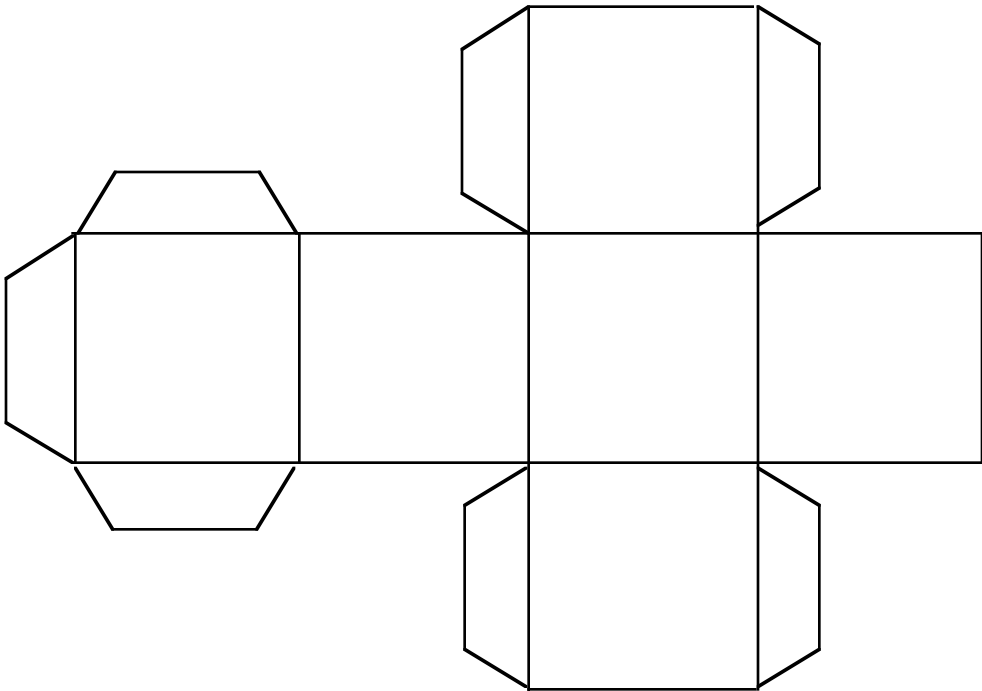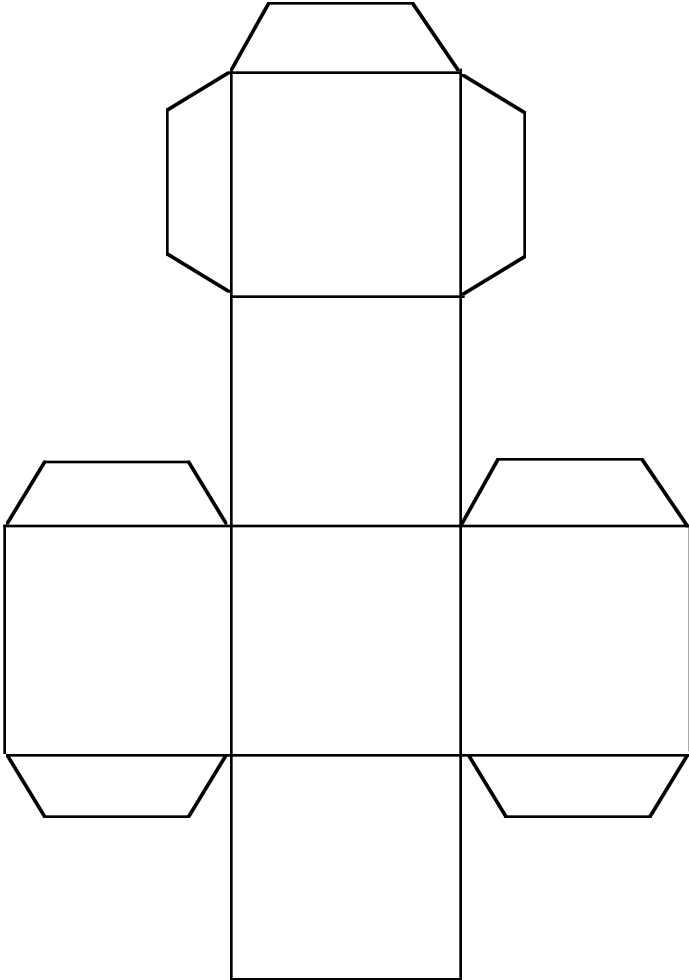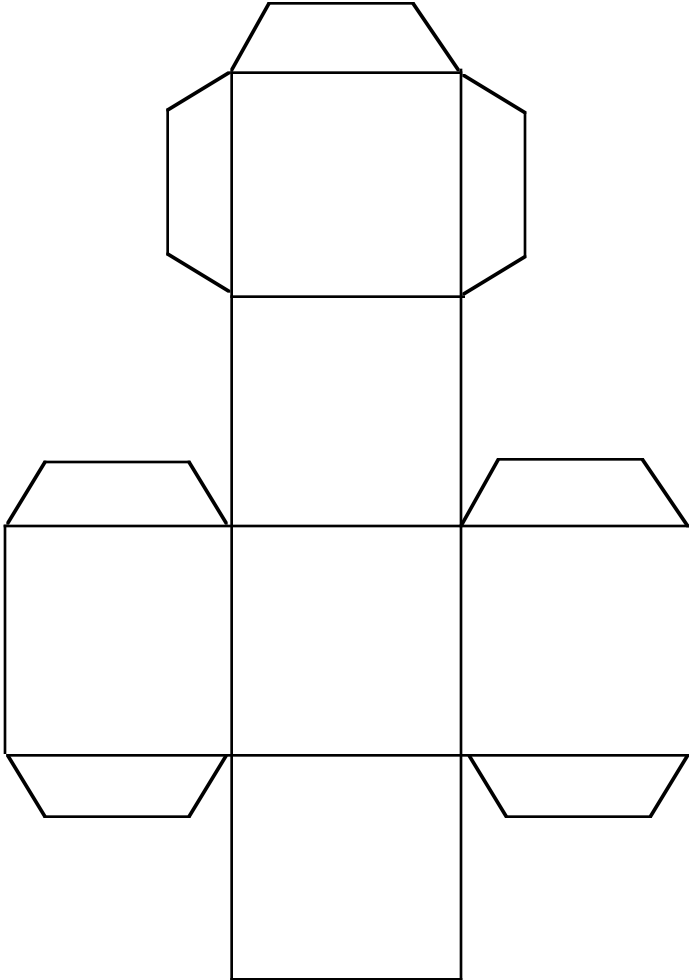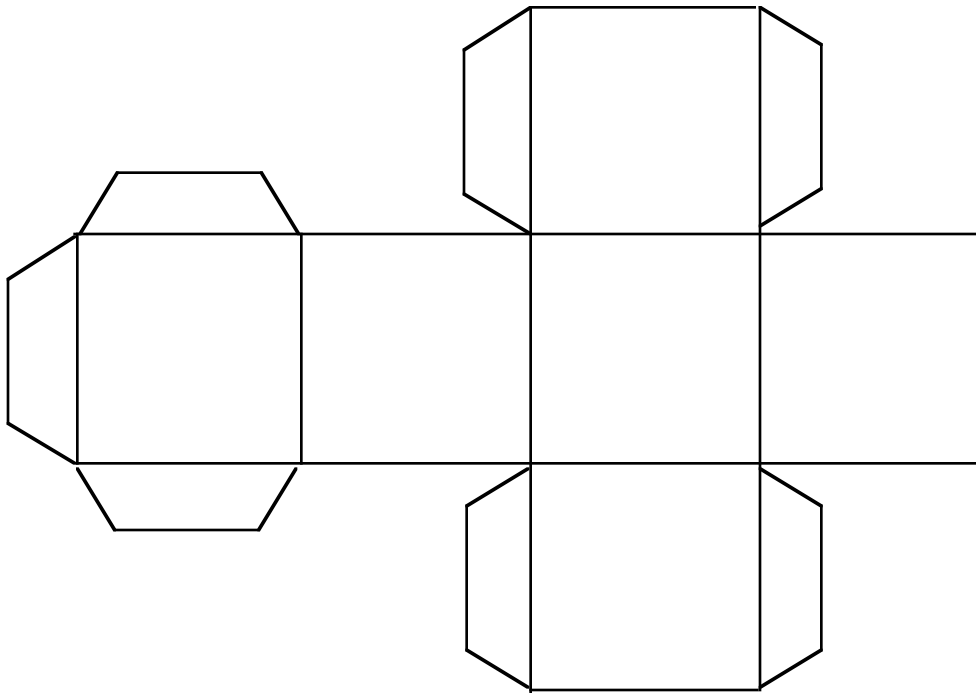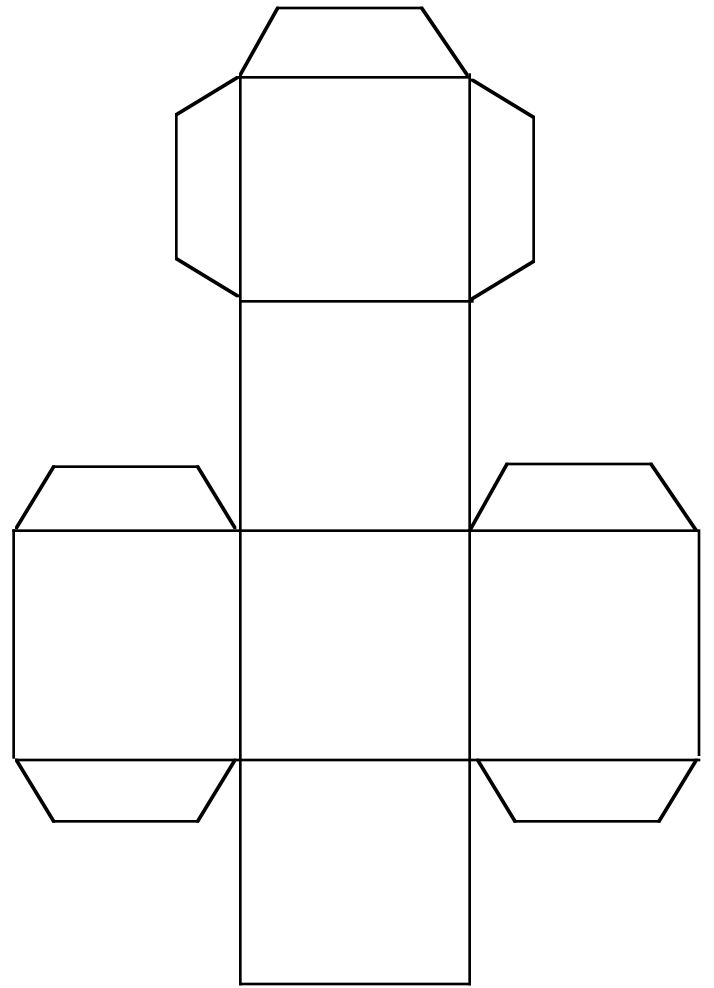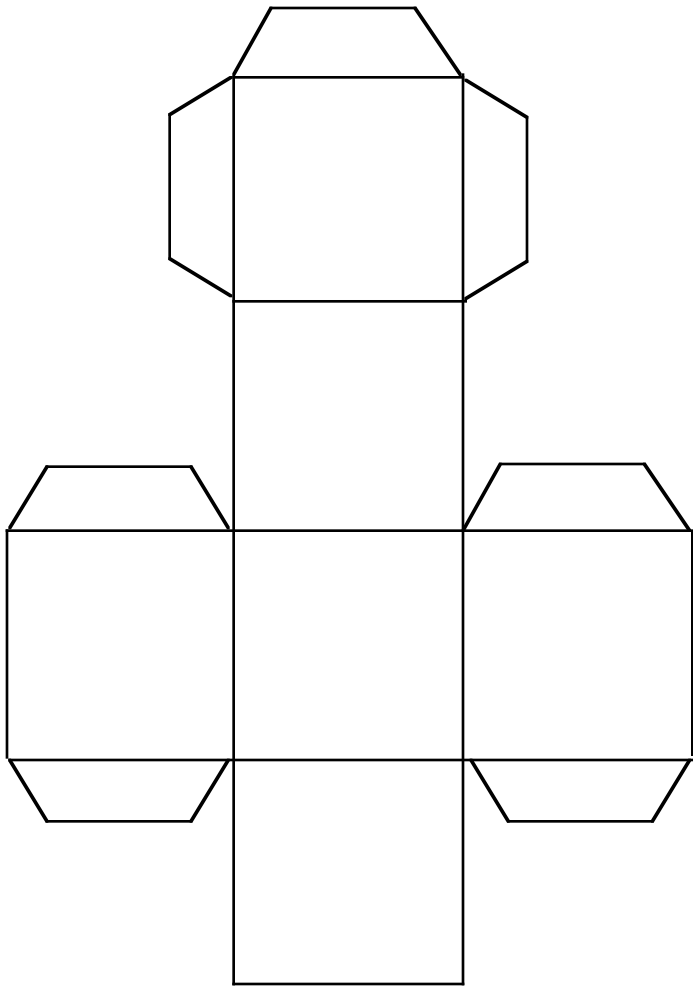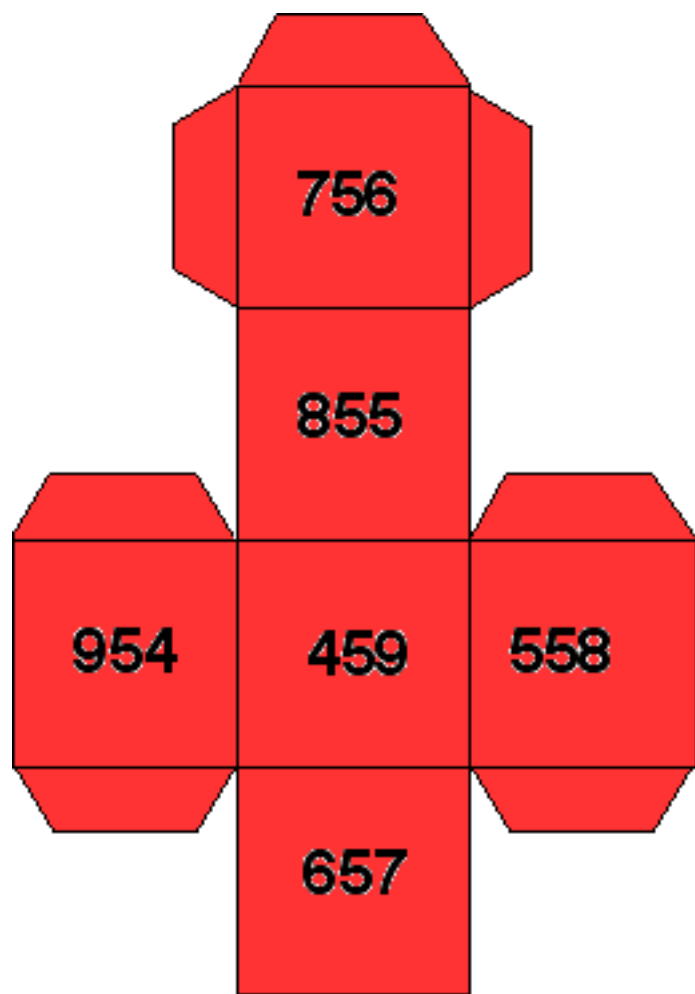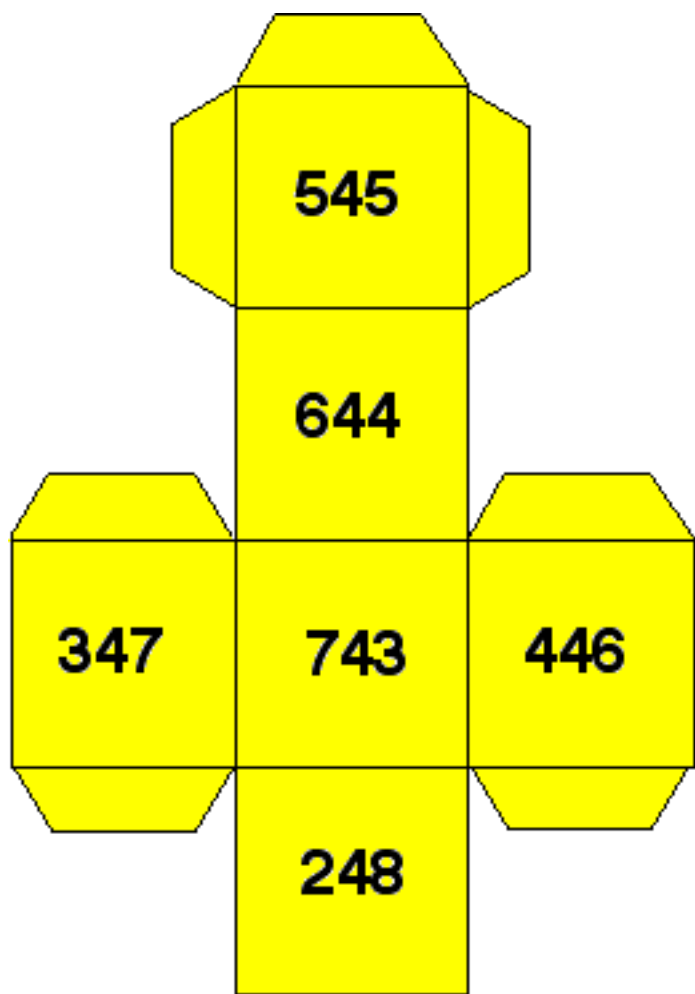
The Magic Dice as a list of numbers.

This lets you carry out the activity without making the dice. It speeds up the activity of getting the numbers and adding them. It also helps if you are trying to find the pattern. Students can see all the numbers at once and the patterns are easier to discover.

Die 1	Die 2	Die 3	Die 4	Die 5
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Yellow cube net

	545	
	644	
347	743	446
	248	

Red cube net

	756	
	855	
954	459	558
	657	

	766	
	865	
869	667	469
	964	

	874	
	676	
973	577	478
	775	

	485	
881	584	287	188
	386	
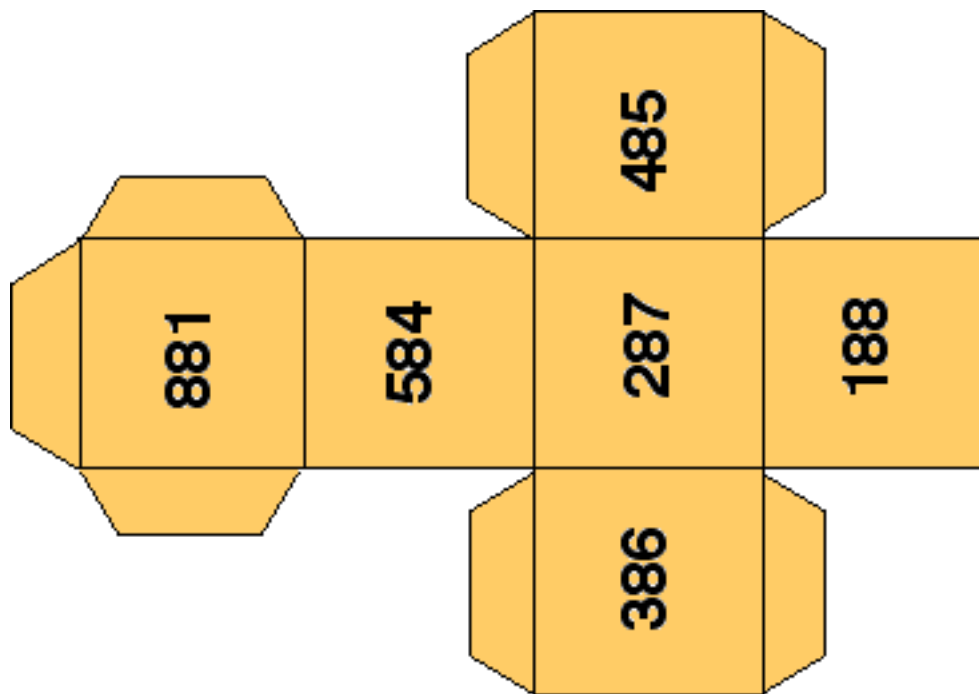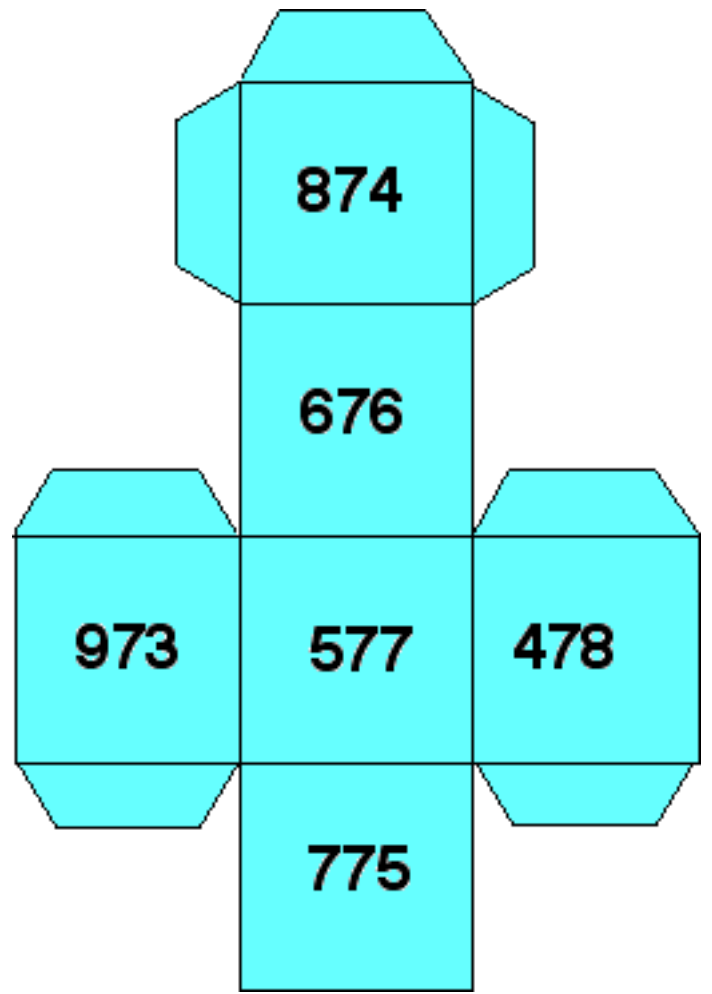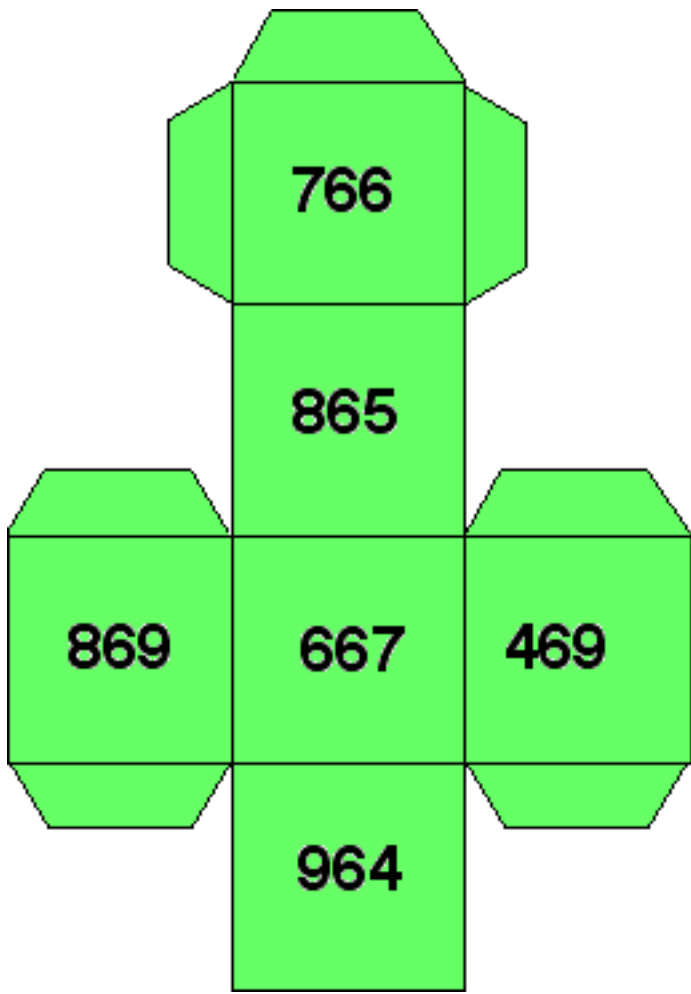
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A Set of 4 Cubic Calculators

Select any one number from Die 1 and then one number from Die 2 and then Die 3 ,and 4
You can state the total at once.

Die 1	Die 2	Die 3	Die 4
840	753	234	780
444	654	531	186
543	357	333	285
741	258	135	384
246	555	630	582
147	951	432	681

The sum of the 4 selected numbers will be a 4 digit number

1. The tens and ones digits of the answer will be the sum of the ones digits on the 4 faces of the dice.

2. The thousands and hundreds digits of the answer will be **33 minus the sum of the ones digits**

A Set of 3 Cubic Calculators

Select any one number from Die 1 and then one number from Die 2 and then Die 3 ,and 4
You can state the total at once.

Die 1	Die 2	Die 3
870	783	851
474	684	752
573	387	653
771	288	158
276	585	554
177	981	257

The sum of the 4 selected numbers will be a 3 or 4 digit number

1. The tens and ones digits of the answer will be the sum of the ones digits on the 3 faces of the dice.

2. The thousands and hundreds digits of the answer will be **29 minus the sum of the ones digits**
    If the number is a single digit the answer is only a 3 digit number.