Whole Class Investigation
Highest Number 1

One 'life' of a task is as a whole class lesson.
The purpose of this life is to model what it means to work like a mathematician.
Content is developed in this context.

In this sample lesson, the ☞ symbol indicates aspects of the Working Mathematically process which teachers may wish to highlight either as the lesson proceeds, or as part of a review and reflection process.

Preparation

Each student needs 6 number cards (1 to 6) - playing cards are convenient. Students also need one dice per pair and scrap paper to record their scores.

Procedure

1. At the centre of the room demonstrate the game by having two students play with the class gathered around.
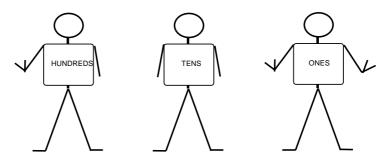
   Say David rolls first and places the card in one of the columns. He is aiming to make the highest number he can after three rolls. For example, if he rolled 4 he might place it here.

   ___ 4 ___

   Then David passes the dice to Jenny who rolls and places her card. They do this until they both have the highest 3 digit number they can make after three rolls each.

   [If you first need to refresh the students' place value concepts, an alternative beginning which involves a kinaesthetic feature is to introduce the problem through physical involvement by preparing two sets of cards on string loops which can be hung around students' necks.

   Select two teams of three students to stand at the front and wear the neck cards. The teacher (or chosen student) calls out a three digit number and the teams race to hold up the correct number of fingers in each place (eg: 204).

   A point is scored for the first team to display the chosen number. Play five games and the team with the higher score remains at the front to challenge a new team.

   Continue *briefly* as appropriate. Then play the main game as above.]

   ☞ **Working in context, acting out**

2. Play one demonstration game with the class and then set pairs of children to play five games, recording their scores vertically. An important rule is that a number can only be used ONCE in any game by each player, so roll again if a repeat number turns up.

   While the students are working, move around the class gathering examples of partly completed games which will be a good source of discussion in the next step.

3. Explore strategies which might be used to decide the placement of a digit. For example:
   When Benny and Roula were playing Roula had this:

	4	

   Then she rolled a three. Where should she put the three? Why? Does it matter what Benny already had?
   Suppose she rolled a six, where should she put that? Which answer do you have to think about more? Why?

☞ **Working in context, planning a strategy, discussing**

4. So far the lesson has reviewed the students' concepts of place value and chance. These are now put to use as the investigation becomes more complex.

   I once saw this game played at a carnival. In order to win, the total of your five games had to be more than a certain number. Of course the players were trying to make the highest score in each game, just as you were when you were playing. Let's see what sort of total scores we get.

☞ **Posing a new problem**

   What would be the highest possible score after five games?

   654 x 5 = 3270

   What would be the lowest possible score after five games?

   123 x 5 = 615

   Set up the board like this:

31	
30	
29	
28	
27	Note: The vast majority of likely scores will fit on this list.
26	
25	
24	
23	
22	
21	
20	
19	
18	

The stem chosen is the hundreds and above expressed as hundreds, and the leaves will be the tens and ones. **However, there is no need to explain to the students what you have done.** Recording as the next step progresses will lead them to learn the Stem & Leaf Plot process for themselves.

☞ **Recording, discussing, using a conventional tool**

5. *OK I want each of you to total your five games. Use your calculators if you want to. However, as is usual in our class whichever way you do the calculation you must check it a different way.*
    When you have calculated and checked, come out here and write your total on the board.

    When the first student comes out, guide them in where and how to record their total, then ask them to guide the next student and so on. After the first few students have recorded correctly, move away and encourage the students who have finished to think about where the cut off number for winning would be. Ask them to think about the things that would matter in making that decision.

☞ **Recording, discussing**

    When the recording is finished, your board will look something like this:

Stem	Leaves
31	06, 78
30	
29	43, 25, 09,
[More stems & leaves here]	
22	23, 45, 00, 12, 23,
21	
20	65,
19	
18	43,

NB: There will be one recording for each student.
Some teachers prefer to have students write their leaves on sticky notes rather than directly onto the board, because it makes it easier to re-organise the data in the next step.

6. Discuss whether the information is presented in a way which would help decide the cut off number. Lead students to rearrange the leaves in increasing order.

☞ **Discussing, organising data**
    Then explore the factors which could affect the decision about which number to choose as the prize cutoff in the carnival game. The important ones are:
    - the desire of the game 'owner' to make money in the long   run.
    - the need for enough people to win so that the game is
      considered 'fair enough to play'.
    - the relationship between the price to play and the reward   for winning.

7. *At the carnival where I saw this game, you had to pay $1 to play, but you got $5 back if your total was above the cut off number. Unfortunately, I have forgotten their cut off number. Do we have sufficient information to work it out again? If we did we could set up the game one lunch time and make some money for Social Service.*

☞ **Posing a new problem**

It is unlikely that the results from one set of five games by each student will provide sufficient information, so ask the students to play more sets of five until they think the distribution is clear enough to make a decision.

☞ **Collecting, recording and organising data**

8. Discuss and agree on a cut off number. Remember, there is an element of judgement in this, so the chosen figure will be an hypothesis.

☞ **Discussion, seeking & seeing patterns, making an hypothesis**

9. OK, we have agreed on this number, but does that mean it is the correct one. Should we just set up the game tomorrow lunchtime and see if we make money?

Encourage the students to understand that at this point the cut off number is an hypothesis and it should be tested before being used in public. The testing will have to involve pretending to pay to play and paying out on a win. This new variation on the problem often rekindles students' interest.

☞ **Discussing, testing an hypothesis, collecting, recording and organising data**

Various teachers have used a range of strategies to arrange this testing.
- Some have spread out the data collection over a number of days by interspersing it with other work.
- Some have enlisted the help of other classes to obtain more data. This has the advantage of promoting the upcoming lunchtime event around the school.
- Some have made use of a computer simulation. This has the advantage that the number of trials and the cut off number can be readily varied. This approach also carries messages about the value of technology in problem solving.

10. Once the cut off number has been decided and tested, make sure that the students have the opportunity to run the Social Service activity.

☞ **Posing a new problem**

Apart from the satisfaction (hopefully) of seeing their research work come to fruition, it is a wonderful stepping off point for a broader curriculum study of the 'morality' of funding charitable work through gambling.