Y7 Standing on the pointy end - drawing pins probability experiment

NEW June 2026

Year level: 7

Approximate number of lessons: 2

Learning goals

Through this probability experience, ākonga will:

- plan and conduct probability experiments for chance-based situations, including undertaking a large number of trials using digital tools, by:
  – posing an investigative question
  – anticipating what outcomes are possible and which of them are more or less likely to occur
  – identifying and systematically listing all possible outcomes to the investigative question
  – collecting and recording data
  – creating data visualisations for the distribution of observed outcomes
  – describing what these visualisations show
  – finding the probability estimates for the different outcomes
  – answering the investigative question
  – identifying similarities and differences between their findings and those of others
  – reflecting on anticipated outcomes

Vocab list

probability experiment	trials	outcomes
data visualisation	bar graph	probability estimate

Resources

- Drawing pins, at least 10 per pair or group of ākonga
- Recording sheet (can be co-constructed with the class or use the one provided **results table**)
- Spreadsheet - e.g., google sheets
- Statistical data analysis software e.g., CODAP
- Google slides **Y7 Drawing pins**

Activity - Lesson 1

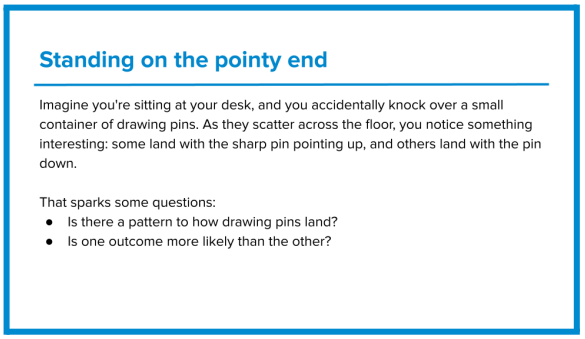
INTRODUCTION

Imagine you're sitting at your desk, and you accidentally knock over a small container of drawing pins. As they scatter across the floor, you notice something interesting: some land with the sharp pin pointing up, and others land with the pin down.

That sparks some questions:

Is there a pattern to how drawing pins land?

Is one outcome more likely than the other?



Google slide 4 **Y7 Drawing pins**

This isn't just a random curiosity—it's a perfect opportunity to explore probability through a real-world experiment. Drawing pins have an unusual shape: a flat, wide head and a small, pointed tip. That makes it hard to predict how they'll land just by thinking about it.

So instead of guessing, we'll use experimental probability. This kind of hands-on experiment helps us understand randomness, chance, and how probability works in everyday situations—even with something as simple as a drawing pin. We'll drop drawing pins many times, record how they land, and calculate the probability of each outcome. This is called experimental probability—we're using real data to estimate the chances of something happening.

? PROBLEM:

Discuss the questions given in the opening scenario. Take each question one at a time and provide an opportunity for all ākonga to say what they think. For example, using a **think-pair-share** strategy or **numbered heads together** strategy.

Is there a pattern to how drawing pins land?

Is one outcome more likely than the other?

Capture ideas on the board, a large sheet of paper, using an online tool, e.g., shared doc, padlet.

Summarise the discussion by getting ākonga to indicate which outcome they think is more likely: pin up or pin down; and then to quantify how much more likely. For example:

- Do they think that the option they thought was more likely will happen twice as much as the other option?
- Three times as much?
- Four times as much?

Different groups/individuals will have different predictions for what they think they will find.

Quantify these using percentages or fractions. For example:

- If twice as much as the other… favoured outcome is two-thirds or ~67% and non-favoured outcome is one-third or ~33%.
- Three times as much… favoured outcome is three-quarters or 75%, non-favoured outcome is one-quarter or 25%.
- Four times as much… favoured outcome is four-fifths or 80%, non-favoured outcome is one-fifth or 20%.

Pose an investigative question for the scenario, for example:

What is the probability that a drawing pin lands pin up (or pin down)?

Note: if the class thinks it is more likely for the drawing pin to land pin up, then phrase the question around pin up, if the class thinks it is more likely to land pin down, then phrase the question around pin down.

📋PLAN:

Work with your ākonga to develop a plan to undertake the probability experiment. An example is below, though as a class you may make different decisions. For example, some ākonga might decide to drop on a hard surface, and some might decide to drop on a soft surface, and/or they might consider different heights.

If this was the case, and different groups decided on different probability experiments, then only those doing the same probability experiment could collate their results. In this instance groups might need to do more trials to get the collective number of trials up to around 1000. For example, if five pairs decided to use a hard surface and 10 groups decided to use a soft surface, then the five groups using the hard surface should do 200 trials each, whereas the ten groups using a soft surface would do 100 trials each.

1. **Get resources together**
    - A container of drawing pins (e.g., ten per pair of ākonga)
    - A flat surface for dropping
    - A data recording sheet (**results table**) or notebook
    - Rulers for measuring the height of the drop
    - A calculator (optional)
2. **Confirm the possible outcomes for the probability experiment**
    - Decide what counts as **“pin up”** (sharp point facing up) and **“pin down”** (flat head facing up).
3. **Agree on the process to under take a single trial**
    - Drop ten drawing pins at a time from a consistent height.
        - This could be dropping a single drawing pin each time
        - Ākonga might choose to do different heights, so results would be collated for those groups with the same height dropped from
        - Surfaces could be different, hard or soft, and the class might decide to look at the outcomes from hard and soft surfaces.
    - Record the result after each drop.
        - Record how many of the ten drawing pins land pin up and how many land pin down

- Repeat for a large number of trials
  - e.g., drop 100 or 200 drawing pins altogether

4. **Set up a table to collect the results**
   - Use the **results table** [Google slide 5 **Y7 Drawing pins**] to collate results for the sets of ten drawing pins.
   - Count how many times the pin landed **up** and how many times the pin has landed **down** in the set of ten.

Results table

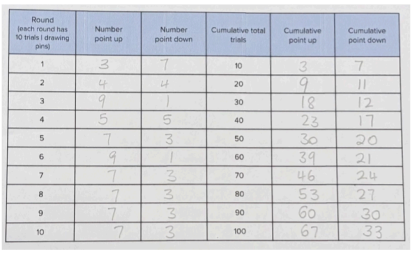
Round (each round has 10 trials I drawing pins)	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
1			10		
2			20		
3			30		
4			40		
5			50		
6			60		
7			70		
8			80		
9			90		
10			100		

DATA:

Once the probability experiment is agreed, or the various versions are agreed, give ākonga the materials and they can undertake the probability experiment, recording their results as agreed.

- Check in on groups to make sure they are doing things as agreed.
- Check in on their results tables, and check about how to make cumulative totals.
- See Google slide 6 **Y7 Drawing pins**

Results table example

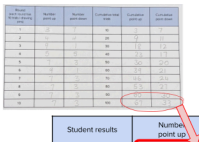


Round (each round has 10 trials I drawing pins)	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
1	3	7	10	3	7
2	4	4	20	9	11
3	9	1	30	18	12
4	5	5	40	23	17
5	7	3	50	30	20
6	9	1	60	39	21
7	7	3	70	46	24
8	7	3	80	53	27
9	7	3	90	60	30
10	7	3	100	67	33

Once individuals groups have finished, get them to share their overall results in a class collation table (example below). This could be drawn up on the board, or the information entered into a Google Sheet.

- Note they are recording their cumulative total for point up and point down in the second and third columns, and then the class cumulative results are updated in the last two columns.
- See Google slide 7 **Y7 Drawing pins**

Example of class cumulative results



Student results	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
Group A	67	33	100	67	33
Group B	60	40	200	127	73
Group C	68	32	300	195	105

Student results	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
Group A	67	33	100	67	33
Group B	60	40	200	127	73
Group C	68	32	300	195	105

This might be a natural end to a session, picking up the analysis in the next session.

Activity - Lesson 2

ANALYSIS:

In the analysis there are opportunities to explore some additional ideas, including the Law of large numbers. The sequence here assumes that everyone did the same experiment, same height, same surface, tossing ten drawing pins at a time.

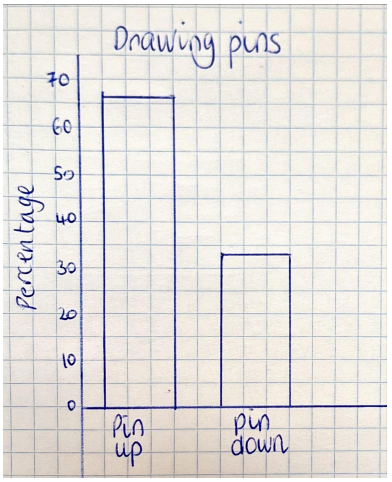
If there were different experiments e.g., dropping onto different surfaces, then the different experiments can be compared and contrasted noting similarities and differences.

Own pair/group results

Get ākonga to make a graph to show the results of their 100 trials. Use a bar graph.

Round (each round has 10 trials I drawing pins)	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
1	3	7	10	3	7
2	4	4	20	9	11
3	9	1	30	18	12
4	5	5	40	23	17
5	7	3	50	30	20
6	9	1	60	39	21
7	7	3	70	46	24
8	7	3	80	53	27
9	7	3	90	60	30
10	7	3	100	67	33

Results table



Bar graph of results

Ākonga describe what the bar graph shows.

- Which outcome was more likely?
- Was the result what you expected?

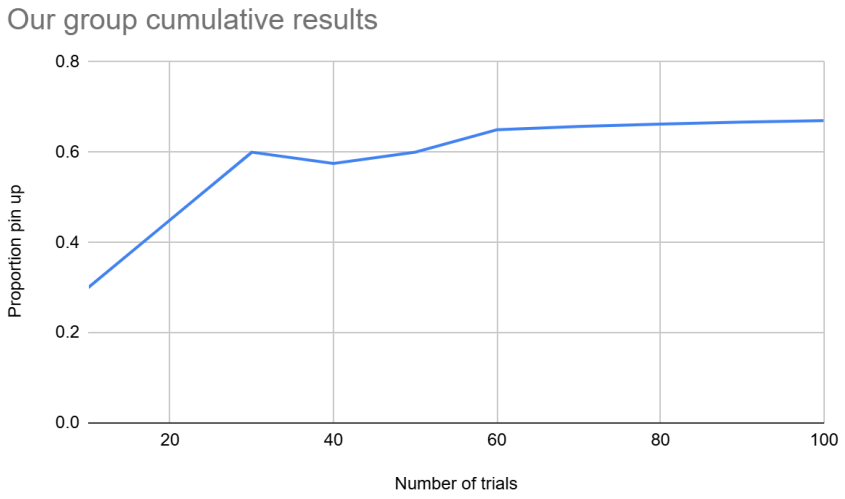
We noticed that pin up was most likely to happen, with 67 out of 100 trials being pin up. We predicted that it would land pin up the most, we thought about three times as likely, this is a little less than what we predicted.

Exploring cumulative proportion over the 100 trials

Ākonga can draw a line graph to show how the proportion of pin up changes as the number of trials increases.

They will need to find the proportion of **pin up** after each set of 10 trials.

Round	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down	Proportion pin up
1	3	7	10	3	7	0.3
2	4	4	20	9	11	0.45
3	9	1	30	18	12	0.6
4	5	5	40	23	17	0.575
5	7	3	50	30	20	0.6
6	9	1	60	39	21	0.65
7	7	3	70	46	24	0.657
8	7	3	80	53	27	0.6625
9	7	3	90	60	30	0.667
10	7	3	100	67	33	0.67



Ākonga describe what the line graph shows.

We noticed that the proportion that was pin up started low and increased quickly at the start. From 30-60 throws it varied a bit up and down but from around 60 throws it started to be similar, changing only a little bit until it reached 0.67 after 100 throws.

Class results

Collect class results, example below.

Student results	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down	Proportion point up
Group A	67	33	100	67	33	0.670
Group B	60	40	200	127	73	0.635
Group C	68	32	300	195	105	0.650
Group D	68	32	400	263	137	0.658
Group E	73	27	500	336	164	0.672
Group F	62	38	600	398	202	0.663
Group G	66	34	700	464	236	0.663
Group H	57	43	800	521	279	0.651
Group I	68	32	900	589	311	0.654
Group J	68	32	1000	657	343	0.657
Group K	70	30	1100	727	373	0.661
Group L	60	40	1200	787	413	0.656
Group M	70	30	1300	857	443	0.659
Group N	68	32	1400	925	475	0.661
Group O	59	41	1500	984	516	0.656
Group P	65	35	1600	1049	551	0.656

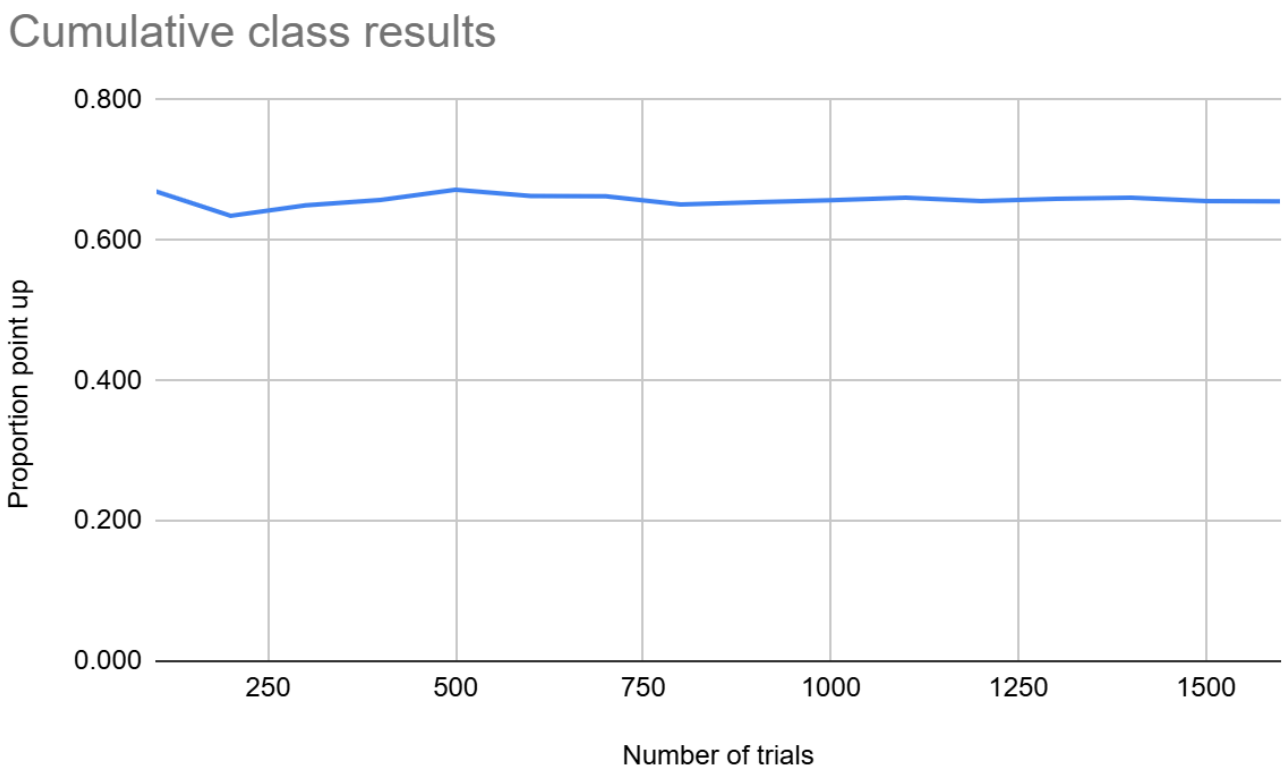
Get ākonga to make a graph to show the results of the class results. Use a bar graph.

Ākonga describe what the bar graph shows.

- Which outcome was more likely?
- How does this compare with your pair's results?

Pin up was more likely for the class results. The proportion of pin up is 66% which is very close to our results of 67%.

Exploring cumulative proportion over the 1600 class trials



Ākonga describe what the line graph shows.

The line varies slightly around the 0.66 mark, sometimes a little up and sometimes a little down. But over the 1600 trials it is very similar.

If other probability experiments e.g., different heights, different surfaces

Collate the same information for each probability experiment, numbers will most likely be lower.

- Once all different probability experiments are discussed and described, get ākonga to compare and contrast between the probability experiments.
    - e.g., how does the surface impact the number of drawing pins that land pin up?
    - e.g., how does dropping from a higher height impact on the number of drawing pins that land pin up?

CONCLUSION:

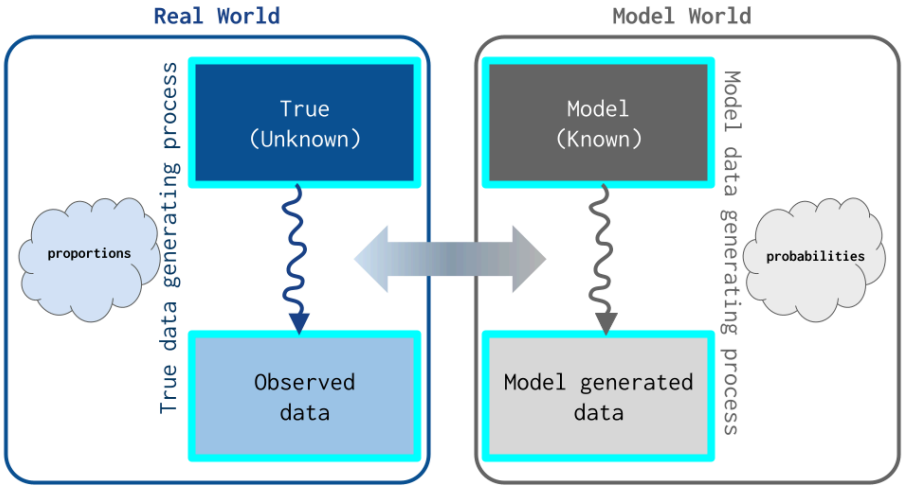
Using the evidence from across the two sessions answer the investigative question:

What is the probability that a drawing pin lands pin up (or pin down)?

Note for teachers: Using the conceptualising modelling (CM) framework

This information is for teachers and is adapted from **Fergusson and Budgett** (2026, Example Four).

For this problem scenario, the modelling approach is closely tied to the wording and context provided, and involves the use of a real object. The real-world situation involving uncertainty has been described, but there is **no contextual information or theoretical basis that can be reasonably used to assign probabilities to each of the events** (pin up or pin down). The focus for the modelling approach is on connecting the Real and Model Worlds by considering all four components of the CM framework.



The **True Data Generating Process (DGP) involves throwing one drawing pin and observing whether the drawing pin lands pin up or pin down**. The drawing pin in this situation is not a physical representation of a model, because we do not know and have not specified as a modeller what the "weightings" are for each of the outcomes, pin up or pin down.

There are several different approaches ākonga can use to develop a model for assigning probabilities..

For instance, ākonga could start by developing their initial model for the True DGP from a theoretical or a subjective perspective.

- Because there are two outcomes (pin up or pin down), a student may naively assign each outcome an equal probability. The student could then compare data generated from their model, to data generated from throwing drawing pins, to evaluate how "good" their model was and update if needed.
- Given the physical features of each drawing pin, it might not seem reasonable to another student to specify that landing pin up and landing pin down are equally likely. This student could assign probabilities to each outcome based on their ideas around the physical structure of the drawing pin and if they think that the head of the drawing pin has more of an influence for one outcome or the other. The student could then compare data generated from their model, to data generated from throwing drawing pins, to evaluate how "good" their model was and update if needed.

Another modelling approach could be to start by **generating data from a large number of physical throws of drawing pins, and use the proportions observed to inform the development of a model for the True DGP.**

Cooperative learning strategies

Cooperative learning is an instructional strategy where small groups of ākonga work together on a common task. Each member is responsible for their own learning as well as helping their teammates learn, fostering a collaborative and supportive learning environment.

Here are some examples of cooperative learning strategies that can be used in mathematics and statistics classes:

1. **Think-Pair-Share (TPS)**
    - Think, Pair, Share is a way of providing increased wait time so that ākonga have time to think before they speak or write. It also provides opportunities for repetition and for practising and polishing language. This strategy is very easy to use and takes no preparation and it can be used across all learning areas.
    - The ākonga first work individually writing down their ideas. Next they share their ideas with a partner and then with a larger group or whole class. It is important that ākonga need to be able to share their partner's ideas as well as their own.
    - The 'wait or think' time that is part of Think, Pair, Share has been demonstrated to be a powerful factor in improving student responses to questions.
        - From ESOL online **Results for Multicultural Learner Success and ESOL Support**

    Example
    - Ākonga might individually consider how to interpret a dataset, then discuss their interpretations with a partner, and finally present their conclusions to the class.

2. **Jigsaw**
    - Jigsaw is a cooperative learning strategy that enables each student of a "home" group to focus on one area, idea or 'piece of the puzzle'. Ākonga become 'experts' in their assigned area by working with members from other groups who are also assigned that same focus. These new groups are called 'expert' groups. The 'experts' then return to their 'home' group and share their expertise, which is required for the completion of the home group task. As in a jigsaw puzzle, each piece or each student's part is essential to enable the completion and understanding of the home group task.
    - The strategy can be used across most curriculum levels, once ākonga are able to work with some autonomy in a group.
        - From **NZ curriculum online Jigsaw**

    Example
    - When learning about properties of 2D shapes, one student might learn about the properties of triangles, another about quadrilaterals, and another about circles. They then teach their respective topics to their group members.

3. **Group Investigation**
    - Ākonga work in small groups to investigate a topic, plan their research, and present their findings.

    Example
    - Ākonga engage in mathematics investigations or statistics investigations in small groups.
    - They undertake their investigation and present their findings.

4. **Numbered Heads Together**
    - Ākonga in a group are numbered. The teacher asks a question or provides a problem to solve, and ākonga put their heads together to discuss the answer. The teacher then calls a number, and the student with that number shares the group's answer.
        - See more at **Numbered Heads Together - Active Learning Strategies**

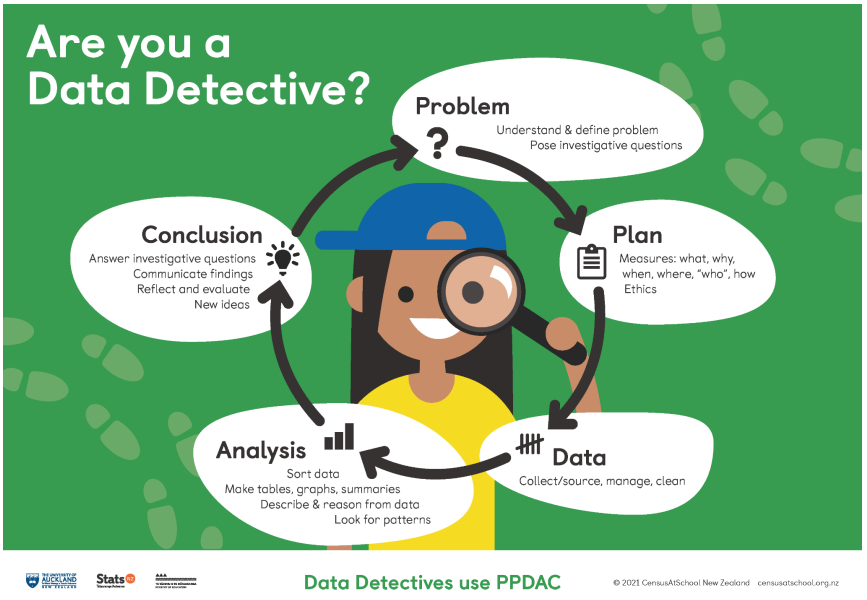
    Example
    - In a mathematics class, the teacher might ask a question about finding the area of a composite shape. Ākonga discuss the solution, and the student with the called number explains the group's solution.

5. **Peer Tutoring:**
    - Peer tutoring is a form of cooperative learning where two ākonga work together – a more skilled "tutor" with a less skilled "tutee".
        - From Inclusive Education **Supporting positive peer relationships**

    Example
    - In class, a student who understands how to find the volume of a prism might tutor a peer who is struggling with the concept, explaining the steps and working through problems together.

Further readings

- **An introduction to cooperative learning - THE EDUCATION HUB**
- **Strategies for teaching and learning in Social Studies - Cooperative learning**



https://new.censusatschool.org.nz/resource/data-detective-poster/

Drawing pins student materials

Resource list with preparation

Resource	Preparation required	Approx numbers
Results table	Print and cut up - two per page	One per pair

Results table

Round (each round has 10 trials | drawing pins)	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
1			10		
2			20		
3			30		
4			40		
5			50		
6			60		
7			70		
8			80		
9			90		
10			100		

Round (each round has 10 trials | drawing pins)	Number point up	Number point down	Cumulative total trials	Cumulative point up	Cumulative point down
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