

Broad Bean Investigation

Aim

To investigate the ways in which temperature affects the period germination & growth of a broad bean over the duration of 21 days.

I will keep 3 beakers in 3 different climates of temperatures and observe and note the alterations the bean will go through. These temperatures will be:

- ⊕ Room Temperature
- ⊕ In a chiller at a set temperature of 5 °centigrade
- ⊕ And, in a water bath in the set temperature of 35 °

I will measure the shoots and roots of the beans and at the end of 3 weeks compare our results and see which temperature is ideal for a broad bean to grow in.

Prediction

I believe that in this investigation the beaker at room temperature will grow the best as I think this because the other two climates I believe are too extreme for the beans to grow in. The water bath I think may damage or kill the enzymes in the bean so there would be no growth. And in the chiller the temperature would be too cold for any thing to grow in at all. I think that the cold would in fact slow down the growth of the broad bean

So this is why I have come to the conclusion that it would be the best temperature at room temperature as you know in nature this is the temperature grows in.

Variables

Independent

- ⊕ The variable that will be changed througho ut the investigation is the temperature. For beaker 1 I will have it at room temperature this I cannot control as this is only based on the outside temperature.
- ⊕ Beaker 2 is kept at the constant temperature of 35 °but there is a problem with this which I will outline in *Problems foreseen*
- ⊕ And in the chiller the temperature will be kept at the constant 5 °but again there is another problem.

Dependent

- ① I will be observing over 3 weeks any changes which may happen to the beans and measuring the shoots and roots at regular intervals.
- ② From these measurements I will then analyse determine which temperature is most suitable for the broad bean.
- ③ I will observe also the temperature especially the one at room temperature to see what different temperatures will do to the broad bean

Control

- ① In this investigation I will control the temperatures of the beakers in the water bath and the chiller but I cannot control the temperature of the beaker at room temperature but it will range from 20 ° to 30 °
- ② When I water the beaker I will ensure it is always topped up to 150ml and I will make sure I do this every Monday, Tuesday and Friday
- ③ I will make sure that the shape and volume of the beaker is the same as it may effect my results
- ④ The length of blotting paper I will also make sure is the same about 15cm enough to go round the beaker once as too little will not water the beans sufficiently and too much blotting paper may result in the opposite and over water the beans causing them to die
- ⑤ The right size and mass of the bean- also I will measure the beans in weight as again this can effect the overall outcome of the investigation
- ⑥ In this investigation I will have 2 beans in a beaker so if one is to die there is a back up in its place if both are alive at the end of the investigation I will find the average between the two and plot on the graph

Safety

There are no foreseen major safety issues except maybe that of glass but that can be dealt with if the beaker is dealt with care

Problems which can be foreseen

- ①. There is the problem of giving sunlight to the beaker in the chiller as when closed there is none light. This will result in an unfair way of carrying out this experiment this will mean that all three beakers will

not receive equal amounts of sunlight which can therefore affect my overall outcome.

- ②. What if it is a cloudy day the beans will get no sunlight this will also go for the beaker in the water bath. This will then mean as in no. 1 that the beakers will receive uneven amounts of sunlight
- ③. Will the position and placing of the beakers affect the overall outcome- such problems include a beaker is facing the sun while another is away and maybe sunlight is blocked by the blinds in the class. In the chiller do I place it at the back where it is the coldest or up front where it is warm
- ④. The beans cannot be observed everyday due to lessons limitation so I cannot record every change, I may miss any significant changes which could happen to the plant over the period of its growth
- ⑤. There is a risk of tampering from other year groups as the lab is used everyday. This can result in them turning off the water bath, contaminating the water of the beaker. They may touch and damage a bean.
- ⑥. It will be very hard to get 6 different beans which are to be identical to each other so I may have to use different varieties in mass and weight this means that the beans are uneven and this can again affect the overall outcome of the investigation as these beans may grow at different rates.
- ⑦. The room temperature I have no control over as it fluctuates the weather is unpredictable so temperature may differ throughout the duration of the investigation. Also due to the hot weather it is likely that the fan in the room will be on so this will change temperature even more affecting the overall outcome.
- ⑧. The beans are not meant to have any contact with water but what if it slips to the bottom the beans to keep far are meant to absorb after as in reality but a bean may slip down causing it to over water which can lead to the bean dying.
- ⑨. When measuring the beaker in the water bath I will have to take it out this may cause a loss in temperature therefore affecting my results. Also this applies to the beaker in the chiller when I take it out its temperature will increase as well as thermal energy being transferred to it from my hand.

Will these problems affect my overall results?

Yes these problems which I foresee can cause major upset to the investigation also resulting in anomalous results and there is a risk that if there is major damage I may have to abandon the whole investigation. The problems if it occurs can really spoil my investigation but some of these problems can be rectified and made sure that they do not happen during the investigation.

Ways of resolving these problems

1. & 2. The problem with uneven amounts of light given to the beaker could be resolved by the fact I put in a artificial light to store in the chiller along with the beaker with the bean but then another problem arises- the problem that at night the beakers not in the chiller will receive no light as it is dark but the beaker in the chiller will it will receive 2 hours sunlight but the other two will not.

So therefore I have therefore concluded that it does not matter as I am measuring the temperature not the amount of sunlight received so this matter does not matter.

3. The positioning I resolved by putting both the water bath and the room temperature beaker nearby each other where I believe that in this way both will receive equal amount of sunlight but then again like problem number 1 I am not measuring the amount of sunlight received but the temperature. For the chiller as long as the temperature is constant position does not affect me.
4. The class limitation can be fixed by if I choose to come in everyday to observe the broad bean but I may not be able to so I have come to the resolution that it is o.k. as there will no really be any big major development over 2 days, I will be able to record at least all of what happens to the broad bean during the length of the investigation.
5. For the risk of tampering this I cannot control but precautions taken to ensure to the best of my abilities is that I have written a word of warning on the water bath as it can be dangerous also a note of plead to them not to touch the apparatus. Also I have covered up the switch of the water bath so no one can turn it off and concealed the beaker from view.

1x Measuring Cylinder

1x Chiller

Method

How to prepare the beaker

1. Using a pair of scissors cut out three 20cm by 5cm strips of blotting paper.
2. Cut a slit in the blotting paper (see above) and put in the blotting paper around the beaker.
3. Insert the two beans into the pockets made earlier.
4. Fill up the beaker, using the measuring cylinder, up to 250 ml.

5. Put in a thermometer

Method

For setting up Water Bath Beaker

1. Fill up the water bath to about finger depth with water.
2. Switch Water Bath On
3. Set the water bath then to your chosen temperature e.g. 35 ° using the knob in the front.
4. And leave for 10-15 minutes in order for the water temperature to rise.

How to Set Up For Beaker at Room Temperature

1. After preparing the beaker place the beaker in a place where sunlight can reach it. (Take care when placing making sure that the beans are not disturbed)

How to Set Up For Beaker in Water Bath

1. After preparing the beaker place the beaker in the Water Bath and secure with string so does not fall. As shown below.

2. Then place near the beaker at Room temperature ensuring that sunlight can reach it.

How to Set Up For Beaker in Chiller

1. After preparing the beaker place the beaker take your beaker to the chiller and place at the back (where it is coldest) and close door.

How to Measure the Shoots/Roots

To measure the shoots and roots in a way that you do not cause any damage to them. Also if your root has bend or twists this method will help a lot

- ④ You should use a string and copy out including bends your shoot or root (as seen in the diagram below)

- ④ Then put your measured string along a ruler (see below) and this is how long your string is

Now leave for duration of 3 weeks making sure you record any changes to the beans at regular intervals e.g. every science lessons

And don't forget to water the bean at your fair tested day or keep filling up to agreed set water level.

Results

	Beaker 1 (Room Temperature)			Beaker 2 (In Chiller)		Beaker 3 (in Water Bath)	
	Bean 1	Bean 2	Temperature	Bean 1	Bean 2	Bean 1	Bean 2
Day 1 - Friday							
height of shoot (mm)	0	0		0	0	0	0
height of root (mm)	0	0	34°	0	0	0	0
Day 2 - Saturday	No school	No school		No school	No school	No school	No school
Day 3 - Sunday	No school	No school	—	No school	No school	No school	No school
Day 4 - Monday							
height of shoot (mm)	22	26		0	0	0	0
height of root (mm)	19	27	29°	0	0	0	0
Day 5 - Tuesday							
height of shoot (mm)	25	28		0	0	0	0
height of root (mm)	22	30	32°	0	0	0	0
Day 6 - Wednesday	No lesson	No lesson		No lesson	No lesson	No lesson	No lesson
Day 7 - Thursday	No lesson	No lesson	—	No lesson	No lesson	No lesson	No lesson
Day 8 - Friday							
height of shoot (mm)	40	50		0	0	12	23
height of root (mm)	45	61	25°	0	0	15	21
Day 9 - Saturday	No school	No school		No school	No school	No school	No school
Day 10 - Sunday	No school	No school	—	No school	No school	No school	No school
Day 11 - Monday							
height of shoot (mm)	50	69		0	0	22	29
height of root (mm)	80	90	30°	0	0	20	25
Day 12 - Tuesday							

height of shoot (mm)	53	71		0	0	22	30
height of root (mm)	82	91	29°	0	0	20	25
Day 13 - Wednesday	No lesson	No lesson		No lesson	No lesson	No lesson	No lesson
Day 14 - Thursday	No lesson	No lesson	--	No lesson	No lesson	No lesson	No lesson
	Bean 1	Bean 2		Bean 1	Bean 2	Bean 1	Bean 2
Day 15 - Friday							
height of shoot (mm)	72	84					
height of root (mm)	89	99	29°	1	0	22	30
				0	0	20	25
Day 16 - Saturday	No school	No school		No school	No school	No school	No school
Day 17 - Sunday	No school	No school	--	No school	No school	No school	No school
	Bean 1	Bean 2		Bean 1	Bean 2	Bean 1	Bean 2
Day 18 - Monday							
height of shoot (mm)	84	93		3	1	0	0
height of root (mm)	97	103	23°	1	0	0	0
	Bean 1	Bean 2		Bean 1	Bean 2	Bean 1	Bean 2
Day 19 - Tuesday							
height of shoot (mm)	87	95		3	1	20	0
height of root (mm)	100	105	24°	1	0	0	0
	No lesson	No lesson		No lesson	No lesson	No lesson	No lesson
Day 20 - Wednesday	No lesson	No lesson		No lesson	No lesson	No lesson	No lesson
Day 21 - Thursday	No lesson	No lesson	--	No lesson	No lesson	No lesson	No lesson
	Bean 1	Bean 2		Bean 1	Bean 2	Bean 1	Bean 2
Day 22 - Friday							
height of shoot (mm)	95	107		4	3	0	0
height of root (mm)	104	111	26°	2	1	0	0

Conclusion

From my results I can conclude the ideal condition in which a broad bean will grow in is in fact in room temperature this therefore agrees with my Prediction as I see from my results that In fact Beaker 1 grew the best growing to the maximum of 111 mm.

I see that the beaker in the water bath died and I will explain this further in Evaluation, as there is a reason why this happened.

Also I see that the beaker in the chiller did grow and this is an anomalous result and this I shall explain in Evaluation.

Also I have learnt in this investigation I learnt how to take down any changes to the broad. I learnt how to notice if there is any changes and how to recognise then record this.

I learnt how to set up the beakers in a way that they are all fair in,

- ⊙ size
- ⊙ volume
- ⊙ How much blotting paper is put in it
- ⊙ How to measure out water then add to the beaker in a way which is accurate and fair
- ⊙ How to place the broad beans in a way that they will not slip down and become over watered
- ⊙ How to place the thermometer in the beaker in a way that does not then disturb the investigation going on in the beaker
- ⊙ How to measure the shoot and root (see above) that is a way that is accurate and precise
- ⊙ How to set up a water bath from filling it up to setting the temperature
- ⊙ How to carry out a fair investigation making sure that all everything I have planned to be equal is kept that way

I have learnt how to how to maintain my beakers for example for the beaker in the water bath was unstable as it kept floating so I fixed it in place with string so it was kept firmly in place

I have learnt how to keep the temperature constant for beakers 2 & 3 I have to keep the temperature fixed for the water bath at 35 ° and the chiller at 5°.

To conclude I have learnt in this investigation that the ideal temperature for a broad bean to grow in is room temperature and I will elaborate on this further in my Evaluation.

Evaluation

In my evaluation I will tell you of the problems faced during the investigation. How if I was to repeat this investigation I would mend these problems. As well as other improved methods of carrying out this investigation.

During this investigation we faced many problems as you may notice from the results table and graph.

Firstly there was the problem with the water bath. At first the investigation was going smoothly till about day 12 where the growth the bean stopped. This I found was not correct I suspected maybe tampering but after consulting the teacher I found that this was due to the school technicians. I found that at night the electricity in the lab was shut off so this meant that the water bath's temperature fluctuated. The temperature would be constant at day but drop down at night. This I believe is what caused my beans to die also another factor may be that the temperature of 35 ° resulted in the enzymes in the bean to die so the bean then basically roasted. But I believe that yes maybe the high temperature from I can see from my limited results that the growth of the beans were steady but not as much as the beans at room temperature. So if I was to repeat this investigation I would make sure that the electrical supply is kept on at all times. Also that the set temperature is lower to guarantee that this time there is no risk of the enzymes in the beans do not die.

For the bean in the chiller as I have said in Conclusion that the beans grew to about 4 mm. This is an anomalous result as it was believed that the cold would make the seeds not grow at all. But I believe that cold has instead just slowed down the growth of the beans.

Also another solution may be that as there is no light in the chiller (see Problems Foreseen) the seed may have been searching for light as it is known that if a plant is in the dark the growth is fast in order for the plant to look for light so this happened but slower due to the cold.

The blotting paper in the beakers we found became too soggy so this may have over watered the beans causing its growth to slow down. This may have affected the overall results so if I were to repeat this investigation I would ensure that every watering day the blotting paper is also replaced.

I believe that there may have been some tampering with the beans as I could see that shoots looked a bit torn as if so this could have affected the overall outcome. If repeated again I would make sure that the beakers are taken somewhere where they will not be near anything which can harm them.

I asked myself does timing effect anything as maybe if you give water too early the bean could die or too late and the bean is already dead. So I would make sure that timing has a part in the investigation as it could mean the bean dying or not.

There was the problem of lack of sunlight and it did cause some problems to my overall results as seen in the results for the beaker in the chiller. We saw that the bean had grown which was not expected and meant that my results were not totally 100% accurate.