Name _____ Period _____ Date _____

Design Detective - Writing Experimental Design's (ExD)

Directions *(to be turned in tomorrow)*

1. On a separate page, **draw a picture** that represents and labels the experimental set-up and procedure.

2. For each experiment, use this information to identify the:

- **PROBLEM:** *(what is the experiment trying to answer?)*
- **HYPOTHESIS:** *(If appropriate, use an "**if** this is done… **then** this will happen…" format)*
- **CONTROL:** *(the neutral group, for comparison with the experimental group)*
- **INDEPENDENT (Manipulated) VARIABLE** - *the Cause: what is being done to each group*
- **DEPENDENT (Responding) VARIABLE** – *the Effect: what will be changing as a result of the experiment?*
- **CONTROLLED VARIABLES (Experimental Constants)** *(Variables are kept the same during the experiement)*
- **NAMES of Experimental Group(s)** *(100% conc., 10% conc., 1% conc…)*
- **NUMBER of Trials and or Sample Size for each group** *(10 times each, 100 beans each…)*

In addition

- ***WHAT SHOULD BE CONCLUDED** from this experiment?*
- ***HOW COULD THIS EXPERIMENT BE IMPROVED?** Look carefull at all the elements: what's missing?*

Experiment #1

After studying about recycling, members of Juan's environmental science class investigated the effect of different recycled products on plant growth. Juan's lab group compared the effect of different aged grass compost on bean plants. Because decomposition is necessary for the release of nutrients, the group hypothesized that older grass would produce taller bean plants. Three flats of bean plants were planted with 25 plants in each flat.

The plants were fertilized as follows: (a) Flat A: 450 g of three-month-old compost, (b) Flat B: 450 g of six-month-old compost, (c) Flat C: 0 g compost. The compost was made of the same materials and the plants received the same amount of sunlight and water each day. The plants grew for 30 days. After 30 days, the group recorded the height of each plant in centimeters.

Fig. 1 Data from plants grown in various ages of compost, for 30 days

# of plants reaching…	Flat A	Flat B	Flat C
30+ cm	0	20	0
20+ cm	23	7	2
10+ cm	5	3	23

Experiment #2

Francisco had been helping to landscape a garden using only native chaparral plants. He wanted to make sure that the amount of water available for one of the major plantings would be sufficient. He designed a lab on his patio using White Sage seedlings in each of 50 pots that contained 500 ml of native Long Beach soil. The pots were given the following amounts of tap water each day: Pots 1-10, 50 ml; Pots 11-20, 100 ml; Pots 21-30, 150 ml; Pots 31-40, 200 ml; Pots 41-50, 250 ml. According to the information tag on the Sage seedlings, the recommended amount of water for the Sage plants was 150 ml of water daily. After 40 days, the height of each plant was measured in centimeters.

Fig. 2 Data from Sage seedlings grown with varying amounts of H2O/day, over 40 days

	Amount of Water (ml)				
	50	**100**	**150**	**200**	**250**
# of plants reaching 30+ cm	0	0	4	2	0
# of plants reaching 20+ cm	0	2	4	6	1
# of plants reaching 10+ cm	2	8	2	2	7
# of dead plants	8	0	0	0	3

Adapted and enhanced by Anne F. Maben, Ap Environmental Science teacher, Long Beach USD from an activity by P. Moorison, Biology Instructor, Rocklin USD.

Experiment #3

Gabby read that certain perfume smells would make Honey Bees angry. Because perfume formulas are secret, she decided to determine if the unknown Smell X (the one that angers bees) was present in four different perfumes by observing the bees' behavior. The perfumes were named Eau de Penguin, Wild Roses, Green Apple and Lavender Ice.

Gabby placed a small jar containing 10 ml of the perfume about 3 meters from the hive opening. She recorded the time required for the bees to leave the hive and made observations about their behavior. After a 30-minute period in between experiments, she tested the next perfume. She compared the bee behavior to 10 ml of distilled water in a jar. All experiments were conducted on the same day when the weather conditions- were similar, e.g. air, temperature, and wind.

Fig. 3 Data on Honey Bee aggression when exposed to different perfumes, 3 meters from the hive opening

	Number of bees exhibiting behavior				
Bee Behavior	Eau de Penguin	Wild Roses	Green Apple	Lavender Ice	Distilled H_2O
Arrived at hive, no aggression, deposited honey	98	97	50	0	99
Agitated when arrived, circled others, finally settled down to leave honey	2	3	20	50	1
Attacked nearby bees who got too close when feeding, circled wide before returning, finally settled down to leave honey	0	0	20	28	0
Attacked Bumble Bees and wasps and beetles nearby while feeding, circled wide for a long time, couldn't follow back to hive	0	0	10	23	0

Experiment #4

Galen became interested in insulation while his parent's new house was being built. He wondered if the same methods used for keeping houses a constant temperature could keep his drinks cool in the summer. Galen decided to find out which insulation was best for keeping a cold drink cold in the summer heat.

Using 4 glasses from his kitchen, Galen wrapped each jar with a different kind of insulation. The insulation types were Styrofoam, paper towel, aluminum foil and no insulation. He wrapped the sides of each glass and layered each type of insulation so that the layers were 1 cm thick around the glass. Each was attached to the glass by clear tape.

Galen cooled 1000 ml of water to 15 ^{o}C in an ice bath. He then added 250 ml of the 15 ^{o}C water to each glass. He placed all the glasses outside in direct sunlight. After 30 minutes, he measured the temperature of the water in each glass. Galen then emptied the water from the glasses, dried each glass and allowed the glass to cool to room temperature in the kitchen. He then repeated the experiment 5 times for each type of insulation.

Fig. 4. Data from the temperature of glasses of water covered with various insulators and kept in the sun for 30 min.

	Types of Insulation			
	Styrofoam	Paper Towels	Aluminum Foil	No Insulation
Mean temperature reached from 5 trials each (^{o}C)	16	21	18	25

Experiment #5

When Fernando heard that plants compete for space, he decided to test this idea. He bought a packet of marigold seeds and some potting soil. He set out 25 plastic drinking cups. In five of the cups, Fernando placed 500 ml of potting soil and planted 2 seeds in each cup so that they were buried I cm deep in the soil.

Keeping the same procedure, Fernando planted 4 seeds each in another 5 cups so they were buried 1 cm deep, 8 seeds in another 5 cups with 500 ml of potting soil at the same depth, 16 seeds in the next group of 5 cups 500 ml of potting soil at the same depth and finally 32 seeds in each of the last 5 cups with 500 ml of potting soil buried at the same 1 cm depth. All 25 cups were watered with 50 ml of distilled water and placed on the same long table in the sun.

Each cup was watered every other day with 50 ml of distilled water for 50 days. As the experiment progressed, Fernando recorded the color of the plants and the height of the plants every 5 days for 50 days.

Fig. 4. Mean height of marigold seed planted 1cm deep in potting soil and watered every other day with 50 ml distilled water

	Number of seeds per plastic drinking cup				
	2	4	8	16	32
Mean height per experimental group (cm)	13.10	13.15	9.25	6.05 (5 dead)	5.00 (28 dead)

Adapted and enhanced by Anne F. Maben, Ap Environmental Science teacher, Long Beach USD from an activity by P. Moorison, Biology Instructor, Rocklin USD.

Experiment #6

Mark wanted to find out if the color of food would affect whether or not kindergarten children would select the food for lunch. He put food coloring into 4 identical bowls of mashed potatoes. The colors were red, green, yellow and blue. One bowl of mashed potatoes was left as the regular white color.

Each child was given the choice to choose the bowl of mashed potatoes of the color of their choice. Each day he recorded the choice of 100 different students. He did this for five days. At the end of 5 days, Mark recorded that 88% of the kindergarten children chose the regular white color of mashed potatoes.

Experiment #7

Magali read that the juice from *Aloe Vera* plant helped heal burned tissue. She decided to investigate the effect of varying amounts of *Aloe Vera* juice on the regeneration of a flatworm (flatworms can grow back body parts.) She cut 5 flatworms in half at the "waist" to obtain 10 parts (5 heads and 5 tails) for each experimental group.

She made concentrations of 0%, 10%, 20%, 30% and 40% *Aloe Vera* to apply to the flatworms. Each flatworm had 15 ml of a different concentration *Aloe Vera* solution applied to its separated head and tail.

All flatworms were kept in a growth chamber with identical food, temperature and humidity. On day 15, Magali observed the regeneration of the flatworm parts and measured the length of each segment. She then sorted and wrote down the regeneration of the flatworms as full, partial or none. Magali's data is as followed:

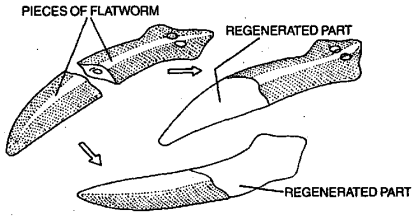
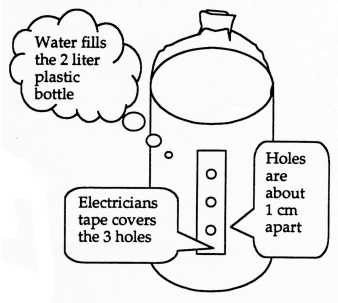


Fig. 7.7. Regeneration in flatworm.

Flatworm	Concentration of Aloe Vera (%)	Head length (initial) cm	Head length (final) cm	Tail Length (initial) cm	Tail Length (final) cm	Regeneration
1	0	6	8.5	5	8.5	Partial
2	10	6	11	5	11	full
3	20	6	7	5	6	partial
4	30	6	6	5	5	None (dead)
5	40	6	6	5	5	None (dead)

Experiment #8

Melissa wondered if the height of a hole punched in the side, of a 2L bottle would affect how far the container a liquid would spurt when the carton was full of liquid. She used 4 identical 2L bottles and punched the same size hole in each. The hole was placed at a different height on one side of each of the containers. The height of the holes varied in increments of 1 cm, ranging from 1 cm to 3 cm from the base of the bottle.



Melissa then put electrical tape over the holes and filled the bottles with liquid. She then placed the bottle in the sink and removed the tape over the bottom hole. Melissa measured how far away from the bottle the liquid squirted when it hit the bottom of the sink. She repeated this with each of the higher holes. The liquid that squirted the farthest was the hole closest to base of the bottle.

Adapted and enhanced by Anne F. Maben, Ap Environmental Science teacher, Long Beach USD from an activity by P. Moorison, Biology Instructor, Rocklin USD.