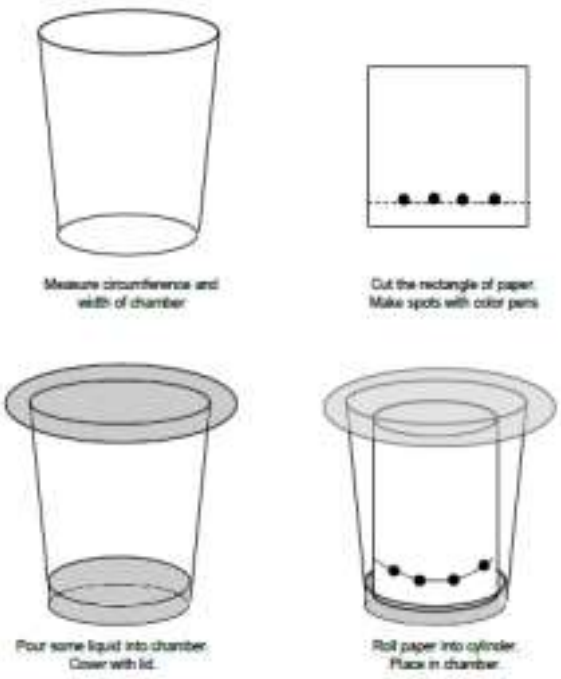
AP Children's Science Congress

Sixty three student of B.Sc. and five staff members of our college conducted hands-on activities to engage around 400 students of 9th and 10th standards from schools near University of Hyderabad on 15 November, 2013. In collaboration with the University of Hyderabad, we conducted on-the-spot Poster-making competitions as well as a Team-Quiz.

Protocols for the hands-on activities are attached - we encourage all our readers to try them out!

Protocols for Hands-on Activities for Children's Science

Congress Activity 1: Quick Chromatography



1. Measure the circumference and height of the plastic glass or beaker that will be used as the chromatography chamber.
2. Pour solvent (plain water / some defined mixture of water:methanol or water:methanol:acetic acid) to a height of ~ 5mm in the chamber. Use a 1 mL syringe to measure the liquids.
3. Cover the chamber with a lid (plastic petri dish).
4. Cut a piece of filter paper to form a rectangle with width = 1 cm less than the circumference of the chamber and height = 1 cm less than the height of the chamber.
5. Draw a fine pencil line 1 cm from the width of the paper. This will be the bottom edge of your 'chromatogram'.
6. Make small but intense spots of color on the line using marker pen. Note the color of each dot using a code (e.g., R = red, Y = yellow; write everything with a pencil near the top edge of the paper).
7. Staple or pin together the height-edges of the paper to make a cylinder of paper. 8. Place the paper cylinder (with the color spots at the bottom) in the chamber. Make sure the paper is not touching the walls of the chamber and the spots are not be submerged in the liquid. 9. Wait till the liquid rises over the paper to almost the top. Take out the paper, take out the pins/staples. Allow to dry.
10. Note the distance traveled by solution and distance traveled by the colored spots. Worksheet for chromatography:

Experiment no.	Solution (ratios)	Spot #1	Spot #2	Spot #3	Spot #4	Spot #5	Spot #6
1.							
2.							
3.							
4.							

5.							
6.							

Protocols for Hands-on Activities for Children's Science

Congress Activity 2: Activity of salivary amylase

1. Take a 1% starch solution (Dissolve 1 g starch in 100 mL hot water). The % of starch is not very critical – a little more or less is quite OK.
2. Using a 1 mL syringe, make 10 well spaced drops of 0.1 mL of iodine solution on a white tile or a set of glass slides.
3. To the first drop add 0.1 mL of starch solution; it should turn blue-black (this shows your solutions are 'working' as expected).
4. Mark the level of 0.5 mL in a test tube (use a clean 1 mL syringe and water). Collect saliva to this mark (now you have 0.5 mL of saliva).
5. Add 4.5 mL of water or a solution of dilute citric acid or lime (choona). Mix well. This is your enzyme stock.
6. In a plastic cup, mix 1 mL of enzyme with 1 mL of starch solution; this is your reaction mixture. Note the time.
7. Every 30 sec., mix 0.1 mL of reaction mixture with a drop of iodine solution on the tile. Mix with a clean (freshly washed) toothpick. Note the time it takes for the starch to be digested (no blue black color produced when mixed with iodine).

Worksheet for amylase activity:

Volume of saliva			
Mixed with substance (and volume)			
Time from mixing	Color of spot	Color of spot	Color of spot
0.0 min.			
0.5 min.			
1.0 min.			
1.5 min.			

2.0 min.			
2.5 min.			
3.0 min.			
3.5 min.			
4.0 min.			
4.5 min.			
5.0 min.			

Protocols for Hands-on Activities for Children's Science

Congress Activity 3: Calculate your BMI

Measure:

1. Your height in cm
2. Your weight in kg
3. Circumference of your upper mid-arm (UMAC) in cm.

Draw:

1. Histogram of height.
2. Histogram of weight.
3. Histogram of UMAC.
4. Scatter plot of weight vs height; use different colors for boys and girls.
5. Scatter plot of height vs UMAC; use different colors for boys and girls.
6. Histogram of BMI; Box and Whiskers plot of BMI of boys and girls.

To draw histogram:

1. Note the lowest and highest reading for the property to be plotted.
2. Subtract former from latter to get 'range'.
3. Divide range into 5 equal parts, or 'class intervals'. You can round off to nearest integer to get equal-sized 'classes'.
4. Note the number of persons in each class interval, or 'frequency'.
5. Mark class intervals on X-axis. Construct rectangles with height proportional to 'frequency'.

To draw scatter plot:

1. Note the lowest and highest reading for both properties to be plotted.
2. Label the X- and Y- axes using a suitable scale.
3. For each reading, make one dot (with appropriate values corresponding to the X- and Y- axes.

To calculate BMI:

$$\text{BMI} = \frac{\text{weight}}{\text{height}^2}$$

**** h**** (**^{2})

To draw box and whisker plot:

1. Arrange the reading in an ascending order.
2. Locate the mid-value or 'median'; this value divides the data set into two sets with equal number of readings (50% of readings are below the median value and 50% of the readings are above the median value). The median is also called the Q2 (second quartile).
3. For each of the two sub-sets, locate the mid values. The mid-value of the first set (with values lower than median) is called Q1 (first quartile). The mid-value of the second set (with values higher than median) is called Q3 (third quartile).
4. Note the minimum and maximum values.
5. Draw the box of the box plot with ends at Q1 and Q3. Draw a line across the box at Q2. From the mid-points of edges of the box, draw whiskers to mark the minimum and maximum values.

Worksheet for BMI:

Name	Gender	Weight (kg)	Height (cm)	Square of height (m^2)	BMI	MUAC (cm)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

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Congress Activity 4: Measure your Resting and Elevated Pulse

1. Measure your resting pulse for 3 consecutive 30 sec. periods.
2. Run or jog or jump for 30 sec., or 60 sec., or 90 sec. (note the time).
3. Measure your pulse for consecutive 30 sec. periods until it returns to resting rate (for at least 60 sec.).
4. Plot your reading (time on X-axis; pulse rate on Y-axis; you can convert to % of starting rate).
5. Compare your readings with at least 4 other persons and answer the following questions: a. What is the average resting pulse rate?
   b. Does pulse rate increase with activity?
   c. Does type of activity (running versus jogging versus jumping) affect pulse rate?
   d. Does increase in pulse rate depend on how long you were active?
   e. Does the time taken for pulse rate to return to normal depend on how much higher it was at starting point?

Worksheet for pulse rate:

	1	2	3	4	5
Name					
Resting pulse 1					
Resting pulse 2					

Resting pulse 3					
Type of activity					
Duration (sec.)					
Pulse count 1					
Pulse count 2					
Pulse count 3					
Pulse count 4					
Pulse count 5					
Pulse count 6					
Pulse count 7					
Pulse count 8					
Pulse count 9					
Pulse count 10					

Protocols for Hands-on Activities for Children's Science Congress Activity 5: Measure your Lung volume

1. Measure the volume of the plastic bottle using the measuring cylinder.
2. Fill the plastic bottle with water to the top and cap it. Make sure there is no air in the bottle.
3. Fill half the bucket with water.
4. Invert the bottle and immerse the top under the water in the bucket. Hold the bottle upright and remove the cap (under water). Note if any air enters the bottle.
5. Insert one end of the plastic tubing into the mouth of the bottle.
6. Blow into the other end of the tubing with your mouth (1 normal breath). Some water will be displaced from the

bottle into the bucket.

7. Cap the bottle and remove from bucket.
8. Measure the volume of remaining water to calculate the volume of air breathed out during normal breathing.
9. Compare readings from at least 5 people and calculate the average volume of 'breathed-out' air.

Worksheet for lung volume:

Volume of bottle used:

Name	mL of water remaining in bottle	mL of air expelled
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Protocols for Hands-on Activities for Children's Science Congress Activity 6: Quick Titration

1. Measure 0.5 mL or 1 mL of base solution into the plastic cup (use a clean 1 mL syringe).
2. Add a drop of indicator phenolphthalein to the base; it should turn deep pink. 3. Fill a clean 1 mL syringe with acid solution.
4. Add the acid drop-wise to the base solution. Mix the solution in the cup by gentle swirling. Keep adding acid just until the pink color disappears. Note the amount of acid required to neutralize the base (in case more than 1 mL is required, refill the syringe with acid).
5. Repeat the titration by switching the solutions: take acid in the plastic cup and add indicator (solution will remain colorless), and titrate with base taken in syringe (note the amount of base required for solution to just turn pink.

Worksheet for titration data:

Experiment no.	Substance in cup (acid/ base)	Volume in cup (mL)	Substance in syringe (acid/base)	Volume added for neutralization (mL)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Calculations: strength x volume of acid = strength x volume of base
If strength of acid = 1N; strength of base =

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Congress Activity 7: Osmosis

1. Peel a fruit or vegetable (potato or cucumber or papaya) and carve it into a cup (height 7-8 cm, depth 5-6 cm, outer diameter 5-7 cm, and inner diameter 2-3 cm; but other dimensions are fine too). Make sure the cup does not leak!
2. Add concentrated salt solution into the vegetable cup (measure volume with a 1 mL or 5 mL syringe). Add a drop of dye/ink (to show that the cup is not leaking. If the cup is leaky, discard it and start with another cup).
3. Place the vegetable cup in a dish of water water; make sure the level of water is not above the level of the vegetable cup.
4. Note the rise of water in the vegetable cup (you can measure the volume using a syringe every 30 min. or some other convenient time interval).
5. Alternatively, fill the vegetable cup with water and place it in a dish of salt solution. With this arrangement, water level in the cup will decrease over time.

Worksheet for osmosis:

	Experiment 1	Experiment 2	Experiment 3
Material used to make vegetable cup			
Total volume of vegetable cup (mL)			
Solution inside the cup (salty/water)			
Solution outside the cup (salty/water)			
Volume of solution in cup at start			
Volume at time (note time)			
Volume at time (note time)			
Volume at time (note time)			
Volume at time (note time)			

Protocols for Hands-on Activities for Children's Science

Congress Activity 8: pH of common substances

1. Make a solution / juice / soft paste of the substance.
2. Place small drop of it on a slide or any other clean surface. Soak it using a piece of pH paper and note change of color.

3. Note the pH based on color scale.
4. Display your results as a graphic.

Worksheet for pH data:

Item	pH
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Congress Activity 9: Measure volume of balloon

1. Cut a small piece of a balloon (~2 cm x 2 cm).
2. Suck it to make a small balloon. Tie it up with a piece of thread.
3. Pull out the plunger of a 50 mL plastic syringe and place the small balloon in the syringe. 4. With the nozzle open, put in the plunger and position it at the 25 mL mark (This is the 'initial volume' of air in syringe). Note the diameter of the small balloon (using marking of syringe). 5. With the nozzle closed, push in the plunger as much as you can. Note the position of the plunger and the diameter of the small balloon. (This is the 'final volume' of air in syringe). 6. Repeat step 4.
7. With the nozzle closed, pull out the plunger as much as you can. Note the position of the plunger and the diameter of the small balloon. (This is the 'final volume' of air in syringe).

Question:

1. Is there any relationship between the volume of air in the syringe and the volume of the small balloon? (Hint: Plot your data as a scatter plot).

Worksheet for pH data:

Experiment no.	Volume of air in syringe (including volume of balloon)		Diameter of small balloon		Volume of small balloon		% change of volume	
	Initial	Final	Initial	Final	Initial	Final	Syringe	Balloon
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Protocols for Hands-on Activities for Children's Science Congress Activity 10: Mass and weight

1. Use a spring balance to measure the weight of a small, water-proof article in air (or place in plastic bag before weighing).
2. Measure the weight of the same object after complete immersion in water.

Challenge:

Explain the relationship between mass and weight.

Worksheet for noting weights:

Object no.	Description	Weight in air (g)	Weight in water (g)	% change
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				