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## iBIO STEM Kits: Diaper Polymers

### iBIO STEM Kits welcomes you to a SCIENTIFIC JOURNEY!

This kit contains the materials you will need to investigate **POLYMERS**. The purpose of this kit is to challenge you to explore what polymers are and what they do. However, we also challenge you to explore as a scientist would. What does this mean?

Scientific exploration is different than just playing around because it asks you to think about **HOW** you investigate. This means you need to do your investigation by observing what happens when you change a variable you have carefully chosen. This helps you to understand **WHY** something happens. Scientific exploration also means that you record **WHAT** you see or measure and that you record **WHY** you think it happens. The STEM Kit Journal that you are holding will help to guide your investigation and give you a place to record your observations, measurements and conclusions.

Follow the QR code at the top of the page for additional resources on this activity. This type of investigation is associated with some very exciting careers! We hope that you will explore these resources while you are doing your investigation!

## Let's Get Started!

**FIRST**, you will need to prepare your workspace. This can be a very wet and messy investigation, so make sure that you are using a space that will not be easily damaged. A kitchen table will work nicely. To make your clean up easier, you should protect your surface by laying out some used newspaper or opening up a paper grocery bag.

**SECOND**, you want to unpack your materials. Use the list below to identify which materials are used in each part and organize them in your workspace. There are some additional materials that you will need to supply from your home.

<p><b>Kit Materials for Part A:</b>            1 Container labeled Polymer A*            1 Container labeled Polymer B*            1 Container labeled Polymer C*            4 Medicine cups            (Re-used in Part B and Part C)</p> <p><b>Other items needed:</b>            A container of water that allows you to easily pour or scoop the water when you need it.            Safety glasses</p> <p><i>*The polymers included are non-toxic but should not be ingested. Please monitor younger children around these polymers.</i></p>	<p><b>Kit Materials for Part B:</b>            2 Gallon-sized Plastic Bags            2 Diapers of different brands</p> <p><b>Other items needed:</b>            Newspaper, paper grocery bag or plastic garbage bag to protect your space            Safety glasses</p>	<p><b>Kit Materials for Part C:</b>            You will be using the materials you prepared in Part B            Salt (for clean-up)</p> <p><b>Other items needed:</b>            Measuring cups            Safety glasses</p>
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**LAST**, you need to be prepared for experimenting safely. Please wear your safety glasses. During Part B, make sure you **DO NOT** breathe in the diaper polymer material. Weather permitting, consider doing that part of the activity outside.



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## Dissecting a Diaper to Investigate Polymers

### Part A: EXPLORE - What is a Polymer?

**Here is what you need from your STEM Kit:**

Mystery Polymer A  
Mystery Polymer B  
Mystery Polymer C  
Four medicine cups (or other small, clear cup)

**Other items needed:**

A container of water that allows you to easily pour or scoop the water when you need it.

**What is a polymer?**

What are hydrogel polymers like? Let's explore! You have three hydrogel polymers to investigate. Follow the directions to do controlled observations of each of the three polymers.

**Procedure:**

1. Separate three medicine cups. Pour some mystery polymer A into the first medicine cup. Pour some mystery polymer B into the second medicine cup. Put some mystery polymer C into the third. Each of these is a type of hydrogel polymer.
2. Make your observations about each of the powders in your data chart. You should record what you SEE, what you SMELL, what you FEEL, what it SOUNDS like when you touch it and move it around.
3. Use the fourth medicine cup to add water to each of the cups. What are your observations as you add the water? Add more water. What happens? Allow the polymer to sit in the water for 5 minutes. Make your observations again. Has anything changed?
4. The powders have properties that make them useful for different things. One of the polymers is Instant Snow. One of the polymers is used by florists because it releases water slowly to provide water to flowers. One of the polymers is used in diapers. Which powder is which? Put your guesses in your data chart.



**DATA CHART**  
**PART A: What is a Polymer?**

OBSERVATIONS	Mystery Polymer A	Mystery Polymer B	Mystery Polymer C
What do you SEE			
What do you SMELL			
What do you FEEL			
What do you HEAR			
What happens after I add water?			
What do you SEE			
What do you SMELL			
What do you FEEL			
What do you HEAR			
Which type of powder do you think it is?			



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## Part B: DISSECT - What is the Anatomy of a Diaper?

### Here's what you will need from your kit:

- 2 Gallon-sized Plastic Bag
- 1 Medicine cup
- 2 Diapers of different brands

### Other items needed:

Newspaper, paper grocery bag or plastic garbage bag to protect your space

To **dissect** means to separate something into pieces in order to study its internal parts.

A diaper has been designed to keep a baby dry by keeping moisture away from a baby's skin. The hydrogel most commonly used in diapers is sodium polyacrylate. It's added to the core of disposable diapers to soak up urine. This helps to prevent diaper rash. The diaper is also designed to prevent urine from leaking out of the diaper to keep the baby's clothing dry. The anatomy of the diaper is a good example of chemistry and engineering working together to solve a problem.

**Let's dissect the diaper and analyze the design!**

### Procedure:

1. Cover your workspace with newspaper or a paper grocery bag or by a large, plastic garbage bag. This will make cleaning up easier later.
2. Place a new diaper on the newly covered surface.
3. Make a drawing of the diaper design. Why was it designed this way? Label your observations about the construction.
4. Look carefully at the lining. Make some observations about the material used to make the diaper. What does it look like? How does it feel?
5. Carefully cut through the diaper lining and remove all of the stuffing material.
6. Put all of the stuffing material into your gallon sized plastic bag. Scoop up any material that may have fallen onto your work surface and put it into the plastic bag.
7. Seal the bag. Open a small area and blow some air into the bag so that the bag puffs up a little bit.
8. Shake the bag for a few minutes. You will begin to see that a powder begins to gather in the bottom of the bag. This is the super absorbent polymer powder.
9. Open the bag and while the diaper is still inside the bag, begin to pull apart the cotton. This will help to release any other polymer that is trapped in the cotton.
10. Continue to pull at the cotton until you are certain that the majority of the polymer has been released and is now at the bottom of the plastic bag.
11. Remove the cotton from the bag. Use the medicine cup to measure the amount of polymer removed from the diaper. Record this amount in your data chart.
12. If you have a second diaper, you will need to repeat this procedure again to collect the polymer. Record this amount in your data chart.



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<b>DATA CHART</b>	
<b>Part B: DISSECT - What is the Anatomy of a Diaper?</b>	
Draw and label the <b>design of the diaper</b> in the space below for <b>BRAND A</b>	<b>Lining Materials:</b> What does it look like?  What does it feel like?
	Amount of powder from the lining:
Draw and label the <b>design of the diaper</b> in the space below for <b>BRAND B</b>	<b>Lining Materials:</b> What does it look like?  What does it feel like?
	Amount of powder from the lining:
Draw and label the <b>design of the diaper</b> in the space below for <b>BRAND C</b> (if you have diapers at home and want to test that brand as well!)	<b>Lining Materials:</b> What does it look like?  What does it feel like?
	Amount of powder from the lining:



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### Part C: INVESTIGATE - How much water can the different brands of diapers hold?

#### Here's what you will need from your kit:

The polymer that has been removed from each of the diapers.

2 Gallon-sized plastic bags

1 Medicine cup

Salt (for clean-up)

#### Other items needed:

Measuring cups

There are many brands of diapers. When we dissected your diaper, you removed the sodium polyacrylate from each of the different brand's diapers. Does one brand work better than another? You can test this out!

We want to test our question in a scientific way. This means that we need to do EXACTLY THE SAME THING to the polymer from each diaper.

#### Procedure:

We want to know how much water is absorbed by each brand of diaper. You will be deciding on your own method for testing the different diaper brands. How can we test the polymers in a scientific way?

1. Choose one diaper polymer to start with. Put your polymer into its gallon bag. Make sure that you label your bag, so that you remember which diaper you are testing.
2. You will be pouring water into the gallon bag a little bit at a time and mix. Decide on how much water you will add each time. We suggest you add 30 ml at a time. You can measure this easily with your medicine cup. If you have measuring cups in your kitchen that you can use, you can measure a different amount each time. But REMEMBER: You will need to add water EXACTLY THE SAME WAY WITH EACH DIAPER. Keep track of how much water you add to the bag by recording it in your data chart.
3. Each time you add water, you will need to mix it with the powder. You will need to do this EXACTLY THE SAME WAY WITH EACH DIAPER.
4. Continue to add water to the powder in the bag until the powder can no longer hold any more water. If you see liquid water in the bag after mixing it with the powder, that will tell you when to stop. You will need to do the EXACT THE SAME THING WITH EACH DIAPER.
5. When you are done, add up the total amount of water added. Which diaper brand absorbed the most? Rank the diapers. (1-BEST, 2, 3-WORST)

#### To safely clean up the polymer:

Add a few teaspoons of salt, stir it with a spoon, and watch what happens. Salt messes up the gel's water-holding abilities. When you're finished, you can pour the saltwater goo safely down the drain.



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**DATA CHART**  
**Part C: INVESTIGATE - How much water can the different brands of diapers hold?**

	Diaper A	Diaper B	Diaper C
Amount of water added  Example: 30 + 30 + 30			
Total amount of water once the polymer is saturated (full)			
Rank the diapers  1-BEST 2 3-WORST			