

# SCIENCE FAIR

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10<sup>TH</sup> GRADE SCIENCE FAIR

## INTRODUCTION (Ask A Question)

What mask is the best for the average consumer during a pandemic?

## Background Research

While reusable masks tend to have less protection against contaminants than their use and throw counterparts, they are better for the environment and tend to be cheaper.

When consumers buy Instagram consider buying masks, they tend to value the protection, environmental impact, and cost of the mask to varying degrees. A self-conducted their (instagram polls) suggested that when buying masks people care the most about its protection, then their cost and they care the least about their environmental impact. We are going to weigh the factors off of this research.

Environmental impact of disposable masks:

Improper disposal of masks can both harm the environment and increase the chance of spreading the virus from person to person.

In the United kingdom alone 102 million plastic, single-use masks are being thrown away in the trash every week. Around 100 million were found off of the coast of Hong Kong, they are described to be swimming in the sea like a hoard of jellyfish. According to SETAC, this plastic waste can persist in the environment for decades to hundreds of years.

A proper N95 Mask is used for airborne particles or to prevent contamination from liquids. This is used for serious medical emergencies or in chemical facilities, such as if a doctor is treating someone directly with the virus/disease. If testing acidic or dangerous chemicals this mask is used to prevent your face from contamination. For 2 N95 masks, it's about \$8 on Home Depot, however there are cheaper prices, 10 for \$20. The reason this mask isn't used as much is that it's mostly for one time and in total it would cost too much money.

**Cloth Mask (broad)** - Washable - 4 for \$10, Can get 25-50 for about \$10-15

**Surgical Mask** - 50 pieces for about \$10, but can get for free now from most places

**Bandana** - Might have at home, but if you don't it's \$3-4

**N95** - 10 for \$20

**Face Shield** - around \$10

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Face Shields however are not good as masks, they are not as effective against disease/virus. They are like goggles and are used to protect eyes from chemicals and such. When there's a large number of people around you like in a school it doesn't help against respiratory droplets. They have large gaps on the bottom and alongside your face. You have to be very careful and cautious when wearing a face shield because there's a higher chance of you transmitting or catching the virus. With a mask it is much safer, however, the shield is not too necessary if you have a mask and a shield.

The amount of environmental waste has been tragic since this pandemic. With the use of disposable masks, we are creating a bigger environmental hazard. On Hong Kong's beach, hundreds of masks were found on the ground within a hundred-meter shoreline. In the Mediterranean Sea, they have been "floating like jellyfish." This has created a global impact since animals, plants, and humans are being affected, with the virus it was just humans. In the ocean, animals can choke since they don't know if it's edible or not similar to how animals are trapped with 6 pack rings around their neck. If the animals eat it and do not choke they become malnourished. Unlike plastic, disposable masks do not break down. With plastic, breaks down into microplastic and eventually is added into our food chain when animals eat them. When an animal eats a mask and doesn't choke, it has the potential to carry chemicals and bacteria which will end up in our water or food.

## HYPOTHESIS

### **Air Test**

We believe that since the cloth mask covers most of the face it will be harder to blow air out of it than the standard blue surgical masks.

### **Particle Test**

With the particle test, we believe that the blue surgical mask will gather more particles because it has more gaps than the cloth mask.

### **Water Test**

For the water test, we believe the spray will not spray onto the second cardboard with the cloth mask since the material is better and denser than the blue mask.

### **Electrostatic Test**

With the electrostatic test, we believe the blue mask is more static than the cloth mask since the blue mask can gather more particles because of its material.

## MATERIALS

1. Cloth Masks
2. Surgical Blue Masks
3. Cardboard
4. Sink (Faucet)
5. Paper
6. Spray Bottle

## PROCEDURE

### Air Test:

1. Got a water bottle
2. Cut pieces of paper and glue them on to the bottom of the bottle
3. Applied a nozzle to the opening of the bottle
4. Added duct tape to make a seal on the bottle
5. Experimented:
  1. Pushed on the pump
  2. Observed the amounts of paper that moved

### Particle passing test:

1. Got a water bottle
2. cut off the bottom
3. Taped a damp poster in place of the bottom
4. Added 0.75 g of flour in the bottle
5. Added face-covering in the neck of the bottle
6. Added nozzle of the pump
7. Created a seal with duct tape
8. Experimented:
  1. Push on the pump
  2. Observed the amount of flower blown

### Electrostatic Test:

I tested the electrostatic test for both Cloth masks and surgical Masks.

1. Cut some paper into small pieces of paper
2. Rub the mask using friction, any form of friction should do
3. Gently place the mask on the paper, if static is attracted to the mask the paper will stick to the mask

You can try the water test too

1. Rub the mask using friction
2. Turn on your sink or faucet
3. Place the mask next to the water, if the water bends, it attracts static
4. If water gets on the mask, the mask loses its static charge

**Water Test:**

I tested if water can infiltrate the mask (ex. If you spill water on your mask, will it ruin it). A good amount of water will ruin your mask if you soak your mask into a large mass of water but we tested if small amounts of water could infiltrate your mask.

1. Get two cardboard pieces, cut a hole in one of the cardboard pieces
2. Put one cardboard piece in front of the mask, and one behind it
3. Spray water into the hole where your mask should be. If the water comes onto the back of the cardboard, the mask is bad.

**DATA**

**Who won the test?**

Experiment	Cloth Mask	Surgical Blue Mask
Electrostatic Test	Cloth Mask didn't attract to static	Blue mask did attract to static
Water Test	Water filtered through and there are clear marks through each side of the mask	Water rolled off a blue mask and didn't filter through
Particle Test	The radius of the circle caused by the flour measured 0.38cm (3/7)	The radius of the circle caused by the flour measured 0.29cm (4/7)
Air Test	1 piece of paper moved - makes it a lot harder to breathe  (6/7)	1 piece of paper moved - makes it slightly harder to breathe (6.5/7)

## RESULTS

### Electrostatic Test

The cloth mask didn't attract static but the blue surgical mask did. We tried two different tests to test the mask's attractiveness of static and both results concluded in the blue surgical masks favour. When friction is applied to the mask it attracts more static, this is why when you reuse this mask more particles and fibres get stuck to it. The blue mask isn't supposed to be reusable even though it can be. The blue mask is for doctors so it's disposable when you are done with the patient so now airborne virus/disease can infiltrate your body.

### Water Test

In the water test, the water passed through the cloth mask and not the blue mask. This is because the blue surgical mask has layers that help it protect it from this. Since doctors use this mask so much, scientists made precautions so fluids wouldn't affect the mask in any way. The three different layers help prevent fluids, filter particles and absorb the heat exhaled from the body. When testing water was on both sides of the cloth mask but only on one side of the surgical mask.

### Particle Test

It was amazing how well the masks performed as compared to the control, the radius of the flour circle was half (two masks averaged together) of the control test. This is amazing as it visualized how much just a mask can help prevent the spread of COVID-19, however, the bandana did poorly in this test too, it only made a marginal difference from the control, perhaps this highlights how bandanas aren't very protective and how they aren't intended to be used as masks.

### Air Test

Masks and barrier devices performed very well as compared to the control test. However, all barrier devices did not perform similarly as thicker, reusable masks and high filtration masks performed significantly better than the bandana. Both the masks only managed to knock wiggle on a piece of paper but the reusable mask performed marginally worse sense the mapper vibrated more when test with this type of mask.

## CONCLUSION

We found out that the best overall mask is a cloth mask. It's cheap, reusable so it doesn't affect the environment and is comfortable because of its material. No particles can get on it, unlike a disposable mask. So if you're working or going to school this is probably the best mask out there. However, if you tend to stay at home and only go out once in a while you should use the disposable mask. It's easier to breathe, waterproof, thin and very cheap. However, if you already have a bandana at home or prefer something that has a thinner material than the previous masks I mentioned then the bandana is the way to go. Overall it doesn't affect the environment, easy to wear even though it might have the occasional slip-off, just be careful when wearing this mask since it does have a lot of negative effects. Hopefully, these tests have broadened your knowledge and made you think twice before choosing what you will go out with so you can help the environment, save money and protect yourself and others.