

# The Most Effective Way to Wash your hands

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### 1.1 - My Broader Topic and Main Aim

Throughout this project, I want to look at the topic of hygiene and how to improve the way in which we clean our hands.

My main aim for this project is to find out what is the best way of washing your hands by finding out which method of cleaning results in the least bacteria being left on your hands after washing.

### 1.2 - Smaller Steps and Objectives

First, I'm going to research the most popular methods of washing hands using a survey. This means that I will be able to apply my findings to the majority of people. Then, I will perform my experiment, where I will find which of the products results in the least amount of bacteria left on my hands. Finally, I will write up my investigation and make conclusions overall.

### 1.3 - The Wider Purpose of My Project

My project is intended to be used to improve our community's hygiene levels. This will hopefully result in a healthier working environment if everyone had clean hands after doing dirty activities like going to the toilet. Improved hygiene has been shown to slow the spread of diseases, researchers in London claim that a million deaths a year could be prevented if everyone washed their hands<sup>1</sup>. If we knew the best method of washing, we could help to prevent diseases spreading round schools as well.

### 1.4 - Historical Significance of sanitation

We are lucky to live in this day and age, because we not only have the knowledge around hand washing, but we have ample opportunities to wash our hands, which we often don't take. In the past, just over 150 years ago, the idea that hands should be washed to protect against infection was not only unproved, but medical professionals ridiculed it, because it was suggested that they were the cause of their patients' minor infections. In the 1970s, an estimated 10.5 in every 1000 births would result in maternal death immediately, many more from the longer infections. In the late 1700s, Alexander Gordon first suggested that rather being caused by vapours in the air, the birthing infections were transferred from patient to patient through the doctors, who used the same tools and didn't wash their hands between patients. Gordon himself admitted that he must have been the cause of many deaths on his ward. Gordon was expelled from the scientific community for his discovery and he joined the navy. In 50 years, Semmelweis continued this idea. He performed an experiment where he sprayed carbolic acid on his tools, on wounds and on his hands to kill the germs. After continually, successfully, performing many operations, the scientific community was forced to accept that it was their germs that lead to the infections. Carbolic acid was then replaced by better, more effective methods of sterilisation. However far we've come, though, we still have far to go, because now, even though we know about the dangers of unwashed hands, we still don't wash our hands as often as we should.

### 1.5 - Global significance of sanitation

Even now-a-days, in countries round the world, millions have no access to clean water or sanitation facilities. In the world, 31% of schools do not have access to clean drinking water, 34% of all schools do not have decent toilets and 900 million children lack good hygiene facilities. This, as well as putting millions at risk of deadly diseases like diarrhoea, results in girls missing one week in every month, as there are inadequate facilities (1 in 3 girls in South Asia miss school every four weeks). Around 429,000 children under the age of 14 (289,000 under the age of 5) die of diarrhoea every

<sup>1</sup>A study published in the Tropical Medicine and International Health Journal in 2006

year due to poor sanitation. This demonstrates how important it is not only to take the opportunities of hand washing that we have in our privileged culture, but to work towards global sanitation.

Sources for 1.4 and 1.5:

<https://www.smithsonianmag.com/smart-news/idea-sterilizing-surgical-instruments-only-150-years-old-180962498/>

<https://www.wateraid.org/uk/media/back-to-school-young-children-most-at-risk-from-lack-of-water-sanitation-and-hygiene-in>

<https://www.wateraid.org/uk/media/the-crisis-in-the-classroom-620-million-childrens-education-and-health-compromised-by-lack-of>

### 1.6 - Why Do I Want To Do This?

I want to do this because I feel as if there is a lack of knowledge about the topic in secondary schools across the country and more should be being done to prevent common infections being spread quickly round schools due to a lack of hygiene regulations. For example, in a study of 457 children, only 72% of boys, and 87% of girls say that they wash their hands after going to the toilet, and 27% of secondary school boys didn't use soap when they did wash their hands. Pathogens can be spread very easily through contact with infected people, but also through surfaces infected people have touched with unwashed hands. The ease of this transmission means that once one student is ill in a school, without proper sanitation, many more will fall ill, and they will all miss school, resulting in a poorer education. The government has estimated that illness accounts for over half of all absences<sup>2</sup>, and those rates are growing, despite the scientific community's advancement in knowledge on the spread and prevention of such illnesses. For example, diarrhoea is spread in schools, because if one person gets ill and doesn't wash their hands properly after going to the toilet, they will have the bacteria on their hands, and everything they touch could contain enough germs to infect other students. Because we live in a time and place that means that we have the opportunity to reduce illness through sanitation, we should make the most of it and raise awareness around schools.

### 1.7 - How Could I Do This?

To collect my data, I could:

- Set up an online survey.
- Ask people face to face.
- Pin up a questionnaire on boards around school.
- Check what people think on the internet, as their views may be interesting as well.

I think the most reliable way is to set up an online survey, as it's anonymous, so people won't feel pressured into saying things, and more people will have access to it than a questionnaire, for example. It also means that I will get a more diverse test group as I won't just ask those who I know.

There are lots of different methods I could use to test the effectiveness of different ways of washing your hand. I could:

- Place my hand onto some agar jelly, to show the original state of my hand. Then, I would try one method of washing and place my hand on a separate dish of agar jelly. I would wait a week and then see the results on the jelly, and repeat with another method of hand washing, insuring that my hands are approximately as dirty as they were when the previous experiment was done. To work out the effectiveness, I could count the number of bacterial colonies on the jelly after a week.

<sup>2</sup>[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/787463/Absence\\_3term\\_201718\\_Text.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787463/Absence_3term_201718_Text.pdf)

- Use Glo Germ, a product that will glow under UV light to simulate germs, and perform each experiment on different days to insure that other methods of hand washing aren't influencing the outcome. I will take photos of my hand before the hand washing but with Glo Germ on (so I have something to compare my final results to). Then, I will wash my hands with the different methods and take photos of the results. I can then inspect and compare the different photos to see the biggest change. To make sure my results are reliable, I will make sure I use similar quantities of Glo Germ each experiment. This is my control variable.
- Use Glo Germ as the indicator as to the number of germs on the hand, but use multiple people at once, each one with a different method of washing their hands, to get the results quicker.

I think I will use Glo Germ to test, because it is a quicker and easier to use, there is also less room for contamination. I will perform each test on just me, so I can regulate the technique of handwashing, as that will affect the validity of my conclusions. Also, using the first method could result in the accidental growth of pathogens, which could be transmitted if not careful.

My control variables are going to be the time I spend washing my hands and the technique I use to wash them. This will mean that only one variable is affecting the dependent variable, which is the Glo Germ left on my hand, and the results of my experiment will show which method is the best.

### 1.8 - Research and Planning

I looked online, and many people have done projects like mine before, washing their hands with Glo Germ and photographing the results. However, my project is more specialised as it will be looking at the methods of washing our hands that our school uses, so I will be able to produce a more specialised result. Also, some of them used the same technique as me, but they investigated different things, like which areas are the hardest to wash. I have looked at how to effectively use Glo Germ at <http://www.glogerm.com/>. I also checked whether temperature effected the outcome, but temperatures would have to be so high to make a difference would burn my hands if I washed for over 30 seconds.

### 1.9 - My Time Management

Planned time management:

Topic:	Hours Assigned:
Researching	9
Planning	5
Doing my project	8
Conclusions	8

My final time sheet:

Day/Date	Time (mins)	Achieved
Mon 16/4/18	45	I have decided on my project idea and worked out my steps for the future.
Mon 23/4/18	45	I have started to plan my method and thought and researched my wider aim.
Mon 14/5/18	45	I have researched around my topic and come up with my final method.
Mon 11/6/18	45	I have set up my survey online and written my Risk Assessment for the experiment
Mon 18/6/18	45	I have researched around my topic and collected the results of my survey into a table

Mon 25/6/18	45	I completed my risk assessment and researched the topic more.
Mon 24/9/18	30	I have done my table and decided on the methods that I will use.
Mon 1/10/18	45	Researching products available and ordering them.
Mon 8/10/18	60	Performing my experiment.
Mon 29/10/18	60	Performing and writing up my experiment.
Mon 5/11/18	45	Writing my conclusion.
Mon 9/11/18	45	Researching the science behind my results.
Mon 19/11/18	45	Researching the uses of different sanitation items.
Wed 21/11/18	30	Researching the spread of illness in schools.
Mon 26/11/18	45	Establishing my steps in order to achieve my main aim.
Mon 10/12/18	45	Starting to research surveying and planning my survey.
Mon 17/12/18	60	Researching Techniques used in schools and hospitals.
Mon 7/1/19	45	Planning and preparing equipment lists and risk assessments for my experiment.
Mon 21/1/19	45	Planning my questions for my second survey.
Mon 28/1/19	45	Researching the history of sanitation.
Mon 11/2/19	45	Researching the global importance of sanitation.
Mon 25/2/19	45	Background research.
Mon 11/3/19	60	I started to complete my survey.
Mon 18/3/19	45	I continued with my survey.
Mon 25/3/19	45	I continued with my survey.
Mon 13/4/19	45	I completed my survey and writing up of results.
Mon 10/5/19	45	I formatted my Workbook (Due to the torch having broken - see 7.3).
Mon 24/6/19	45	I performed my experiment with Glo Germ.
Mon 1/7/19	45	I performed my experiment with Glo Germ again to ensure accuracy.
Mon 08/7/19	45	I prepared & sorted my photos.
Tue 17/9/19	45	I organised the results onto my workbook.
Tue 24/9/19	45	I reorganised my photos.
Tue 01/10/19	45	I reorganised my photos.
Tue 8/10/19	45	I started to write my conclusion.
Tue 15/10/19	45	I finished my conclusion.
Tue 19/11/19	45	I took photos for and made my poster.
Tue 26/11/19	45	I finished my poster, printed it out and distributed it.
Tue 10/12/19	45	I was finishing my workbook.
Tue 17/12/19	45	I was finishing my workbook.
Tue 28/01/20	45	Ensuring I had fulfilled the criteria.
Tue 4/02/20	45	Ensuring I fulfilled my criteria.
Tue 11/02/20	45	Finalising my workbook.
Total Time (h)	32	

### 1.10 - Risk Assessment

Because Glo Germ is inedible, I will make sure I don't put my hands in my mouth or on a surface that would result in it getting ingested, like a packed lunch box. I will also make sure not to rub my eyes as it will irritate them. After the experiment, I will wash my hands thoroughly to ensure no residue is left on my hands. For my survey, I will make sure that only those who I send it to can see it, to protect me online. In addition, I will only use a weak UV torch, so as not to damage my skin when it's under the light and UV light is ionising radiation, so could cause burns/skin cancer.

### 1.11 - Ethical Issues Assessment

Glo Germ is toxic, so I will use as little as possible to get a result, as all of it will be washed into sinks, which could lead into waterways where there are living species. I will also do as few tests as possible in order to draw my conclusions, as unnecessary testing will lead to high quantities of Glo Germ in waterways. I will ensure that the tap is turned off fully between each experiment, to avoid wasting water.

### 2.1 - Equipment list

- Computer - To set up the online survey. (School)
- Glo Germ (Internet)
- Tap/Water source (School)
- Soap (School)
- Paper towels (School)
- Camera (Home)
- A dark cupboard/room (School)
- Tap (School)
- UV light (Internet)

All of these I can bring from home, purchase from the internet, or find at school.

### 2.2 - Background Research

I used <https://www.cdc.gov/handwashing/why-handwashing.html> to help me to understand the significance of washing hands and the risks associated. It explained that germs, like the norovirus, are in faeces, which not only can get onto hands after going to the toilet, but after things like handling meat, as it contains trace amounts of animal faeces. It listed the statistics of hand washing and how it reduces the spread of disease, like the fact that by washing their hands, students in school miss 29-57% less school due to gastrointestinal diseases. It also explained why, by washing your hands, you reduce antibacterial resistance, as fewer unnecessary antibiotics are used, and overuse of antibiotics is a main cause of bacterial resistance. The site <http://www.glogerm.com/> has helped me to know how to use Glo Germ properly, both the technique of using a coin sized amount of Glo Germ and how to effectively shine the UV light to show the residue Glo Germ on the hand. Also, I used the site <https://www.glogerm.com/pdf/msds-glogerm-powder.pdf> to find out about the safety measures that I have to take when handling Glo Germ, like not ingesting it or getting it in my eyes. I read <https://www.independent.co.uk/life-style/health-and-families/health-news/school-toilets-are-disgusting-say-pupils-2106969.html> to give me information on the state of hygiene in schools, like how in secondary schools, 42% of students said the soap was only sometimes available.

### 2.3 - Problems

Not many people took my survey when I'd sent them the link, so I sent follow-up emails. Some people suggested methods that weren't practical to do in class, like washing with boiling water, so I had to ask them to choose a different best method in order to perform the experiment. Also, when I dry my hands, I don't want to cover a towel in Glo Germ, so I will have to use disposable tissues. In addition, when my hands were wet because I only shook them dry, that reflected some of the light back to, so it looked as if there was Glo Germ there when there wasn't. Also, the camera I am using can only focus on one area of the hand when taking a photo, so I will have to take several photos to show my whole hand.

## 2.4 - Prediction

I predict that washing with soap and water and toweeling it dry will be the most effective method while washing with just water and shaking dry will be the least effective method for getting the Glo Germ off my hands.

## 3.1 - My Survey Results

Methods Of Washing Hands Generally	Number of People
Tap Water and Soap	III
Tap Water	I

Method Of Washing Hands Before a Meal	Number of People
Tap Water and Soap	I
None	II
Antibacterial Hand Wash	I

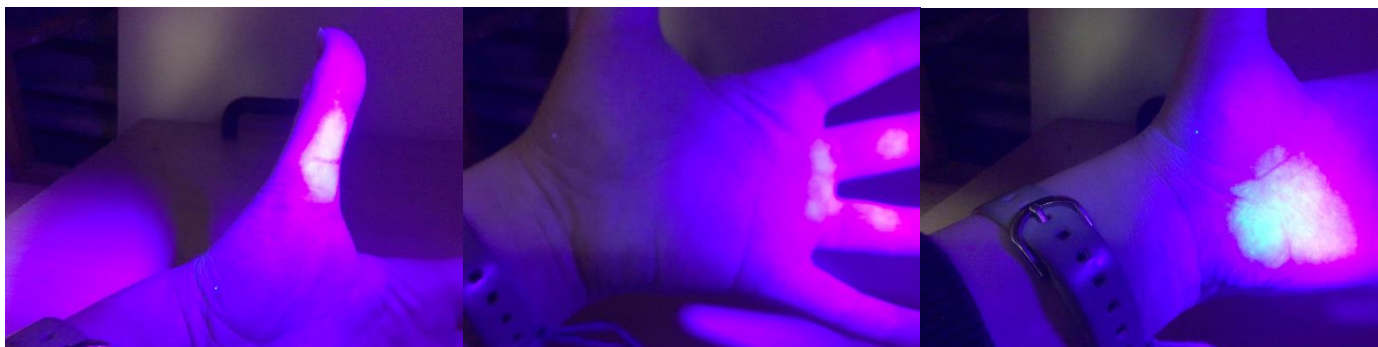
Best Method?	Number of People
Anti-Bacterial Hand Wash	I
Tap Water and Soap	I
Hot Water and Soap	II

## 3.2 - My Hand Washing Result

Before:



Tap water and soap with towel:





Tap water and soap shake dry:



Tap water shake dry:



Tap water with towel:

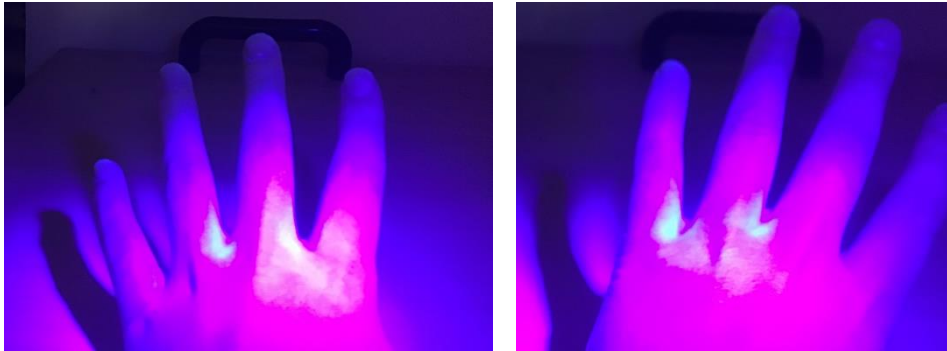


### 3.3 - Unexpected Results

I found that the tap I used for my experiment, when I used my UV torch on it was also covered in Glo Germ:



I also noticed that even after I'd washed my hands several times after the experiment, the areas between my fingers still had Glo Germ on them:



### 3.4 - Conclusion

In conclusion, no method of hand washing removed all of the germs, but using both soap and a towel improved the amount of Glo Germ removed from my hands, and just using soap and not a towel was more effective than just using a towel without soap, as when I used soap but no towel, more Glo Germ was removed than when I just used a towel. This matched my prediction because the most effective one, where the least amount of Glo Germ was left on my hands, was the experiment with both soap and a towel and the least effective one was the one where I used neither.

This is because soap has a chain-like structure that allows one end of it to bind to the oil and the other end to water molecules, lowering the surface tension, making it a surfactant. This allows the water to mix with the oil on our skin - which traps both Glo Germ and pathogens - and wash it away. Water alone can't wash away the oil, dirt and whatever else is trapped in them, but with soap, it is much more effective. Also, if you don't use a towel, you could leave germs on your hands as the water containing the bacteria would not have been washed off and the spread of bacteria wouldn't be prevented. Also, wet hands pick up and transfer germs easier than dry hands will, so even though this is not clear in my experiment, using a towel is also better because it leads to less germs transferred.

My conclusion fulfilled my main aim, because it allowed me to identify the best method for getting germs (as represented by Glo Germ) off my hands, and the result was accurate because I controlled the other variables and my results made sense with what science would suggest.

Sources: <https://www.quora.com/When-taking-a-shower-why-do-we-use-soap>;  
<http://www.madsci.org/posts/archives/1999-10/941028142.Ch.r.html>

### 4.1 - Follow Up

After my original experiment, I noticed that some areas, like between my fingers and at the base of my thumb, has more Glo Germ independent of the method of hand washing. This made me think that different techniques of washing my hands that would cover all the areas of my hands would be more effective at preventing the spread of disease. In some schools, they put posters which recommend different techniques of washing, making sure that the children will use effective techniques, and I thought that this was a good idea, as long as the technique recommended works. Therefore, I decided to perform a second experiment to determine the best techniques to wash hands, to further my aim of decreasing the spread of disease in schools.

#### 4.2 - Smaller Steps and Objectives

First, I am going to look at techniques that schools recommend, and how other people in school wash their hands, so I can get a wide range of data points to ensure that I can find the best technique, despite not knowing lots of different methods myself. Then, I will test each technique and reach a conclusion. Finally, I will implement my research into the school community.

#### 4.3 - How I Will Perform My Experiment

For my survey, I will use a different method of collecting data that in my previous experiment because my previous method wasn't very effective as many people didn't complete my survey. Instead, I could perform a cross-sectional survey and ask face to face a random selection of people to ensure I get many responses that represent many types of people in our school. I will also search about techniques recommended in other schools to broaden my options.

I will use my previous technique of applying and recording the levels of Glo Germ on my hands as this was extremely effective at conveying my results as well as being easy to record and perform. I also won't face the problem of reflecting water appearing as Glo Germ, as I will use a towel in every experiment, so no residue water will be left on my hand. However, instead of changing the method of washing (I will use soap and a towel as this has proven the most effective method) I will use the data from my survey to make a list of the most popular and widely used techniques for washing hands to use as my independent variable. This will also, therefore, effect the time taken the wash hands, as different methods take different amounts of time. I will be recording the levels on different parts of my hands to ensure that no parts, possibly with different levels of Glo Germ, are left out of the results. I will document the Glo Germ left on my hands in 6 key places: palm; inside fingertips; base of thumb (or thenar); between fingers; wrist and under the nails. This will ensure that I can tell the best method for all areas, not just those most visible in a whole hand picture. In my previous experiment, the areas of the hand that were photographed didn't cover the whole hand, so I will use these key parts to ensure my results do cover the whole of my hand. Also in my previous experiment, the before and after photos were generic, and some variation may have occurred between applications, because while I applied equal amounts of Glo Germ each time, they may have been unevenly spread around my hand. To fix this, I will take before and after pictures for every experiment, to make comparisons easier.

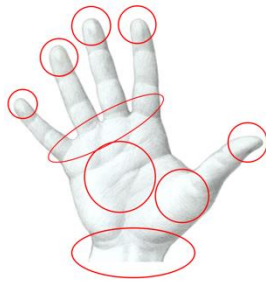
I will also photograph my hands before each hand washing, as different amounts of Glo Germ may have been applied, so the results can be compared fairly as the change, rather than just the final value.

The dependent variable is that amount of Glo Germ left on different parts of my hand after washing.

My control variables are that the same amount of soap is used each time and a clean towel is used each time.

Using this method means that the risk assessment and ethical issues assessment for both parts of my overall experiment will be the same, as it carries the same risks as before, except as the survey is person to person, I don't need to consider internet safety.

The 6 Key Areas:



(Under the nails can't be seen on the diagram)

#### 4.4 - Research and Planning

I searched online and while many people have looked at similar factors like time, or used different methods, like using agar jelly. While agar jelly is good for evaluating the number of real germs on hands, it isn't as effective for my experiment as you can't tell the different areas of the hand apart as easily when you use a swab. Another school that had done a similar experiment over a longer period of time (using agar) found that the hand washing had decreased school absences due to illness by 71%, which shows that this is helpful for students in schools, and what a big impact it can have on the community.

#### 5.1 - Equipment list

For my survey:

- Paper
- Pencil
- Printer
- Camera
- Computer
- Volunteers to participate in the survey

For my experiment:

- Glo Germ
- Soap
- Paper towels
- Camera
- A dark cupboard or a dark room
- Tap
- UV light

I have all of these from my previous experiment, or can find easily around school.

#### 5.2 - Background Research:

I have researched the best techniques that other schools and organisations, using <https://www.nhs.uk/live-well/healthy-body/best-way-to-wash-your-hands/> to find out the technique recommended by doctors, which I will also use in my results. I also used the background research I gained from my previous experiment, as the significance and equipment for my experiments are the same, so the information needed is the same. I also researched experiments similar to mine, like one that was documented on <https://www.dailymail.co.uk/health/article-3269827/How-clean-hands-answer-revealed-unique-experiment-shock-change-wash.html> which

was similar to mine, but they focused more on the time, rather than the technique, and its effectiveness for washing hands. I also researched the key areas that should be checked during my experiment on <http://www.absolutecleanonline.com/wash-your-hands-from-dirtiest-to-cleanest-areas>.

### 5.3 - Survey questions:

For my survey, I need to ensure that I get the best possible answers from people, so I can accurately perform their technique, however, I will have to group similar techniques together as otherwise they would yield very similar results and would mean that it is less clear which is the most popular technique, as there are so many options. Additionally, I will use a camera to film them imitating their technique before classifying it to ensure that I accurately mirror their technique. With a verbally described technique, there is a risk that I might accidentally misinterpret it and do a technique that is more or less effective than theirs.

Q1 - My first question will be 'How long do you wash your hands for on average?' This should allow me to differentiate more between the methods and to replicate them easier.

Q2 - Then, I will ask them to imitate their normal technique under a camera. This will allow me to describe each one with continuity, so similar methods are described similarly and differences are specified clearly in my write up so I can accurately come to a conclusion. I will break their method down into basic steps to allow for comparison to other school's recommended methods, which are also written in a step-by-step method.

Q3 - Finally, to find out for my wider aim, I will ask them 'How often do you wash your hands on an average school day?'. This should help me to get a better idea as to the numbers of people who need to have better sanitation and I'll get a bigger idea of average sanitation in the school.

### 6.1 - Survey results

As I can't insert the videos into the Workbook, I will instead insert pictures from each step of their technique and add captions to each one so that my methods will be clear, and repeatable so I can repeat my experiment if necessary.

#### Person 1:

A1: Around 5-10s

A3: Around 10 times (depending on how often they go to the toilet.)

#### Person 2:

A1: 10s

A3: 5 times

#### Person 3:

A1: 7s

A3: 4/5 times

#### Person 4:

A1: 2

A3: 6 times

#### Recommended:

A1: 30s

A3: At least 6 times, but 10 times is optimum.

### Techniques:

I then took a tally as to who used which method demonstrated by the interviewees, interviewing different people. (Person 2 and Person 3 had a very similar technique, so I combined them). The number of people I interviewed who used a certain technique is in brackets.

#### 1 (II):

- a. Palms rubbed together.
- b. Knuckles rubbed to palms.
- c. Fingers rubbed up and down flat hand.
- d. Fingers rubbed to back of hands parallel to the body.
- e. Inside of hand rubbed to outside of hands.

#### 2(I):

*\*This is the technique I used for my previous experiment*

- a. Cupped hand rubbed over fists.
- b. Cupped hand rubbed over fingers
- c. Left inside fingers rubbed between right fingers.
- d. Right inside fingers rubbed between left fingers.

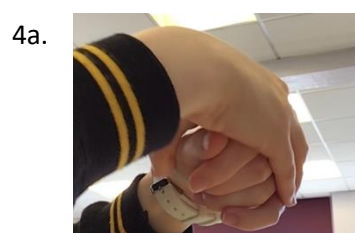
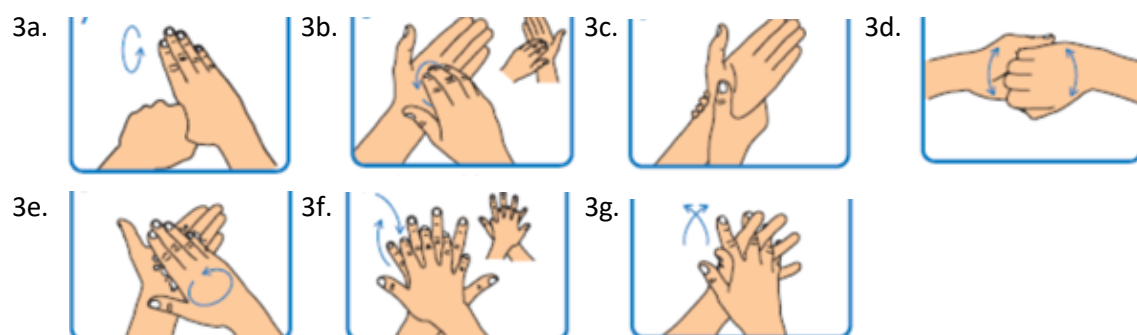
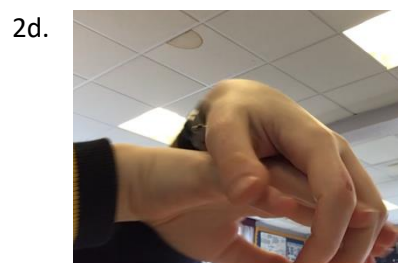
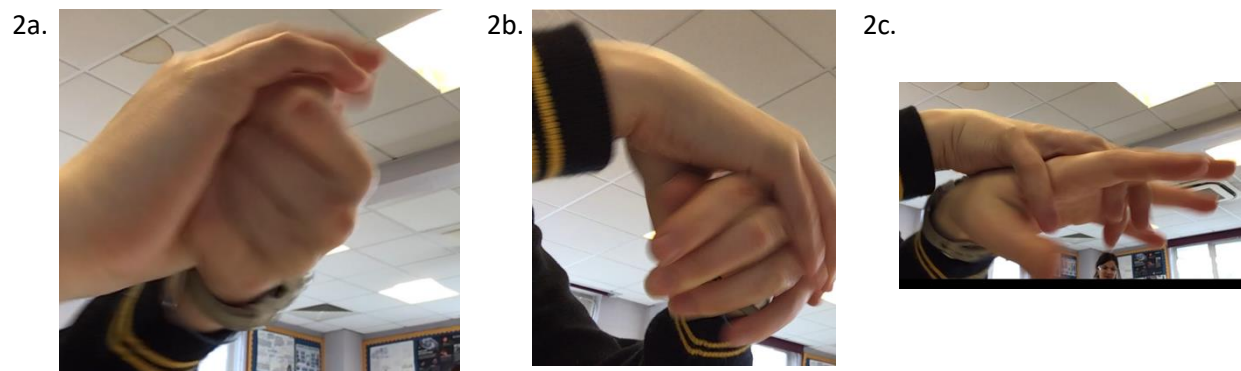
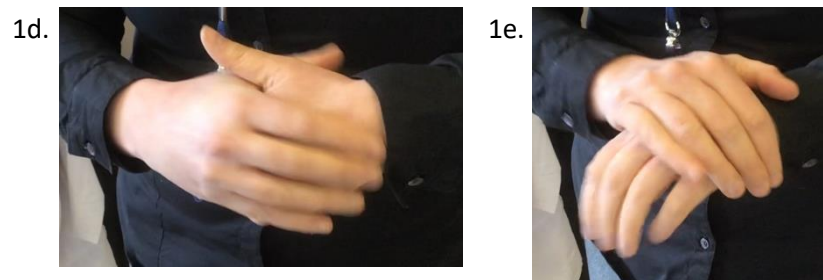
#### 3 (NHS):

- a. Rub hands palm to palm.
- b. Rub back of hand with palm of other hand with fingers interlocked.
- c. Rub palm to palm with fingers interlocked.
- d. Rub with back of fingers to opposing palms with fingers interlocked.
- e. Rub each thumb clasped in opposite hand using a rotational movement.
- f. Rub tips of fingers in opposite palm in a circular motion.
- g. Rub each wrist with opposite hand.

#### 4 (III):

- a. Rub hands together in a circular motion, going over the knuckles and under the palm.





## 6.2 - Prediction


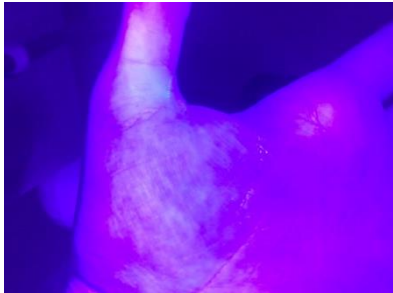




I predict that the NHS version will cause the most Glo Germ to be removed from the most places, whereas techniques 1 and 2 will remove the same amount of Glo Germ, but from fewer places, while technique 4 will remove very little Glo Germ from very few places. I think that the palm and the inside of the fingertips will be the cleanest places of all the experiments, while under the nails will be the dirtiest area.

## 7.1 - Results

With my previous experiment, it was quite hard to see what had happened to the Glo Germ, as a direct comparison was hard. This time, I will lay out my results in a more user friendly way, so it's easier to see my how I reached my conclusion from my results.


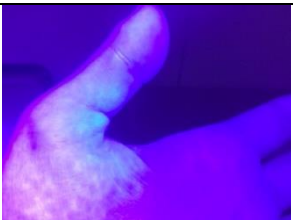

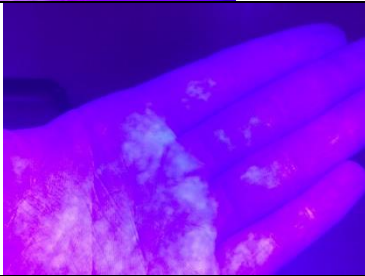





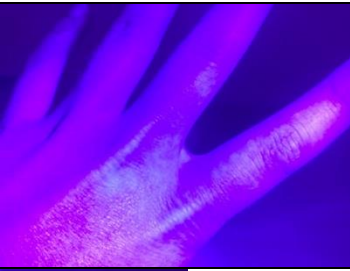


1<sup>st</sup> Experiment:

1:

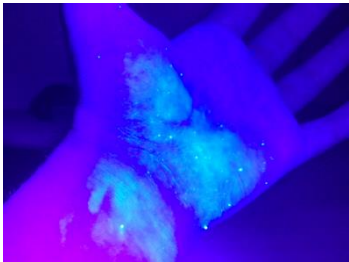


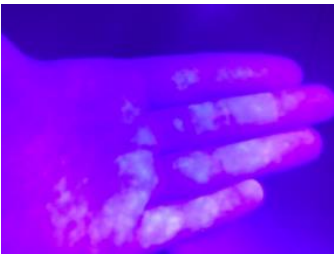

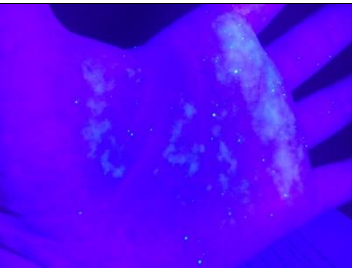
Before	After
	
	
	




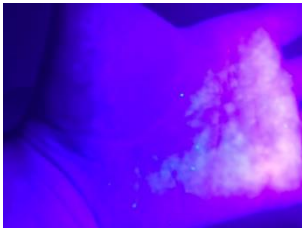

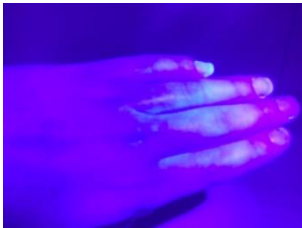




2:

Before		After	
			
			
			
			
			
			

3:

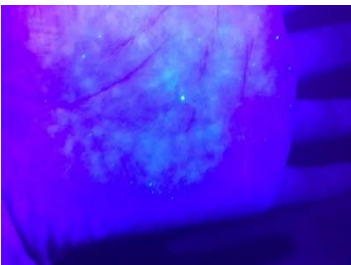

Before	After
	
	
	
	
	

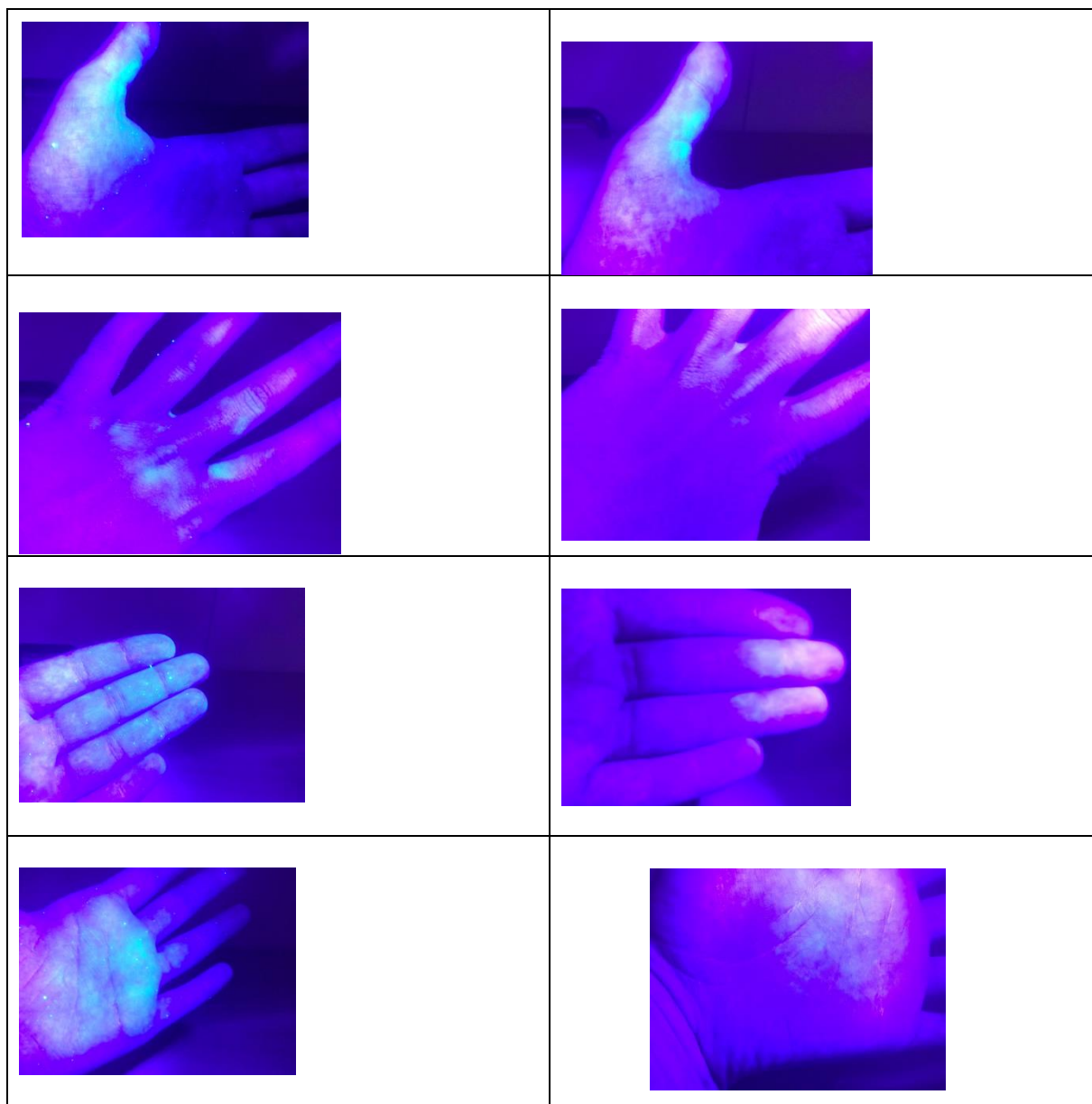
4:

Before	After
	
	
	
	

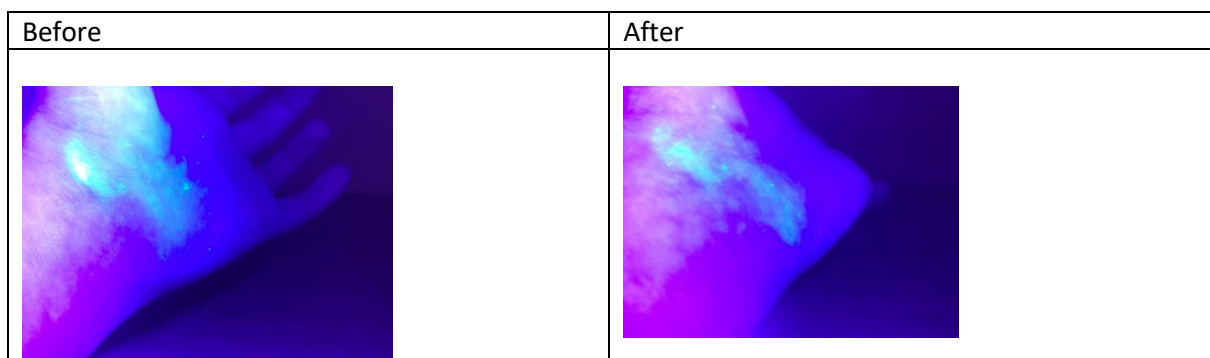
2<sup>nd</sup> Experiment:

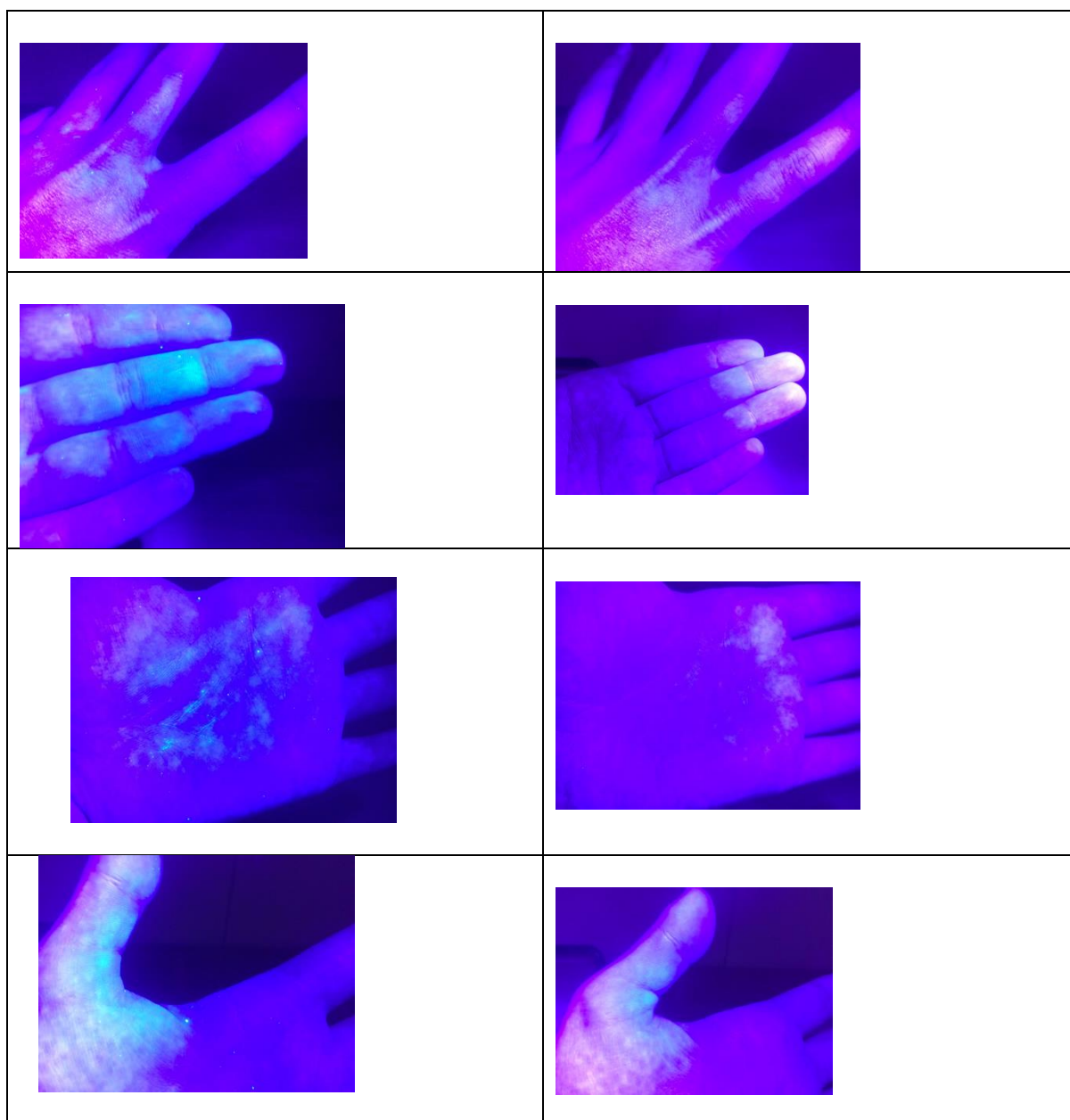
1:

Before	After
	

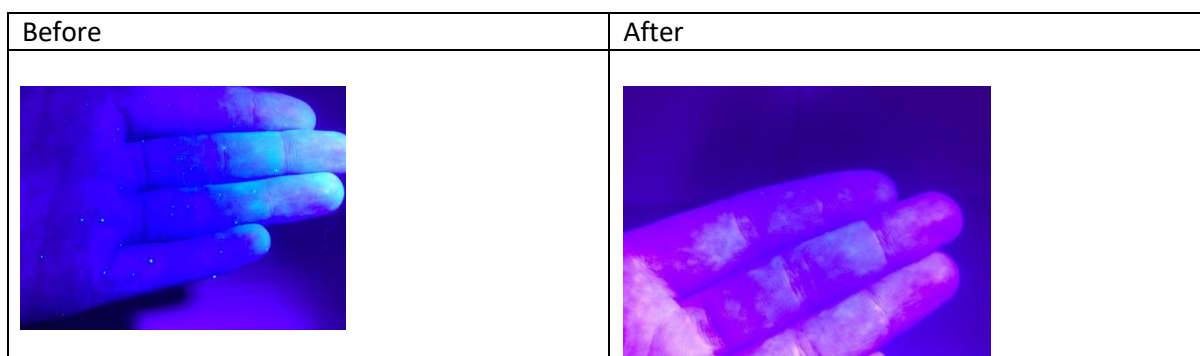


2:

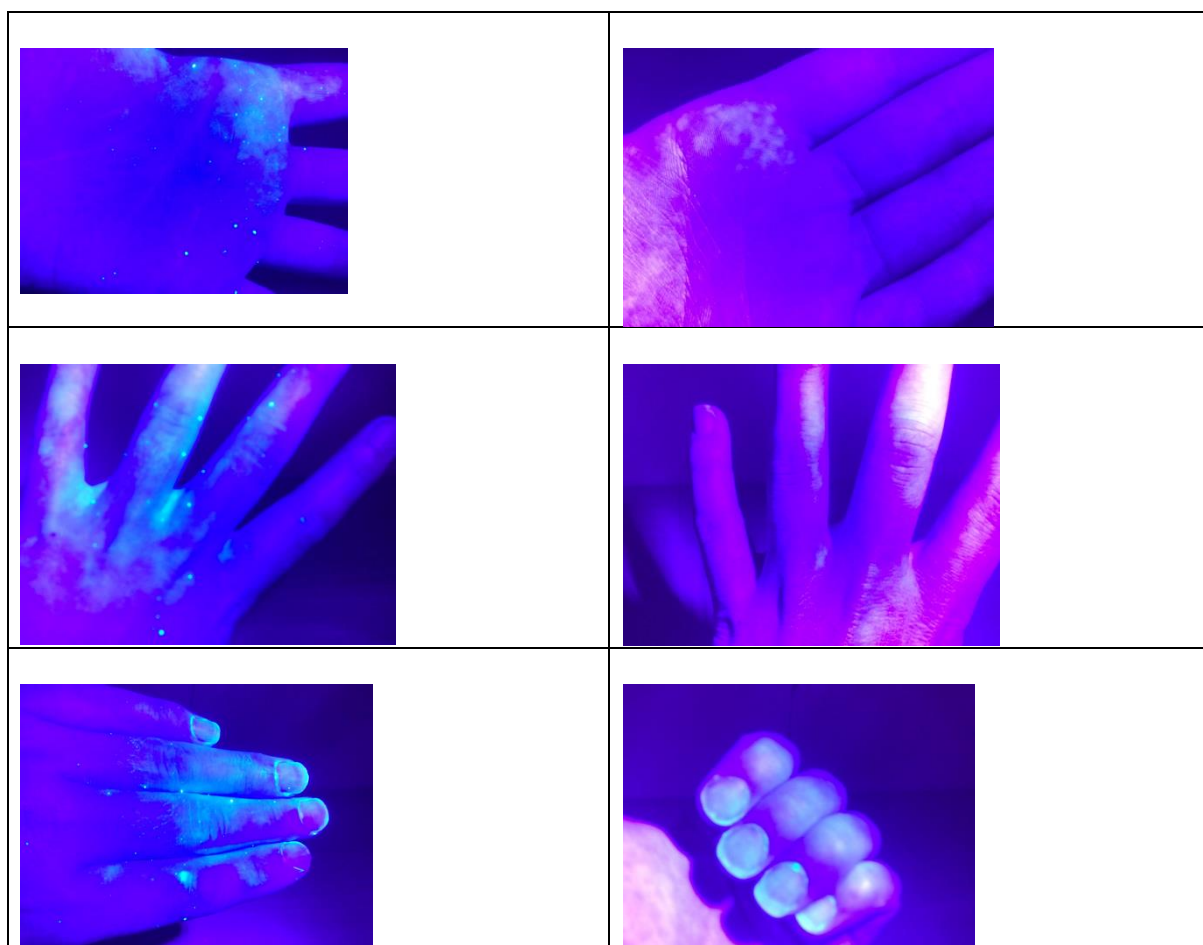




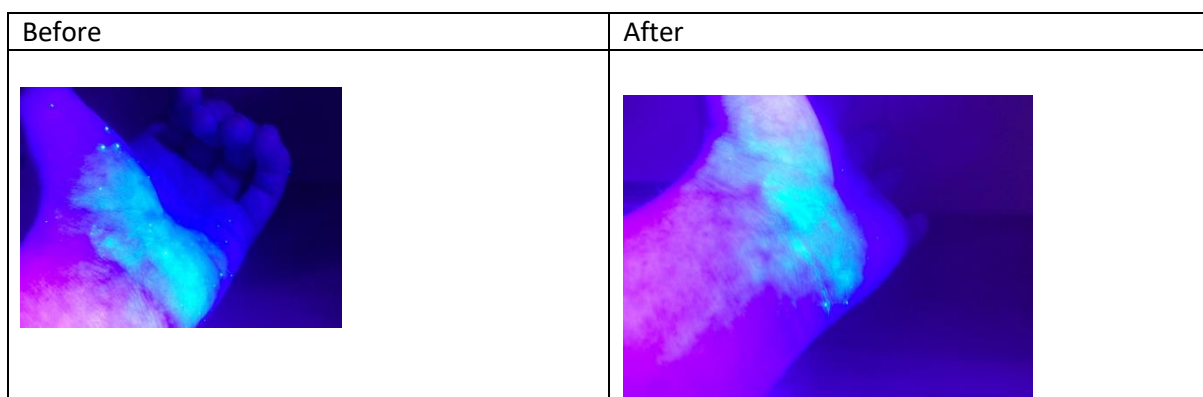
3:

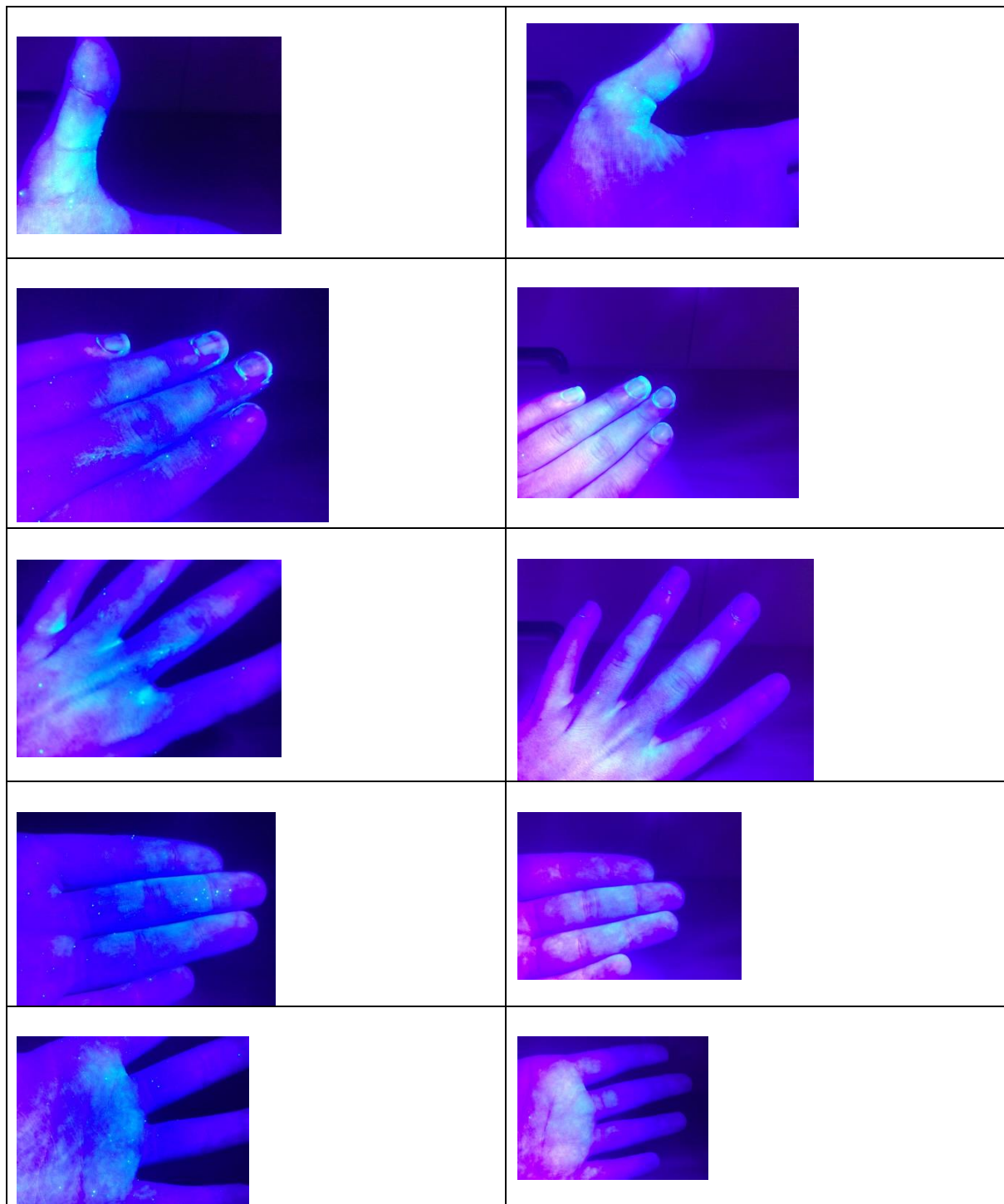






4:





## 7.2 - Conclusions

As the pictures show, the fourth technique has clearly taken the least of the Glo Germ of the hand both times, which agrees with my hypothesis. This is because the soap isn't rubbed into the hand, so fewer germs are washed from the hand. As I said before, Glo Germ is held onto the hand by the oil. While soap and water is a good way of getting the oil off your hand, it's the contact between the water/soap and the oil that removes the oil, rather than the fact that the soap touches the hand. If the soap/water isn't rubbed against an area, the oil won't come off, and neither will the Glo Germ in

it. As Glo Germ represents germs, this means that areas that aren't vigorously rubbed during handwashing aren't cleaned of pathogens. Because technique four involved rubbing the fewest areas and the shortest time washing, so the fewest 'germs' are removed. Technique one was the second least effective, as it too covered fewer areas of the hand and in a shorter amount of time than the other two, it only took a bit of the Glo Germ off, especially not around the thumb and the fingernails, where it didn't rub as thoroughly as the other areas (like the palm of the hand). This was then followed by technique two, and the most effective one was technique three, which consistently removed the most Glo Germ from a wide range of areas (although due to photo quality, some of those areas can't be seen in the above tables). This agreed with my hypothesis. This was unsurprising, as this is the NHS recommended version, and they are professionals in health matters, as well as investing a lot of money into finding the perfect technique. None of the techniques, though, removed much Glo Germ from the wrist, but this is a less important area to clean as not only does it not touch food we are eating or stuff we are holding, but it doesn't touch other people when we touch them, so keeping it clean is less important when our concern is the spread of germs in schools. Although, all the techniques removed at least some of the Glo Germ, it shows that it is worth, even when you're in a hurry, sparing a little time to wash your hands, whatever the technique, is useful.

The fact that the non-recommended techniques were ineffective, but still all of those interviewed used them, shows why germs are spread so quickly in schools. My results highlight the importance of using the correct technique and method when washing hands, as using the wrong one won't help clean hands, so the spread of disease will continue. Hopefully, by showing the school the correct technique, I can reduce the spread of diseases and reduce the number of days that students take off ill, so we all get a better quality of education.

However, these results may not be fully accurate, as I had to both take the photo and shine the torch onto my hand in the shot, I could only ever get one of my hands into the light, so I couldn't evaluate how effective each method was on both hands, as it may have yielded a slightly different result.

### 7.3 - Problems

My UV torch from my first experiment broke (the battery had leaked and ruined the inside), meaning that I had to delay my experiment until I could obtain another UV torch, as the Glo Germ can only be seen under UV light and the only UV light in my school emitted dangerous levels of ionising radiation, and could have burnt my skin.

Many of the techniques were hard to break down into steps, as washing hands is one continuous motion, rather than many separate motions. To overcome this, I tried to ensure that each step took about the same length of time to perform, to allow for representative methods.

Also, because I compiled my photos in the weeks after performing my experiment, I discovered that some of the photos weren't clear enough, meaning that for some of my techniques, I couldn't accurately measure how much Glo Germ had been removed from certain areas, however, I had enough clear photos to be able to draw results from.

In addition, I had spent a few weeks formatting my photos so that that were easy to look at, but due to Word (the app in which I was compiling my work) crashing, I lost lots of the progress that I'd made, so I spent a lot longer than anticipated on formatting my results, so I had to edit my timesheet to give me more time, but as this didn't require any extra lab time, I could do it.



Another problem was that the NHS method used antibacterial hand gel rather than soap and water, so didn't have the same first or last steps, so I had to think of those myself, which I did by using common sense.

#### 7.4 - Improvements

If I were to repeat both my experiments, I would use many other people's hands rather than my own, because this would solve many problems that I faced, such as photographing both hands and the fact that the method was only performed by me, and I may interpret different techniques and methods differently. By using many people, I would eliminate most of this subjectivity and be able to photograph them, not myself, which is easier. Furthermore, I could use a clamp stand to hold the torch, so I can operate the camera with both hands for clearer shots. I would ensure that compiling my photos happened directly after taking them, so I could redo those that didn't come out clear enough. I could have used a better camera to take photos that didn't solely focus on one area of my hand to get a better idea of the whole hand and it would be much easier to look at my results and draw conclusions, and for others to be able to check my conclusions through reading my results. Also, my data was qualitative and subjective, there were no numbers involved, so the results weren't able to be easily, directly or accurately compared. To solve this, I could use the better camera and divided my hand up into a grid of squares, and count the number of cells change between photo one and two, giving me quantitative data that could be compared and plotted on a graph for a clearer conclusion.

#### 7.5 - Implications for the Wider World

To share this message with my school, I decided to make a tailored poster for my school to show people how to wash their hands. I needed to get these number key points that I learnt across:

- Soap should be applied before hand washing.
- Soap should be applied using NHS technique.
- Hands should be dried using a towel

I needed to include the method, the technique and school specific details. I hope that this will encourage those in my school to wash their hands better, which would result in a drop in the spread of disease in my school.

Here it is:

# How to Wash Your Hands



Wet hands with water



Apply soap



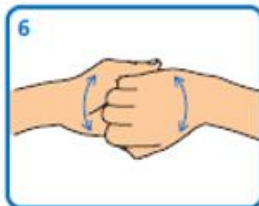
3 Rub hands, palm to palm



4 Rub each hand with palm of other hand with fingers interlaced



5 Rub palm to palm with fingers interlaced



6 Rub with back of fingers to opposing palms with fingers interlocked



7 Rub each thumb clasped in opposite hand using a rotational movement



8 Rub tips of fingers in opposite palm in a circular motion



9 Rub each wrist with opposite hand



Rinse hand with water



Use elbow to turn off tap



Dry thoroughly with a towel



13 Handwashing should take 15 – 30 seconds