Space Food - Teacher Notes

Safety First

Before starting the experiment, check in the school records that the children in the group do not have any food allergies - and also ask the children themselves whether they think they might be allergic to strawberries or milk products.
If it is school policy to do so, make sure you obtain parental consent before the children sample any space food.

About this Activity

This activity involves investigating, sampling and experimenting with some space food.

The activity introduces the children to:

- thinking about practicalities of long distance space travel;
- why some foods are more suitable for space travel than others;
- why some foods last longer than others;
- (optional) the amount of water contained in a strawberry.

Before You Start

Equipment needed:

For Part 1 of the activity – tasting the space food – you will need the following:

- Space food. Your Mission to Mars Science Pack should contain 1 packet of Space Strawberries and 2 packets of Space Ice Cream. This should be sufficient for about 35 pupils to try a little of each. The number of strawberries per packet varies as they are sold by weight, so if there are insufficient you may need to cut a few of the larger strawberries in half. You can purchase additional packets of Space Food from www.profbrainstorm.co.uk or from Amazon or eBay.
- Two bowls or plates - to put the space food on.
- Having a small drink of water available may also be a good idea – just in case some of the pupils do not like the taste of the Space Strawberries!

If you are going to do Part 2 of this experiment – rehydrating a Space Strawberry - you will also need the following:

- 5 or 6 average size Space Strawberries. (Make sure you don't eat them all in the first part of this activity!)
- Mug or cup.
- Digital weighing scales.
- Kitchen paper.
- A calculator (if you are using Worksheets **p2B** and **p2C**).
- A few fresh strawberries of different sizes (if you are using worksheet **p2C**).

Worksheets:

The experiment is in two parts:

- Part 1 - touching and tasting the space food and comparing it with ordinary food. The worksheet for this section is **Space Food p1**.
- Part 2 – rehydrating a Space Strawberry – and trying to determine what proportion of a strawberry is water. There are 2 versions of this activity:

- **Space Food p2A** is a simpler version of the experiment.
- **Space Food p2B** and **p2C** is for children who are confident using fractions and percentages. (The second page of this section, **p2C**, involves more complicated mathematics, but this can be omitted if you wish. The first page of the handout alone describes a complete experiment.)

Preparation:
Before you start you may wish to open the packets of space food and place it on a plate or bowl. You will need to break the Ice Cream up into 'bite size' chunks.
Also, if you are going to do Part 2 of this experiment, you will need to know how many Space Strawberries were in the packet to begin with. So count them – and write the number below so you don't forget!

Number of Space Strawberries in packet .....
*Make sure you **keep the packet** from the Space Strawberries.*

Note – once you have opened the sealed packets, the space food will start to absorb water from the air. If you intend to keep it for more than a day, make sure that it is stored in an airtight container. Once opened you should consume it within a few days.

Pt1 - Examining and Tasting the Space Food
(Worksheet p1)

#1. Space food is ordinary food that has been 'dehydrated'. What does this word mean?
Dehydrated means that all the water has been taken out of the food.
(Note - we use the term in a slightly different sense when we haven't been taking in enough liquids. Although we say that we are dehydrated, our bodies still contain lots of water - but just not quite as much as usual.)
Observant children may notice that the packaging uses the term 'freeze-dried'. This is the process which is used to dehydrate the food. The food is placed in a vacuum chamber, and as pressure in the chamber is reduced, the water in the food evaporates. (You probably know that the boiling point of water is reduced if you go to high altitude – because the air pressure is less. In a vacuum chanber the air pressure is really low, so water can 'boil' at temperatures even colder than 0°C.) This process is also used to dehydrate some common supermarket foods - such as coffee.

#2. Why is it a good idea to take dehydrated food into space?
Pass around one of the Space Strawberries for the children to feel. They should notice that it is much 'lighter' than an ordinary strawberry. (You may like to pass around a similar-sized fresh strawberry for comparison.)
For space travel we need to keep everything as light as possible. Current estimates are that it costs about $20 000 for every kilogram that we send into space! So if we can save even a few kilograms by using dehydrated food, that is a lot of money saved!

Also show the children the best-by-date on the space food packet. (This is printed on the bottom reverse of the packet - and is the American-style format month-day-year. It is

usually easier to read on the Space Strawberry packet.) When you receive the space food the best-by-date should be at least a year ahead.
Dehydrated foods last for a long time. They do not go rotten or mouldy because they have no water in them. (You could also examine the best-by-dates on some other dehydrated foods – such as instant pasta snacks.) Having food products which last a long time is very important on long space missions. For example, with current technology it would take nearly a year to get to Mars.

Now it is time to find out what the space food tastes like. Start by handing out the Space Strawberries.

#3. How is a Space Strawberry different from an ordinary strawberry?
There are several obvious differences. Just from handling it you can feel that it is much lighter than you would expect, and the surface is quite rough. When you bite into it, it is hard and dry, rather than being soft and juicy.
Whilst it does taste like a strawberry, you may notice that the flavour seems to be more concentrated. Some children may say that they are very sweet, but a few may say that they are quite sour. This depends on how ripe the strawberries were when they were freeze-dried. (Unfortunately there does not seem to be any way to identify the sour ones – other than by tasting them!)

Now try the Space Ice Cream.

#4. How is Space Ice Cream different from ordinary ice cream?
The Space Ice Cream is hard and crunchy – although if you keep some in your mouth for a moment, it does start to 'melt' and has a texture quite like ordinary ice cream.
The flavour is quite like ordinary ice cream – although some people say it is more like milk shake.
Also, of course, it is not cold, it does not need to be kept in a freezer, and it does not melt even if it is kept in a warm room.

How Much Water is in a Strawberry?
(Worksheet p2A)

This section is designed for pupils who are not confident in the use of fractions and percentages. In this section I have used the term 'weight' rather than 'mass', as the majority of pupils using this worksheet will not be familiar with the latter term.

#5A. Weighing a Space Strawberry.
This is not as simple as it sounds – because a typical Space Strawberry weighs less than 1 gram, but most digital scales are only accurate to 1 gram. So when you put the strawberry on the scales it will probably still read Zero grams. (Of course, this does not mean that the Space Strawberry weighs nothing!)
One way to solve this problem is to put more Space Strawberries on the scales – one at a time – until the reading changes to 1 gram. (Do not put the strawberries on too quickly. With such small masses it can sometimes take a couple of seconds before the reading on the scale changes.)

It usually needs 3 or 4 Space Strawberries before the reading changes to 1 gram.

#6A. Rehydrating the Space Strawberries.
Now put the 1 gram of Space Strawberries into a cup of water. They will tend to float at first, so push them down gently with your finger so that they are below the water level.
It will only take a few seconds for the Space Strawberries to rehydrate.
Take them out, and allow them to drain on some kitchen paper for a few seconds.
Now weigh them again. (You could now weigh each individual strawberry if you wished, but for the purposes of this experiment it is better to weigh them altogether.)

They should now weigh considerably more than 1 gram. Typically they will probably weigh about 10 grams. The extra weight is obviously due to the water that they have absorbed.

Why did we drain them on kitchen paper before weighing them? This is simply to get rid of any excess water.
If the children are not convinced about the necessity to do this, put the strawberries back in the water, and then place them directly on the scales. You will probably find that they weigh slightly more than before, but when you remove the strawberries from the scales you will find that there is a small puddle of water – and the scales will probably now show a reading of 1 or 2 grams (rather than zero).

#7A. What proportion of a strawberry is just water?
The way in which you answer this will depend on the mathematical knowledge of the children.

When I did the experiment, 1 gram of dehydrated strawberries weighed 9 grams after they were rehydrated, i.e. the water in the strawberries weighs 8 grams. So we could answer that the strawberries are ***8 parts water to 1 part 'strawberry'*** (where I have used 'strawberry' to mean everything that is left when all the water is taken away).

If the children are familiar with simple fractions or simple percentages, then we can make

the maths simpler by saying that the weight of the rehydrated strawberries is ***'about 10 grams'***, and therefore the water content is 'about 9 grams'. So we can see that water makes up about $\frac{9}{10}$ths or 90% of a strawberry.

What do the rehydrated Space Strawberries taste like?

(This is not included on the worksheet as there will probably not be enough rehydrated strawberries for everyone to try.)

Most noticeably, the texture of the rehydrated strawberry is very different from the dehydrated one. However, it still does not have the same texture as a fresh strawberry. It is very soft and mushy – more like a tinned strawberry.

Also, the taste changes slightly. Personally, I think that the rehydrated strawberries taste more like fresh strawberries than they do when they are dehydrated. (Isn't it strange that adding water – which doesn't really have any flavour – can change the flavour of something! Our sense of taste is actually very complex.)

How Much Water is in a Strawberry? (advanced)
(Worksheets p2B and p2C)

The worksheet for this section is quite challenging – and involves a knowledge of fractions and percentages. In this section I have used the term 'mass' on the handouts. If your children are not familiar with this term you can say that it means the same as 'weight'.

#5B. How do you find the mass of a Space Strawberry?
Finding the mass of a Space Strawberry is not as simple as it sounds – because a typical Space Strawberry has a mass of less than 1 gram. Most digital scales are only accurate to 1 gram, so when you put a Space strawberry on the scales the reading will probably be zero grams! Give them a moment to see if any of them can solve this problem.

One way to solve this is to put more Space Strawberries on the scales – one at a time – until the reading changes to 1 gram. (Do not put the strawberries on too quickly. With such small masses it can sometimes take a couple of seconds before the reading on the scale changes.) The mass of a single strawberry is then (approximately) 1 gram divided by the number of strawberries in 1 gram.

An alternative method is to use the information that we know about the whole packet of strawberries. We know that the packet of strawberries has a mass of 14 grams (this is printed on the packet), and we previously wrote down the total number of strawberries in the packet, so we can use these two pieces of information to obtain an estimate of the mass of an individual strawberry.
I have just opened a packet which contains 39 strawberries, so the average mass of the strawberries in my packet is

$$14 \div 39 = 0.36 \text{ grams}$$

(Note – when you work this out on a calculator you get lots of digits in your answer – but most of them are meaningless! What we have really found out is that an average Space Strawberry in this packet has a mass of between 0.3 and 0.4 grams.)

You may get quite different answers using these two methods. The second method should give us a more accurate value for the average mass of a Space Strawberry – because we have taken the average over a larger number of strawberries. But it **does not** give us a more accurate answer for the mass of any particular strawberry!

#6B. Rehydrating the Space Strawberries.
Place some Space Strawberries on the scales – one at a time – until the reading changes to 1 gram. Put your 1 gram of Space Strawberries into a cup of water. They will tend to float at first, so push them down gently with your finger so that they are below the water level. It will only take a few seconds for the Space Strawberries to rehydrate.
Take them out, and allow them to drain on some kitchen paper for a few seconds.
Now weigh them again. (You could now weigh each individual strawberry if you wished, but for the purposes of this experiment it is better to weigh them altogether.)

They should now weigh considerably more than 1 gram. Typically they will probably weigh about 10 grams. The extra weight is obviously due to the water that they have absorbed.

Why did we drain them on kitchen paper before weighing them? This is simply to get rid of any excess water.
If the children are not convinced about the necessity to do this, put the strawberries back in the water, and then place them directly on the scales. You will probably find that they weigh slightly more than before, but when you remove the strawberries from the scales you will find that there is a small puddle of water – and the scales will probably now show a reading of 1 or 2 grams (rather than zero).

#7B. What percentage of a strawberry is just water?
When I did the experiment, 1 gram of dehydrated strawberries weighed 9 grams after they were rehydrated, i.e. the water absorbed by the strawberries has a mass of 8 grams. (You may get slightly different results, but I will use my results to illustrate how we calculate the percentage of water in the strawberry.)
So from these results we can say that a strawberry is $\frac{8}{9}$ ths water (with the remaining $\frac{1}{9}$ th being what is left when it is dehydrated.)
To convert this to a percentage we multiply by 100%,

$$\frac{8}{9} \times 100\% = 89\%$$

So in this case we have found that strawberries are 89% water.

Note – if you want to make the maths simpler we can 'round-up' our measurement, saying that our rehydrated strawberries have a mass of *'about 10 grams'*. So the water content of the strawberries is now $\frac{9}{10}$ths, or 90%. (So the answer is virtually the same!)

What do the rehydrated Space Strawberries taste like?
(This is not included on the worksheet as there will probably not be enough rehydrated strawberries for everyone to try.)
Most noticeably, the texture of the rehydrated strawberry is very different from the dehydrated one. However, it still does not have the same texture as a fresh strawberry. It is very soft and mushy – more like a tinned strawberry.
Also, the taste changes slightly. Personally, I think that the rehydrated strawberries taste more like fresh strawberries than they do when they are dehydrated. (Isn't it strange that adding water – which doesn't really have any flavour – can change the flavour of something! Our sense of taste is actually very complex.)

This provides a convenient place to finish the experiment as it coincides with the end of the **first page** of the **Pt2B** handout. If you want a (mathematically) more challenging activity you can continue with the sections below. (These are on the **second page** of the **Pt2B** handout.)

#8B. An alternative method for estimating the water content of a strawberry.
In this method they are going to compare the mass of a fresh strawberry with that of a Space Strawberry.
When selecting their fresh strawberry, they need to choose one which is about the same size as an average Space Strawberry.

#9B. Comparing the mass of the fresh strawberry with that of an average Space Strawberry.

We have already calculated the mass of an average Space Strawberry in Section 5B.
When I performed the experiment I obtained an average mass of 0.36 grams.
So now you need to **divide** the mass that you obtained for your fresh strawberry by this figure. My fresh strawberry weighs 4 grams, so my calculation is:

$$4 \div 0.36 = 11$$

So in my example, the fresh strawberry has 11 times more mass than the Space Strawberry.

#10B. Use this result to calculate the percentage of a strawberry that is just water.

Using my above results, this suggests that a fresh strawberry is 10 parts water to 1 part 'strawberry', so the percentage of water is

$$\frac{10}{11} \times 100\% = 91\%$$

You may wish to discuss with the pupils why there is some discrepancy between this result and the value calculated in Section 7B. There are several possible reasons:

- The main factor is that we are measuring quantities of just a few grams using scales which are only accurate to 1 gram. For example, I measure the mass of my fresh strawberry as 4 grams, but it could be anywhere between 3.5 grams and 4.5 grams.
- We have chosen a fresh strawberry which looks about the same size as an average Space Strawberry – but this is not a very scientific process. Someone else could think that a different sized strawberry represented a better average.
- We have noticed that the texture of the rehydrated strawberry is quite different to that of a fresh strawberry, so it is quite possible that when it is rehydrated it holds less (or more) water than it did before.

Despite these concerns, the agreement between our results is actually surprisingly good.

