

## **FOSS® NEW PLANTS TEACHER PREPARATION VIDEO TRANSCRIPT**

### ***<Larry Lowery Introduction to FOSS Program>***

Lowery: Hello. Welcome to the Full Option Science System. This program was funded by the National Science Foundation. Its goal was to develop materials that would involve youngsters with both the processes and the content of science.

The program is developed at the Lawrence Hall of Science, with scientists, science educators and teachers working together as a team to develop the materials. The materials are tested in the hands of teachers and children in classrooms. It takes about two years to turn out a module.

Each module begins with firsthand experiences. This is done because it has been found that firsthand experiences are the best way for youngsters to learn about the concepts of science. As the module progresses, children are introduced to abstractions and reading materials. The sequence from firsthand experiences through reading materials is deliberate because it has been found that youngsters, when they have some experience before they read, learn and understand more from the reading. Authors of reading materials can then take youngsters to greater abstractions.

Trust the materials that you are getting acquainted with. They have been well tested. We found that they work extremely well in the hands of all teachers and are effective for youngsters in learning about science.

### ***<Larry Malone Introduction to Module>***

Narrator/Larry Malone: Hi. I'm Larry Malone. And I'll be your guide as we take a brief excursion through the New Plants module. This module is developed for youngsters in Grades 1 and 2 and is built on the premise that no individual plant lives forever. And in order to guarantee that we live in a world filled with plants, there has to be a steady supply of new plants coming along.

Now, if you ask any first and second grader "How do you get a new plant?" they'll doubtless respond "Plant a seed." And certainly that is one way to get a new plant. And we will confirm and expand on that basic concept. But plants have many additional strategies for propagating. And we will explore some of those as this module unfolds.

Now, here on the table in front of me you see the kit for this module, New Plants. In it you'll find most of the equipment needed to conduct all of the activities with up to 32 students. Two other things can be found inside the kit. First of all, the video, which introduces the program. But most important we have the Teacher Guide.

Open your Teacher Guide to the Overview folio which contains many helpful suggestions for getting started. In it are the national standards that are addressed in this module, background information on plants, ideas for organizing your classroom for the investigations and suggestions

for scheduling the activities, which is very important in this module.

The schedule shows how the investigations follow one after the other over a ten-week period. You'll find an overview matrix to help you plan the entire module and integrate it into other areas of your curriculum. In the Materials folio you'll find an inventory list for the kit, lists of any materials you'll need to provide for the investigations, directions for repairing the materials and information on ordering any replacements.

The next four folios are the Investigation folios. These are the heart of the program. The first page gives overview information. The At A Glance chart summarizes the investigation and helps you plan for assessment and extension activities. Next you'll find background information specific to the investigation. And there is a section called Teaching Children About which gives you some insight into research on how children think and learn.

Each investigation has several parts. For each part you'll find a materials list, Getting Ready section, and then step-by-step directions for conducting the activity with your students. The interdisciplinary section in the back of the folio has many ideas for extending the investigation into other areas of your curriculum.

In the next section are the duplication masters. Here you'll find all the student sheets used in the investigations. There are also masters for math extensions and Home/School Connections for each investigation.

There are lots of ways to assess your students' learning as they progress through the investigations. Read through the Module Assessment folio at the back of the Teacher Guide for information about the Formative Assessments, End-of-the-Module Assessments and portfolio suggestions. After the Assessment folio you'll find the duplication masters to help you with assessments. On the Anecdotal Notes you can record your students' insights or the difficulties they run into. The Assessment Checklist is used when assessing specific skills or concepts the students have learned.

In the kit you'll find a class big book and eight matching student books, the FOSS Science Stories for New Plants. These are designed to be read periodically throughout the module after students have had hands-on experience with the activities. The Science Stories folio in the Teacher Guide provides background information and follow-up activities.

Check out the Resources folio near the back of the Teacher's Guide. This annotated list includes both fiction and non-fiction books for student reading, videos, software and teacher resources.

There are a few things to get ready that will be used throughout the module. Make copies of the Anecdotal Notes and Assessment Checklist sheets for assessing student understanding during the investigations. Many teachers write the students' names before making copies. Word Bank and content charts are used to help students remember the new vocabulary and concepts they've learned while the module progresses. Students will add to these charts at the end of each session.

### ***<Investigation 1, Setup>***

Narrator: Now let's take a few minutes and look at the first activity in the module called Brassica Seeds. I'm starting my preparation now to teach the first activity in the module,

Brassica Seeds. I'm surrounded by the materials I've taken out of the kit so let's see what those are. This is the simple basin used to distribute dirt, as we get into the activity. Here is liquid fertilizer used after the plants are growing in the tray. Here a half liter container and the vial that the students use to water the plants initially.

Here are the little cups -- planting cups with drainage holes in the bottom that the students use to plant their brassica seeds. Here are labels that you'll cut apart so that the students can label their own cup of seeds. And here's the plastic cup used to distribute the seeds initially to the students. And here is the all important tiny package of brassica seeds, the central players in this module. All of these small items in this green plastic tray will house the planter cups from each of the students while the brassica plants develop.

Now over here I have a copy of the Growth of Brassica booklet. Each student will keep track of developments in one of these. There's a calendar on the front and places to draw developments as time passes. These were copied from these duplication masters in the back of the Teacher Guide.

Also at the back of the Teacher Guide is this Letter To Parents describing what the students will be investigating and learning as the module progresses. And finally, two brassica pictures that can be used as embedded assessment as the students learn about growing brassica.

Up here I have a copy of the class calendar which is laminated and can be used to keep track of significant events in the life of brassica as they happen. And finally, this lamp and support structure. This all important light source will have to burn 24 hours a day to provide light continuously for the brassica plants as they grow.

Underneath here you'll find two cool white lamps. That doesn't refer to the temperature but the color of the light. It has to be on the blue end of the spectrum. And this frame which obviously is somewhat larger than would fit in the box has to be assembled as part of the activity.

In addition to the items just discussed, there are a few items that you'll have to provide from the classroom or from the local store. A few paper towels of any description, a pair of scissors for cutting the labels apart, a water colored pen for marking on the class calendar, a bag of potting soil for planting the seeds and a container for bringing water to the seed.

Okay. Now it's time to take a look at the assembly required for that light support. I've gone to the kit and gotten out all of the pipes, and this is what I've discovered when I inventory them. Four long ones, six short ones with no hooks, two short ones with hooks and eight corners.

Here is how they go together: Now there's no absolutely right way to do this. You just start putting things together. I'm going to build a square first by putting angles on the end of the short ones like this. So I get something that's approximating a square. Okay. And then I'm going to put one of these pieces in with the hooks. Okay. Like this. Now, that looks pretty good.

Now I'm going to build another one like this. And I'm going to get the hooks on this one so that they face the opposite direction. We'll see why that's important in just a few minutes.

Now -- okay, now I've got two squares. And I'm making sure that the hooks are facing opposite directions. The hooks are toward me here and away from me on this one.

Now I'm going to separate the two squares using the long pipes. Now we're getting there. Now if I were going to actually use this for suspending the lamp, I would bang things together very securely. But I'm going to dispense with that step now.

Here is what I meant by hooks in opposite directions. These are open on the outside of this enclosure now. And these are also open on the outside of the enclosure. That's so when I hang the light in here, I can have easy access to these hooks. And all I do is slide one of the links over the hook here, over the hook here and come down to the other end and do the same kind of an operation.

Now, we use this chain suspension system so that as the plants, which will be positioned underneath the lamp, grow, I can raise the lamp so that they don't impact the lights. So I'll be lifting this up and finding ever and ever shorter lengths to suspend the lamp. That's the system.

### **<Investigation 1, Part 1>**

Narrator: Part 1 is an orientation to the brassica activity. You call the students to the rug. You discuss what the students know about planting seeds. And you introduce the class calendar. Each student gets his or her Growth of Brassica booklet. They put their name on it. And now they are all set to launch into the activities ahead.

### **<Investigation 1, Part 2>**

Narrator: In Part 2, Planting Brassica, you have to do a few preps ahead of time. First of all, you'll need to cut a couple of these sheets of labels into individual labels so that the students can stick them on their cups. Cut a couple of dozen paper towels in half. Dump your soil into two of these basins where the students can scoop it up easily. And finally, distribute the brassica seeds into eight cups.

Here is the little bag of brassica seeds. Shake them down to the bottom, take your scissors and cut the top off of the bag. Here is one I've already cut. Dump the little seeds out on some white paper so they are easily visible. And using your finger, just press down on the seeds to pick them up.

There I've got three. And there's five more. That's eight. That's how many I need in a cup for a group of four students. Repeat until you've got the seeds distributed into eight cups.

Now we're ready to move into the classroom and do some planting. You should be prepared to demonstrate this planting procedure for the students, which they will then do on their own. First each student will get one of these little planting cups with holes in the bottom and a label. And they'll identify their own planting cup. Next they will in turn go to one of the two strategically positioned soil supplies and scoop up a full measure of soil and then level it off and then tap it down.

Teacher: Okay. How many seeds do you get?

Student: Two.

Teacher: Two seeds.

Narrator: They take two of these precious little seeds and place them on the surface of the soil. You then come back to the soil and put just a pinch of soil on top, just enough to cover it. Tap it down.

Teacher: And then you water your plant. But we don't want to get water all over our table so --

Narrator: You're going to place the cup on a folded paper towel. And then taking the vial and the water supply, scoop up one full vial of water and carefully pour it over the surface of the soil. And then finally, each student places the cup in the tray where it will stay until a big giant plant.

Now the students place their tray of brassica plantings underneath the light, making sure it's close to the light but not touching. And then they make a calendar entry so they can remember the date that they planted their brassica seeds. The students from time to time will need to get their tray out from under the lamp. And probably the easiest way to do that is just to get a couple of students to lift the whole framework and slide the tray right out. That's the safest and most convenient way to do this.

Several matters of maintenance must be attended to as the plants grow and mature. First off, any time the tray is dry on the bottom, the plants need to be watered. The way we water the plants is to take one of these half liter containers. And now we're going to add fertilizer each time we water. And I'm going to take this liquid fertilizer and put four drops -- two, three, four -- into the container. And then fill it up right to the top with water. And then simply pour this half liter of water right into the tray with the plants. The water will come up through the drainage holes on the bottom and provide them with the proper moisture that they need for growth.

That concludes Part 2.

### **<Investigation 1, Part 3>**

Narrator: Here we are in Part 3 of the activity. And as you can see, our plants are doing nicely. They've been growing now, oh, it looks like maybe for a week, two weeks, three weeks because I have plants here of several different ages. Now, if you want to grow viable seeds, seeds that you can plant and grow new plants from yet another time, it's necessary to cross pollinate the plants.

So as they grow, it will be necessary to find blooming plants, different plants. And gently bump the flowers together. Flowers from the same plant can't pollinate each other. So they need to cross pollinate. This ensures that the pollen from one plant gets to another and that the seeds that develop will be fertile.

The rest is just left up to time. As the plants grow and mature, the students will make entries in their brassica logs. They'll make entries in the calendar as important events emerge. They will be learning the names and descriptions of the different structures that develop on the plants. After students have completed their drawings, the teacher can use the class calendar to record the events in the development of the brassica plants and to guide discussions at later dates.

Teacher: Anything else? Let's see what we have. We've got flowers. We've got more roots. We've got bigger leaves. And we've got more buds. Any other changes that you noticed since last Friday? Anything else?

Narrator: They will notice the development of seed pods. And I can see on this plant that there are some tiny ones just starting to show. And these will get bigger and bigger. And eventually they will look like little string beans. The little seed pods will start to appear probably after three, three and a half weeks. And they will continue to expand and grow to their full size at about the end of the fourth week.

At that time you can stop watering the plants. And then in short order they will shrivel up and die. And at that time the students will be able to harvest the mature seed pods. Open them up, take out the tiny seeds and these can either be planted immediately to confirm the life cycle or they can be saved for the next class that will engage in the brassica planting activity.

Let's review the development of our brassica plants over time. Here is planting day. After a week we can see the plant is starting to develop nicely with the first leaves. After two weeks pods are forming. After three weeks the plants are in full bloom and the first indication of some little seed pods are fairly visible. And after five weeks the plants have dried up, are dead, the seed pods are mature and inside are the viable seeds that can be planted immediately to restart the life cycle.

And that concludes the first activity, Brassica Seeds. Here are the concepts that students have been introduced to in Investigation 1: Plants are alive; seeds are alive and grow into new plants; plants need water, air, nutrients and light to grow and develop; as plants grow, they develop roots, stems, leaves, buds, flowers and seeds in a sequence called a life cycle; bees and other insects help some plants by moving pollen from flower to flower.

Now that the students have had experience with the concepts, you can introduce the FOSS Science Stories. Students get a lot more out of reading material when the subject matter is familiar.

### **<Investigation 2, Part 1>**

Narrator: In Activity 2, Grass and Grains, the students continue their investigation of seeds. In the first part, they are going to grow some weedy lawns, planting rye grass and alfalfa. In Part 2, they'll mow those lawns to see what happens to the two different plants after mowing. In Part 3, the students will grow a very important grain, an individual wheat seed in a straw. And they'll observe what happens to it over time.

Let's see what equipment we need for Part 1. Now, some of this will look very familiar because it's the same material we used in the first activity. We've got our basin for soil. We need two of those. We've got the tray that the plants will be put in as they grow.

We have some new seeds to plant this time. We have rye grass seeds. And over here are the alfalfa seeds that will function as weeds in the lawns. In the Teacher Guide the alfalfa seeds are not referred to as weeds. But nonetheless, that is their role.

We'll use these plastic cups to distribute the seeds to the students. These small spoons will be used to measure the seeds into the planter cups. And here are the little planting cups, the same ones that were used with the brassica seeds. And the labels that we put on there to identify them.

You'll also get from the kit the half liter container and the small vial so that the students can water their lawns. And for watering the lawns after they are established, we need the fertilizer once again.

In addition to the materials from the kit, the students will each get their Growing a Lawn booklet in which they'll keep records of what happens with their lawn. Additional materials supplied by the teacher include scissors, paper towels, soil -- and this can be the same soil that was used in the brassica seeds activity -- and a supply of water.

Part 1 of the activity starts by calling the students to the rug to have a discussion about lawns to find out what they know about them. In the course of the discussion, the students will probably say that lawns are made out of grass. And you can introduce them to the seeds of the grass plants. You should then be prepared to demonstrate the procedure the students will follow when they plant their lawns and introduce some weed seeds in, as well.

So this is that procedure: Each student gets a cup. Remember, drainage holes, same cup. Puts on a label to identify it. And then scoops up soil in exactly the same way as they did in the first activity, leveling the soil, tapping it down a bit. Make it nice and solidified.

Teacher: Okay. You can start passing them around.

Narrator: And now we're going to add one level spoon of grass seed. And then go to the weed seeds. We're using alfalfa as the weed seeds. And take one pinch and distribute those over the surface of the soil. Now the students return to the soil supply or use a supply that's been brought to their table. And just cover the seeds with a shallow layer of soil. And again, pat it down firmly. Take out one full vial of water and carefully pour it over the surface of the soil.

Now that all of the planting cups are in the tray, the students find a suitable location in the classroom for them to stay. They don't have to be under continuous light as the brassica did. But they do have to have some light so near a window would be ideal. The students observe the emergence of the plants over time marking the calendar and keeping records on their individual sheets. The students should draw a picture of their lawn and they should be invited to speculate about what they think might happen as the plants continue to grow.

*<Investigation 2, Part 2>*

Narrator: Part 2 starts when the plants have grown up to be about six to eight centimeters tall. And I've got a sample right here of what a typical planter might look like after perhaps a week or ten days. A discussion of the results of the growing so far might suggest that the lawn should be mowed. And that's a good idea. That's what we want the students to do.

So the students are invited to mow their weedy lawns. Armed with scissors they are then asked to cut the lawn right even with the top of the planter cup. The students should draw a picture of their mowed lawn and they should be able to speculate about what they think might happen as the plants continue to grow.

Here is a sample of a lawn mowed yesterday. And the students will observe similar results in the classroom as they see the grass continue to grow quite rapidly even after being mowed. But there are no weeds in evidence. None of the broad leaf alfalfa plants. And after a week, they

might see something that looks like this. The grass continues to grow. And a few weeds are still in evidence down in here. But nothing like they were before.

In fact, it's a good idea suggested in the manual that you keep a control, a weedy lawn that is never mowed, so that the students can refer back to what the lawn would have looked like had it never been mowed. If the students look closely, they will see that there's an abundance of weeds growing down in among the grass plants so that the alfalfa plants are succeeding just fine in the environment where they have never been mowed.

The lawns can continue to grow as long as the students have interest in observing what happens each subsequent time they mow the lawn. Or the students might want to take their little lawns home to share with their parents or to plant.

It's easy to remove the lawn from the cup just by grabbing the plants firmly and lifting them right out of the cup. This can then be placed into a paper cup or plastic bag to be taken home. But be sure to keep the planter cups because these are not consumable items. They will be used time and time again. That concludes this part of the activity.

### **<Investigation 2, Part 3>**

Narrator: Part 3 is called wheat. And in this activity, the students have a chance to have an up close and personal look at the development of an individual wheat seed. Let's take a look at those materials now and see what you'll need to get out of the kit.

Most important are the wheat seeds. Each student needs three seeds, two to plant in straws and one to glue on his or her record sheet. If you choose to do an extension activity investigating another grain seed, there are oats in the kit as well.

You need clear plastic cups to distribute seeds. And these clear plastic straws are the chambers in which the seeds develop. Students keep their straws on their desks or on a counter in large plastic cups. A permanent marking pen is used to mark the straws at three inches. And labels are used to identify each students' straw. Extremely absorbent paper towels are in the kit. Use these to make the wicks that go in the straws.

Students record the growth of the seeds in their straws on this sheet, Growing Wheat. There's room for four entries as the seeds develop over time. In addition, you'll need to supply a few items from the classroom. A pair of scissors or a paper cutter to cut the paper towels, a ruler and some white glue.

Two items need to be prepared before you introduce the activity to the students. You'll need to cut some of this absorbent paper towel into some wicks. And you'll need to mark soda straws at three inches.

To start the preparation of the wicks, I'm first going to take the paper towel and fold it in half matching the ragged edges. I've chosen to use the paper cutter to cut the wicks because it will go much quicker. But it can be done with scissors.

First thing I need to do is cut this into three and a half inch strips. So I'm going to set the paper at ten and a half inches, which is three times three and a half, and cut off this little excess at the

end. Now I'm going to advance the paper to seven inches. And finally three and a half inches.

Now I'll stack up the three strips. And I'm going to cut these now into one inch lengths. So by putting these into the paper cutter and finding the nearest whole inch, which is five inches, I'll cut off the little ragged edge and now advance to four inches, three inches, two inches and with a magnificent guess, one inch.

I now have about 30 little strips that can be used as wicks. And I'll need to prepare two paper towels in this fashion. Now we'll move onto the straws.

I'm going to use the fence here on the paper cutter to assist me. I'm going to take a bunch of straws and push them all down here so they are all aligned. I'm then going to measure three inches on two of the straws and make a mark with my permanent pen.

Okay. Now I'm going to put one of those marked straws at each end of this set of straws making sure that all are pushed down against the fence. And I'm going to put my ruler now as a straight edge across the whole bunch of straws, hold it down securely and draw a line across all the straws right at three inches. I'm going to let them sit there and dry for just a few seconds and then bring another batch of straws in until I've got a total of 72 straws marked.

Teacher: Anybody have an idea of what kind of plant you actually eat a part of the plant?  
Michael?

Narrator: You begin Part 3 by calling the students to the rug and entertain a discussion about grain seeds. The wheat seeds are introduced and the students are challenged to plant a single grain and to observe it grow over time.

Each student gets a marked straw and a wick. The first part of the procedure is to twist the wick into a little stick. It needs to be twisted firmly enough so that it can be inserted into the straw from the marked end. Once the wick is inserted, you can pinch down on the straw and untwist the wick and that will help to hold the wick right in place. The top of the wick should be near the black mark on the straw. Now, the students are going to place a single wheat seed in there.

Teacher: I want you to be a scientist and observe the seeds. Look at them very carefully.

Narrator: When the students look at the wheat seeds, they will notice that one end has an indentation kind of like a fingerprint. That's the end that should go into the straw first. And then the wheat seed should slide right down and sit on top of the wick. They can adjust the length of the wick so the seed is right at the black mark.

Teacher: All right. Does everybody have two seeds there? Okay. Now --

Narrator: Each student prepares two straws like this. There's always the chance that one will fail and we want the students to have the opportunity to observe the growing seed. So each student sets up two.

Now, when all four students in a group have completed the assembly of their two straws, they will put them all into this large cup. And the cup will be filled about one centimeter deep with

water. The water will wick up and provide just the right amount of moisture for the seeds. And in time, they will be able to observe them grow.

After five days, this is what you might expect to see in the straws where the grain is growing successfully. You can see the seed right here at the black mark still. There's a nice green shoot extending up about three or four centimeters. And it's difficult to see against the white paper toweling. But the root is extending down through the bottom. And it's coming out clear at the very tip of the straw here. The root has been growing very rapidly.

This is the point at which the students select one of the plants to monitor continuously from this point on. Take one of these little labels and wrap it right around the straw and write their name on.

And here is a little collection of wheat seeds that have been growing for various number of days. This one over here has been going about five days. That's the one we looked at earlier. This one has been going about ten days. There are two leaves coming up and the roots have extended out quite nicely. Here is one 15 days. The vegetative growth has come up above the top of the straw and there's quite a bundle of roots down here.

And after 20 days we've got two leaves coming up out of the top and roots that extend well out the end of the paper down here. As we can see, they are about 10 or 12 centimeters long. Marvelous growth for the students to observe up close.

The record sheet can be maintained throughout the process of growth. And the students can lay their experiments right here on the paper to get a good idea of how they should represent the growth. And they'll see the advance in growth over time as the plants develop.

Students can glue a dry wheat seed to their Growing Wheat record sheet to compare with their sprouted seeds. And again, the students often become very attached to their wheat seeds and want to take them home, which they can do, straw and all, and plant it and hope for the best. Maybe get a wheat crop at the end of the activity.

Here are the concepts the students have been introduced to in Investigation 2: Seeds are alive; seeds need water and light to grow into new plants; some plants die and some plants continue to grow after they are mowed; wheat and other cereals that we eat come from seeds called grains; plants have different structures that function in growth and survival.

### **<Investigation 3, Part 1>**

Narrator: Activity 3 called Stems has three parts. In this activity the students will be trying to generate new plants from old, mature plants. And the vegetative stems are the part that they will be investigating.

In Part 1, the students will be working with pieces of stem that you've brought in from house plants or garden plants that can be sacrificed as the students investigate new plants from stems. There are a few items we'll need from the kit so let's see what those are.

Each pair of students will need a plastic cup like this one and a lid that fits securely on top with two holes. The cups will be labeled with the usual removable labels. And once again, the

students will have a recording sheet to keep track of the growth of the plant parts. This one is called Stem Cuttings.

The teacher will need to provide a few items: Water, scissors for cutting the stem samples, a container to put the cups that we'll prepare and, of course, some stems, some plant material. What I've got in here is English ivy. This is a good plant to use. It's very common. Found throughout the country. And it roots readily.

Over here I've got some other samples that would also be appropriate. Some of these are house plants. Some can be found out doors, depending on what part of the country you come from. This is Swedish ivy, sometimes known as Creeping Charlie. It's a member of the mint family. You can tell because it's got a square stem. Any of the mints, spearmint, peppermint or any of the other house plants like coleus that are in the mint family will work just fine for this.

This other plant over here is a Wandering Jew plant. It also roots quite readily. So any plant that will grow roots readily in a week or two is appropriate for use in this activity.

Part 1 starts with the students being given a section of stem much like this one. They observe it, they describe the parts that they see. In this case I can see leaves. And if I follow the stem clear down to the tip, I can see tiny leaves and a bud. I can see where these leaves join the stem and where these leaves join the stem. It seems like that's a distinct piece of the plant. And in fact, those areas where leaves or branches or flowers come off the stem are called nodes. And that will be an important concept for the students to develop.

The idea of developing a new plant from a section of a stem is a novel one for most first and second graders but they are game to give it a try. You'll ask the students to work together to come up with a plan for what they'll do with a piece of stem to see if they can make a new plant from it. This is the point at which you can introduce the plastic cup as a container for attempting to grow a new plant from a piece of stem.

Students decide how they want to prepare their stem into cuttings and fill their cup most of the way with water. Snap the lid on and then insert the cutting, the piece of stem, in through the holes.

Now, occasionally you may find that some students will take their section of stem and chop it up into little bitty pieces like coleslaw and put that into the holes. I'm not sure exactly what this behavior is, but I think it might be that they are trying to make their stem into seeds and that seeds are the source of a new plant.

After two or three weeks, this is what the students may observe. You can see here that there's a nice growth of roots on the end of these cuttings. And it's now time to go onto Part 2 where the students will plant these cuttings in soil to develop a nice, new plant for the classroom.

### **<Investigation 3, Part 2>**

Narrator: In Part 2 the students will take their rooted cuttings and transfer them to a flower pot or perhaps a discarded ice cream container to have a nice house plant for the classroom. The container is filled with soil, holes poked down for the rooted stems inserted it in, the soil pulled around and the plant put into a nice sunny place in the classroom.

Here is an example of one that some students put together earlier this week. It looks a little ragged right now. But as it takes hold and the plants start to grow, this will be a lovely possession for the students in the classroom.

*<Investigation 3, Part 3>*

Narrator: Part 3 is called spuds. In this part, the students will plant pieces of potatoes which are really modified stems to see if they can grow a new plant from a piece of potato. Let's take a look at the materials that the students will need.

Each group of four students will get a half liter container like this that they'll fill with soil to plant their spuds. And as usual, they'll label it. And you'll also need to get out another half liter container and a vial so that the students can water their spuds.

And you'll need to supply water, the soil, a paring knife for cutting the spuds and, of course, the spuds themselves. You can get either the brown potatoes, russet type, or the red potatoes. We recommend the red. They seem to sprout a little bit better. Plus, it's best if you purchase your potatoes two, three weeks, even four weeks before you're going to use them so that there's the possibility that the eyes will be developing into sprouts already.

You can see on this potato here that I've got early growth from this eye. And on this brown one, I can also see a few little locations where it looks like action is about to begin.

Part 3 starts at the rug. The teacher introduces the potato as a modified stem and the students observe it closely and notice the eyes. The eyes are actually the nodes on this section of stem. The students then go into their groups of four, pass the potato around, observe even more closely and then we have to decide how we're going to cut the potato into pieces.

I've brought a paring knife from home. Certainly you wouldn't want students to use this one. It would be far too dangerous. In some classes the teachers choose to do the potato cutting themselves. However, if you would like the students to cut the potatoes trying to get a node off an eye on each piece, provide some plastic knives for them to do that.

Let's see how that planting might advance in the classroom. In this class, I'm going to cut the potato. So I've got my paring knife. I see a nice eye right here. And I'm going to just cut down so that I've got that cut off with a substantial piece of potato, as well. I'm now going to fill the half liter container with soil following the usual procedure, filling it up, leveling it off. But this time I don't want to pat it down because I want to be able to push the piece of potato into the soil.

Now, I don't want to push it down so that this is buried because this is going to be the leaves. But this is also where the roots will come out, too. So rather than having that up or down, I want to insert the piece of potato sideways pushing it into the soft soil. I want to cover it over. And now I'm all set. Now, bear in mind that in the classroom, each of the four students in the group would have a piece of potato in here. So I would have four chunks ready to grow.

The last part is to water the potato pieces in the usual fashion using the little vial to measure water. Now we're going to set them in a nice place in the classroom where they will be warm

and perhaps in the light as soon as something starts to happen so that we can observe the growth of this particular stem into a new plant.

And after three or four weeks a nice new plant is emerging from our potato eye. Leaves, more leaves along the stem, nodes clearly visible along the stem and emerging from the soil. Over here a second spud starting to put up its roots. And if we poke around down in the soil, maybe a harvest of new potatoes.

Here are the concepts the students have been introduced to in Investigation 3: New plants can grow from stems of mature plants; plants need water and light to grow; leaves, twigs and roots develop on stems at the nodes; potatoes are underground stems.

#### **<Investigation 4, Part 1>**

Narrator: In Part 1, Bulbs, the students will be planting onion starts or perhaps garlic to see if they can generate a new plant from this new and novel structure. They start at the rug, have a discussion about bulbs, discuss whether they think they are alive or not.

By this point in the module, the students are just about convinced they can make a new plant out of anything so they will plunge in with great enthusiasm. Let's see what we've got here for the students to work with for the Bulbs activity.

You'll want to find the cups with the snap-on lids with the holes on the top and labels so the students can identify their cup. Cotton balls. These the students will tease apart and put in the bottom of the cup to grow their bulbs. They don't use soil in this activity. The half liter containers with the vials once again for watering the plants.

Here is the Growing Bulbs recording sheet which provides a record of the changes observed. And there are a few items that you'll provide including water, scissors to cut the labels apart, a knife to cut some of the bulbs so the students can see what's going on inside and then the bulbs themselves. We recommend either onion starts or garlic. But some have found that shallots are nice, too. In fact, I can see that this one is starting to grow already. I can see a green shoot coming out.

Part 1 of Activity 4 starts with a discussion of what is a bulb? The students look at a few bulbs at the rug, pass them around, talk about bulbs that they've seen and prepare to see if they can grow a new plant from a bulb. So let's see how they do that.

Each student gets a cotton ball. And then in a group of four, they can decide whether they want to use their little mats to build a nest into which they will place the onion bulbs or some students choose to each individually use their cotton to make a little cozy with their bulb.

Teacher: Okay. Now we're going to put that in there and pass the cup around, please.

Narrator: The end product is that the four bulbs are placed in cotton for support down in the cup. They then use the vial method to dip up one full vial of water, pour it in over the onions and cotton. Put the lid with the holes on top securely. And find a safe place in the classroom to place it.

After the students have their bulbs securely planted, it's a good idea to cut one of the bulbs in half so that the students can see the internal structure. By doing this, the students can see the concentric rings which are the leaves, the modified leaves that make up the bulk of a bulb.

You can also cut a second bulb along the other line of symmetry to see what it looks like when it's cut from top to bottom. And again, you can see the modified leaves inside the bulb. After a week we've got action. Indications are good that we're going to see a new plant.

Student: The roots are stuck.

Student: Look, the roots are all under water.

Student: The roots sort of look like spaghetti.

Narrator: Here is an onion bulb that's been growing for a week. The roots that the student just referred to as spaghetti are well developed. And here comes the shoot up through the top.

After two weeks, even more growth. Roots are about the same. But the vegetative growth above ground, quite extensive.

And after three weeks, the growing leaves have even found the holes in the top of the container and are reaching up for light. At this point the students may want to take their onions home, find a place in their garden and plant their onions with the anticipation of an onion harvest.

With the completion of the work with the bulbs from the kitchen, the onions or garlic, the students might want to move onto flower bulbs. And there's a whole universe of bulbs available in this category.

This is a hyacinth that's coming along very nicely just planted in gravel. It makes a nice house plant. And if you time these activities right, your students might be able to plant some bulbs that will be ready to take home to their families around Mother's Day or perhaps May Day. So that makes a nice conclusion to Part 1 of this activity.

#### **<Investigation 4, Part 2>**

Narrator: In Part 2, we return to the produce market to get some edible roots, radishes and the like. The students will cut up the roots into pieces to see if any part will produce a new plant. So let's see what materials we'll need for this.

The kit contains a couple of bags of vermiculite. This is used as a substitute for soil in this activity. And you'll need to get your basins. The vermiculite will be distributed in a fashion similar to what the soil was earlier on.

You need your container and vial for measuring water. And the students will plant their roots in the plastic cup which will be labeled in the usual way. The Cutting Roots sheet provides a little guidance to the students for how to prepare the roots for planting.

The more bulbous roots should be cut into three sections: Leaf, top of the stem and root section. And longer roots should be cut into four sections: Two pieces of root, the top and the leaves.

You'll need to provide, as usual, some water. This time you'll need to also provide some root vegetables, a knife for cutting them and scissors for preparing the labels.

I've selected radishes today. But on another day I might select some carrots, turnips, rutabaga, anything that looked good at the market that particular day. Or I might have a mix. Today it's radishes.

This final part of the activity starts at the rug where roots are introduced. And you can demonstrate a procedure for planting the root parts. Let's see how that procedure goes.

A pair of students working with in this case a single radish have to decide how they want to prepare it for planting, which part might produce a new plant. We decide to cut right here and then to cut off the greenery at the top. So we have three distinct portions. We then go to the vermiculite storehouse, fill our cup most of the way with vermiculite.

Teacher: Okay. Are we ready for radishes to plant?

Narrator: And then work together to decide how we want to orient the parts of our plant.

Teacher: Put them in the vermiculite. There are three separate parts.

Student: Put it on top of this one. We'll get all this and put it on top.

Narrator: Take two vials of water to irrigate the plants. We'll then find a suitable location in the classroom for nature to take its course. And we'll observe the possibility of a new plant emerging from a root.

Here is a carrot that some students planted a couple of days ago. I can see that things are looking fairly well in here. The leafy part is wilted. But the root parts have good color. And the portion of the carrot where the leafy part was previously attached is looking fine, too. So we'll need a little more time to tell if we're going to get a new plant from any part of this root.

Here are the concepts that students have been introduced to in Investigation 4: Bulbs are alive; bulbs need water to start growing; parts of roots will grow into new plants. Other parts will not.

And that brings us to the end of this module. But of course, the module is never really over because the plants will continue to grow, your classroom will become greener and greener as the brassica and the bulbs, the roots, the stems all continue to expand throughout your classroom. You may look around and see at this point that it looks more like a jungle or a greenhouse than a regular classroom, but that's fine. And you may even notice that the students are developing that fabled green thumb.