THE AMAZING TRADE SHOP SCIENCE RACE
A Colonial Williamsburg Electronic Field Trip
FINAL VIDEO SCRIPT

By

Abigail Schumann

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ACT ONE

PROFESSOR EDDIE exits Charlton Coffeehouse, excitedly paces up and down porch.

PROFESSOR EDDIE
Welcome to "The Amazing Trade Shop Science Race!" I'm your host Professor Eddie, speaking to you from the porch of Richard Charlton's 18th-century coffeehouse in Colonial Williamsburg's Historic Area.

OK, I'm not really a professor and this isn't really the 18th century. But I guarantee that this is Richard Charlton's coffehouse, painstakingly reconstructed on its original foundation using a mix of modern and colonial tools and techniques. And that's what the Amazing Trade Shop Science Race is all about.

We're going behind the scenes with two competing teams to discover how Colonial Williamsburg's tradespeople helped with the reconstruction of this historic building, and discover the science behind their work. Yet, I said it, science! Oh, here come the teams now--

AMARRA and DYLAN run up to the porch.

PROFESSOR EDDIE
On the red team we have Amarra...

AMARRA
Hi!

PROFESSOR EDDIE
... and Dylan.

DYLAN
Hi!

SHANNON and KENNETH run up to the porch.

PROFESSOR EDDIE
And on the blue team we have Shannon and Kenneth.

These digital devices will provide the teams with maps and videos to help them on their discoveries.

Professor Eddie offers the blue device to the red team and the

red device to the blue team and the teams correct him.

RED TEAM/BLUE TEAM
Red!/Blue!

PROFESSOR EDDIE
Oh, and help me remember who is the blue team and who is the red team.

And now the rules!

Each team will visit three Historic Area trades, each of which have contributed to the rebuilding of the Charlton Coffeehouse. Your mission is to look for the science behind their work. Be on the lookout for physical changes, chemical changes, simple machines, and transfers of energy. I'll be keeping score and providing engaging commentary to our viewers. The team that comes back with the most points will be our winner. Everybody ready?

KIDS
Ready!

PROFESSOR EDDIE
Get set, Go!

Both teams are heading toward their first destinations.

PROFESSOR EDDIE (VOICE-OVER)
The Red Team is heading down Duke of Gloucester Street in search of the Anderson Blacksmith Shop, while the Blue Team, well, they catch the bus to Great Hopes Plantation.

The red team walks into the Anderson Blacksmith Shop.

PROFESSOR EDDIE
The Red Team is approaching the Anderson Blacksmith Shop now. Very exciting!

The red team starts talking to SHEL the blacksmith, asking him questions. There are a number of items on a table in front of them that they pick up and play with as they ask about them.

DYLAN
So, what did you make for the coffee house?

PROFESSOR EDDIE
They don't waste any time, do they?

AMARRA
Right here, this hinge, would it be considered as a wheel and axle?

PROFESSOR EDDIE
Score one for the Red team!

SHEL (THE BLACKSMITH)
It is indeed a wheel and axle.

AMARRA
So this could be the wheel even though it's not round, and this right here is the axle?

SHEL
The center part is the axle and both of the sides would perhaps be spokes of a wheel.

AMARRA
Ok.

DYLAN
Wow, look at this key and lock. Hey, this key would be a lever, right?

PROFESSOR EDDIE
Red team scores their second point!

SHEL
A lever, or perhaps a wheel and axle. When you turn the key it operates the parts of an engine, a complex machine.

AMARRA
So right here, these nails. Would they be considered as wedges?

PROFESSOR EDDIE
Did she say wedgies?

SHEL
They are wedges, though a wedging action is to move things apart and you really want a nail to hold things together, so, you have to be certain that you don't split the board when you drive it in.

AMARRA
So how do you make all this stuff?

SHEL
I believe that you have some video that'll...

AMARRA
That's right!

DYLAN
Yeah!

SHEL
...start us on this journy.

CUT to close-up of video device: the video is of a blacksmith working with red hot iron.

PROFESSOR EDDIE
I love movies.

SHEL
What tools do you see?

AMARRA
Well there's a hammer right there, used to bend the metal?

PROFESSOR EDDIE
Aww, a hammer is a class 3 lever. Too bad the Red team didn't notice.

DYLAN
And an anvil.

SHEL
An anvil backs up the hammer, so you're squeezing between two separate tools.

Camera zooms out again to the Red team and Shel looks at the video and talks about it.

AMARRA
I guess the fire would--may be a tool.

SHEL
The fire's a very important tool and there's one more tool that we haven't seen. Perhaps we can walk over here and look at that.

PROFESSOR EDDIE
Ooh, a mystery tool! Meanwhile, the Blue team arrives at Great Hopes Plantation to meet the carpenters.

The Blue team walks toward TED, the carpenter, at Great Hopes Plantation. The three of them watch AYINDE, another carpenter, who is splitting wood.

TED (THE CARPENTER)
Hi, welcome to Great Hopes PLantation.

Are you guys here for the Amazing Trade Shops Science Race?

SHANNON
Mm-hmm.

KENNETH
Yes.

TED
Well great, let's walk over here and take a look at what's going on. What do you think he's doing here?

KENNETH
He's cutting the wood.

TED
Well, he's not actually cutting it, he's splitting it, so the fibers are being separated as opposed to being cut. What simple machine is he using here?

SHANNON
It's a wedge, right?

PROFESSOR EDDIE
The Blue team scores with a wedge!

TED
He's driving that down into the wood, but once he buries that into the wood, what other simple machine is going to be used?

KENNETH
It's a lever.

PROFESSOR EDDIE
And again!

TED
Yeah. He's going to use the handle as a lever, and as you see him press that down, you can see how it starts to separate the material. The material he's working up is going to be plaster lath.

SHANNON
What is plaster lath?

Cut to a video of plaster lath on a building, which someone is smearing plaster onto.

TED (VOICE-OVER)
It's what goes onto the frame of the

building, and it's what helps to support the plaster that you're going to smear onto the walls to help make the walls nice and smooth.

Cut back to AYINDE, TED, and the Blue Team at Great Hopes Plantation.

AYINDE
You guys want to try?

SHANNON
Sure.

Shannon helps Ayinde separate the wood.

PROFESSOR EDDIE
Aww, the maul is another class 3 lever, like the hammer. Blue team missed that one. And speaking of hammers, what about that mystery tool back at the blacksmith's shop?

SHEL brings the Red Team over to the fire to show them the bellows.

AMARRA
Oh it's a bellows.

SHEL
It is.

DYLAN
That's a lever, isn't it?

PROFESSOR EDDIE
Yes it is Dylan! Red team widens their lead.

SHEL
Why do you need a bellows?

AMARRA
I guess 'cause it pumps air up?

DYLAN
And it makes the fire hotter, right?

SHEL
Doubles the heat of the fire. Very important. Why don't we try twisting something cold to see why you need a fire. Let's go back to the vise over here.

PROFESSOR EDDIE

The vise is a wheel and axle. Come on guys, the vise! And the tons are a lever. Hello!

SHEL and the Red Team walk over to the vise, where he has them try to twist cold iron.

DYLAN
Man, that really is hard. You wanna try?

AMARRA
Sure. Oh yeah, you're right.

Dylan and Amarra take turns pumping the bellows, watching the pice of iron in the fire change color.

SHEL
It should be ready. You see the changes occurring to the piece in the fire now?

AMARRA
It's changing color.

SHEL
When the color is the same as the fire behind it, it'll be time to walk over to the vise and twist it. Are we ready yet?

DYLAN
Whoa.

SHEL picks up the metal and carries it over to the vise, where he lets the Red Team try to twist it again now that it's hot.

SHEL
You need to move quickly, 'cause it'll cool off quickly.

DYLAN
Wow, that's really easy. A lot easier than before. Whoa, what's all those flakes coming off it?

SHEL
That's oxidation that occurs in the fire.

AMARRA
A chemical change, right?

SHEL
A chemical change.

PROFESSOR EDDIE
It IS a chemical change!

Back at Great Hopes Plantation, SHANNON shows TED and AYINDE a video of the construction of the Charlton Coffeehouse and asks about it.

SHANNON
So what can you tell me about this video?

TED
Let me see what you've got.

PROFESSOR EDDIE
Where's Kenneth? Whoa!

KENNETH runs over to join them watching the video.

KENNETH
Hey, what are you guys looking at?

TED
Oh, this is the Charlton Coffee House when we raised the front wall. Can you guys see any kind of simple machines in here that we're using?

Cut to the video of several men raising the wall of the Charlton Coffeehouse.

SHANNON
Well, I see a couple of pullys.

PROFESSOR EDDIE
Pulleys score Blue Team one point!

TED
Actually, this whole wall, initially we started with manpower, but we used these pulleys to help take up the load. Can yous ee anything else that we're using there?

KENNETH
I see a lever.

TED
Yeah, we're using some levers to...

PROFESSOR EDDIE
Four! (Fore!)

TED
...gain some advantage at the top of the wall as well, and that was a good day of work. But now I think I'm going to put you guys to work, so let's go over here and try this out.

TED, AYINDE, and the Blue Team walk over to a timber cart nearby.

TED
Now, this cart is called a timber cart or a drug, and we're going to use this cart to move those heavy timbers like you saw in the video of the coffeehouse. That's how we transport timbers from one point to another. Now, what--what do you see on this cart that's going to help us obviously to transport it?

SHANNON
How about a wheel and axle?

PROFESSOR EDDIE
Yes!

TED
Exactly. And that's the first real obvious simple machine, but there's one that's not quite as obvious. I tell you Kenneth, start to lift up on this handle, what does this start to do here? What have we got here?

KENNETH
It's like a lever.

PROFESSOR EDDIE
Blue Team takes the lead!

TED
Yeah, exactly. Where's the fulcrum on this lever?

SHANNON
Where the wheel meets the beam?

PROFESSOR EDDIE
Another point for Blue!

TED
Exactly. And if you notice, this tongue is very heavy right now. It's done intentionally that way...

The four of them push the cart forward.

TED
...so that when we push this cart over the timber, we're going to off-center that center-point of the fulcrum, and that way when we start to pull down on this cart to lift the timber, we're

going to take advantage of the natural weight of that beam.

SHANNON and KENNETH help chain a piece of timber to the cart.

TED
See that lever working, with a good fulcrum there.

Ayinde chains the other end of the timber to the cart, and Shannon and Kenneth pull it forward.

TED
Alright, spin around to the other side.

PROFESSOR EDDIE
(talking over Ted)
Well, the score is Blue Team seven, Red Team five. We'll be back soon with round two.

ACT TWO

Red Team walks towards Governor's Palace and into the kitchen.

PROFESSOR EDDIE
Welcome back! The score is Blue Team seven, Red Team five. Red Team is entering their next trade shop. Let's listen!

The Red Team walks into the kitchen and looks around.

AMARRA
This is a kitchen. What does it have to do with the coffeehouse?

PROFESSOR EDDIE
Hmm, good question, Amarra. We'll get back to that in a minute. But meanwhile, Blue Team is getting started in the foundry.

SUZIE, the founder, has set up several items on the table, and she talks about them to the Blue Team on the other side of the table, handling the objects as they go.

SUZIE
Do you all know the difference between a foundry and a smith shop?

SHANNON
Well, don't smiths pound metal to make it into the shape that they want?

SUZIE

Exactly! And here in a foundry, we melt the metal. How do you suppose I'm going to shape melted metal?

KENNETH
Well, you put it in the molds.

SUZIE
Exactly. So, I have different kinds of metals that I work with here in this foundry, and some of the metals are the same metals that smiths work with. What do you all suppose some of these metals are? And these are metals that we've alloyed.

SHANNON
What's an alloy?

SUZIE
An alloy is a mixture of metals, as opposed to an elemental metal, which is in its pure form. All of the metals we work with are mixtures. So what do you think that this is?

SHANNON
Hmm.

KENNETH
It could be brass.

SUZIE
It is! Exactly. Brass is a mixture of copper and zinc. What about this metal?

SHANNON
Silver?

SUZIE
Exactly--sterling silver. So it's a mixtur eof about 92 and a half percent pure silver and seven and a half percent copper. This might be a hard one, we don't use this metal very often.

KENNETH
Is it bronze?

SUZIE
Bronze, exactly! It's the same thing a cannon or a bell is made out of. Bronze is copper and tin. What about this? This is pretty tarnished.

SHANNON

Lead?

SUZIE
It looks like lead and it has lead in it, it's an alloy of pewter. Pewter is tin. Sometimes it has lead or bismuth or antimony mixed in. This is what pewter looks like shiny. Here in the colonies they're not alloying or mixing their metals, they're taking metal that you brought in as a customer that was broken and worn out and melting it. What do we call that today when we do it with bottles and cans?

SHANNON
Recycling?

SUZIE
Recycling, exactly. So you bring in your old buckles, and we weigh them out, melt them, and then pour that metal out into a mold. Now we make the mold, or build the mold, by taking a model of the item, a mock-up of it, and packing wet sand around it. Sand is packed so tightly that it holds the shape of the object. The object that comes out looks like this. We'll take a saw, and cut this off, and do the finishing work. It's going to actually look like this.

Snapshots of the coffeehouse fireplace appear on screen, so that we can see the items in the fireplace that were made in the foundry.

SUZIE
Let's look at one of the other types of molds. This is a brass mold, and you can pour this metal, pewter, into a brass mold because the pewter has a lower melting temperature than brass. Now we don't have a temperature guide, but I know that this is around maybe 600 degrees as a liquid, and when I make something out of brass, it's going to be around 2,000 degrees. So I could pour pewter into brass, and it will not melt my brass mold.

Cut to PROFESSOR EDDIE standing in a hot frying pan in the Palace Kitchen, surrounded by roasting cacao beans.

PROFESSOR EDDIE
Well, out of the fire and into the

frying pan! Yikes! These are roasting chocolate beans. Turns out Red Team is going to make chocolate to serve in the coffee house! Let's check it out! Ow! Ow!

Amarra and Dylan are standing behind a counter in the kitchen with JIM, the chocolatier. He shows them the cacao nuts, and demonstrates how to separate them.

AMARRA
So, what do you do after the beans have been roasted?

JIM
Well, what we have to do is we have to shell them. Each and every bean has a shell around them, so if we take these nuts, you can see as we pull it off, you have to separate. This is what you eat, this is what you can't eat.

DYLAN
Hold on, is this a nut, a bean, or a seed?

JIM
Well, Dylan, it's actually all three. Go ahead and hand me that pod right there. This is the cacao pod as it's growing and these are the seeds that come out of this fruit. However, in the 18th century we called them "chocolate nuts" or "cocoa nuts," and in the 19th century we called them cocoa beans, so actually they're all three. So go ahead and start shelling all of these, and you guys get to shell these for about two hours--

Amarra and Dylan look at each other in dismay.

JIM
So I'll be back when you're done.

PROFESSOR EDDIE
Two hours, huh? We'll come back too.

Cut back to the foundry with SUZIE, who is showing the Blue Team the fire and various apparatus used in the foundry.

SUZIE
What is this?

SHANNON
A bellows, to heat the fire.

SUZIE
Exactly! Now, what kind of simple machine is this?

KENNETH
A lever.

PROFESSOR EDDIE
Blue team scores!

SUZIE pantomimes the process of melting and pouring brass, matching word to action.

SUZIE
Now, if we're pouring brass, we would pump the bellows about an hour, melting the metal in a crucible, a special melting pot made of clay and graphite, and then pour the metal into that sand mold that we made for the finials. You want to try that out, Kenneth?

KENNETH
Yeah.

KENNETH pretends to pour brass into the mold.

SUZIE
Ok. Just grab the tongs and clip it in.

PROFESSOR EDDIE
Kenneth is preparing to pour invisible brass. It's a good thing the crucible isn't filled with 2,000-degree molten metal, or Kenneth's fingerprints would be gone!

Cut to the Red Team shelling cacao beans.

PROFESSOR EDDIE
Time flies when you're shelling cacao beans.

Jim walks in and joins them at the table.

JIM
So, how's it going? Well, where are the seeds? You didn't separate them, did you?

DYLAN
I guess we could pick them out, one by one.

AMARRA
Or we could have separated them while we

were shelling.

JIM
You have another way of doing it too.

JIM places a large, flat basket on the table.

DYLAN
Oh! A winnowing basket!

AMARRA
Winnowing!

DYLAN
We have a video of that.

The three of them watch a video of JIM using the winnowing basket.

JIM
You throw the seeds up in the air and let the wind blow the chaff away.

Back at the foundry with the Blue Team, SUZIE demonstrates pouring pewter.

SUZIE
Now we can't pour brass today, but we can pour pewter. Now the metal is in the pot in a liquid form here in the furnace. I'm going to scoop it out with my iron ladle, and pour it into my brass mold. How long do you think it's going to take before I can open up my mold and we can have a spoon?

Professor Eddie records the seconds on a stop watch.

PROFESSOR EDDIE
Wow.

SUZIE
It's actually already hardened. It's very quick.

SUZIE takes the brand-new spon out of the mold to show the Blue Team. She then puts it back in the molten pewter to re-melt it--she dips it in and the bowl of the spoon vanishes!

SUZIE
How, this is much too hot to handle, but you can see how it's a solid. Now I mentioned earlier, taking old and broken things and reusing them. Let me scoop in so you can all see this metal. If I have a spoon that's broken, or worn out, I

could put it back into the metal and re-melt it. Shannon, would you like to melt the spoon?

SHANNON
Sure.

SUZIE
Now remember, everything's very hot.

Shannon takes a spoon from Suzie and dips it into molten pewter, and the spoon melts.

PROFESSOR EDDIE
Talk about changes in state. Too bad Blue Team missed that point. Liquid to solid, solid to liquid!

Cut back to Red Team and JIM in the kitchen.

JIM
So now, we're going to make chocolate.

JIM spreads shelled cacao beans on a grindstone and begins grinding them.

DYLAN
What do we add to that?

JIM
Well actually nothing, it's already in it. When we grind it, it's going to turn into liquid.

DYLAN
If you don't add anything, how does it become a liquid?

JIM
Well, you're familiar with coffee, aren't you? What happens when you grind a coffee bean?

AMARRA
It turns to powder.

JIM
Right. Because coffee doesn't have any fat in it. Cocoa, on the other hand, has--is about fifty percent fat. So when you grind it, it'll turn into a liquid. And you take the nut, or the bean, or the seed, or whatever you want to call it, and it still has fifty percent fat, and that's called cocoa butter. You guys want to try this?

DYLAN AND AMARRA
Sure.

JIM shows Dylan and Amarra how to grind the beans. Amarra grinds the beans.

JIM
Ok. Come on Amarra, go ahead. Grind away. You can see underneath that we have a little bit of a heat source there, that's to transfer the heat to the stone to kind of keep the chocolate in its liquid form.

AMARRA
Transfer of energy, right?

PROFESSOR EDDIE
Red Team scores! It'll be a while before they have liquid chocolate though. Here's how it'll look when they're done.

Cut to a shot of grindstone with liquid chocolate running off of it into a bowl.

PROFESSOR EDDIE
Yummy.

PROFESSOR EDDIE stands by himself on Duke of Gloucester Street.

PROFESSOR EDDIE
The Teams have one more round, and Blue Team is holding their lead with eight points to Red Team's six. See you in a bit!

PROFESSOR EDDIE walks off the screen.

ACT THREE

The Blue Team walks down the street, heading towards the brickyard.

PROFESSOR EDDIE
Welcome back! Blue Team has a two-point lead as they enter the final round. They are headed to the brickyard now. Let's join the Red Team at the joinery, where they're learning about plaster.

Video of someone plastering a ceiling.

MATT (THE PLASTERER)
So this is plastering at the coffee house, and the material he's applying it to is called lath. And the lath has

holes in it so the plaster pushes through, and it attaches to the wall...

MATT and the Red Team stand in the joinery.

MATT
... So what I thought we would do, is we would make a little bit of plaster, and it's going to be a little bit messy, so here are some shirts, and let's get to work!

MATT hands AMARRA and DYLAN large colonial shirts to protect their clothes.

PROFESSOR EDDIE
This sounds fun!

Matt and the Red Team stand around a table, on which are laid out the various components of plaster.

MATT
Plaster's made out of forty-five percent lime putty.

PROFESSOR EDDIE
Wait a minute! What's lime putty?

MATT
Lime putty is made from shell, and in this case it's made from oyster shell. What we do is we take the shell, which is calcium carbonate, and we burn it. And when we burn it we drive off moisture and carbon dioxide.

PROFESSOR EDDIE
Get out of here, you!

MATT
And that makes a material called calcium oxide. And you know what type of reaction that is?

DYLAN
That would be a chemical reaction, right?

PROFESSOR EDDIE
What did he say?

(Replay)

DYLAN
--a chemical reaction, right?

PROFESSOR EDDIE
Score another point for the Reds!

MATT
Correct! Very good. And so from there, we then add water. And when we add water, all that moisture and carbon dioxide starts to come back into the material, and it creates calcium hydroxide, also known as lime putty.

PROFESSOR EDDIE
So that's lime putty! Where were we?

Matt and the Red Team add things to the mixing bowl as he explains each ingredient.

MATT
Plaster's made out of about forty-five percent lime putty, forty-five percent sand, seven percent clay--and what we use that for is called a plasticizer: it makes the plaster very sticky and makes it go on very smooth--and about three percent brick dust. The bricks have silica in them, or sand, and when that silica gets really hot, it forms a material called a pozzolan, and the pozzolan, when added to our plaster, helps it cure a little bit faster, as well as makes it--makes it much harder. And now we can go ahead and mix up our plaster.

PROFESSOR EDDIE
Let's see what the Red Team is doing!

The Red Team is at the brickyard with JASON, who holds a brick in his hand. They are all moving up and down, as if marching in place.

JASON (THE BRICKMAKER)
So what can you tell me about this?

SHANNON
Well, it's a brick.

KENNETH
And it's red.

JASON
And it's red.

SHANNON
What makes it red though?

JASON
Well, there's a lot of iron in the clay that the brick is made out of.

KENNETH
Well, how does the iron turn it red?

JASON
Well, when we cook the clay in the kiln, the iron will go through a chemical change...

PROFESSOR EDDIE
Rats! No score on that chemical change. Too bad.

JASON
...and turn everything red.

SHANNON
Is clay the only thing in the brick?

JASON
Clay and water, that's it. We're stepping in it right now.

The camera zooms out to reveal that the three of them are barefoot, stepping up and down in a huge bed of clay.

PROFESSOR EDDIE
Were you wondering why they wobbled?

KENNETH
Oh look, our feet are like wedges.

PROFESSOR EDDIE
Wedges! Score one for the Blues!

SHANNON
How do you make the clay into a brick?

JASON
I'll show you. Come over here.

The Red Team is at the joinery. DYLAN is mixing paint, matching his movements to Matt's words.

MATT
So this type of mixture is called a colloid, and that means that one material is evenly dispersed in another, but it doesn't dissolve-- it just floats there. And so the very important part of the paint is that we get this very even, or we'll get globs. So we're going to grab the muller, which is this right

here, and you can go ahead and set that on top, and start grinding in a circular pattern. And you'll do this until all the little chunks in there are completely ground in, and it's nice and smooth. So, what we've done, is I've already made some, and all the ground pigments are now on this slab. What we want to get is a nice tan color.

They mix the pigment with white and add oil.

MATT
You can see it start to change color--you can see the tan coming out now? This is a little thick for paint, so what we would do is we would add a little bit of linseed oil. So we grind seven--seven gallons of putty, we add oil, and we make about fifteen gallons of paint.

In the Brickyard, JASON demonstrates how to make a brick. He rolls the clay into a large ball, pushes it into the mold, and smooths the edge.

PROFESSOR EDDIE
Oh! Jason is showing the Blue Team how they form bricks. Brickmakers made ten thousand bricks for the coffeehouse! Just like this.

JASON
That's two bricks.

SHANNON
What do you do with the bricks now?

JASON
Well now we have to dry them. So we'll set them out in the sun to dry over there on that--on that drying bed for a couple of days till it gets nice and hard, then we'll move it over to that big shed over there where we can dry the bricks for weeks, and get them even dryer.

Snapshots of the drying bed and drying sheds flash on screen.

KENNETH
And that's evaporation.

PROFESSOR EDDIE
That's science!

SHANNON
Put the water in the clay and evaporate it out.

PROFESSOR EDDIE
And that's a change in state! One point for the Blue Team!

JASON
But we still have to cook it.

SHANNON
Oh, we have a video of that.

Cut to video of people tending a kiln, feeding the fires, etc.

JASON (VOICE-OVER)
A kiln fires for a week. Those tunnels where the fires burn underneath all the bricks have to be fed day and night, the whole fire.

SHANNON
Where do the tunnels go to?

JASON
All the way across the bottom, but the bricks on the bottom, by the fire's tunnel's going to be a lot hotter than some of the other bricks in the kiln, and that means they'll come out a different color...

The video shows a line of bricks arranged according to color from the darkest, closest to the fire, to the lightest and furthest away.

JASON
... The different colors in the bricks might tell the bricklayer where he's going to use that when he builds the walls of the coffeehouse.

Cut back to the brickyard.

JASON
But a bricklayer needs two things if he's going to build a wall. He needs bricks, and...

SHANNON
Mortar!

JASON
Mortar, right. Which is made out of burnt oyster shells.

SHANNON
I think we have a video of that too.

JASON
You do? Let's take a look at that.

Video of oyster shells being burnt.

JASON
Lime is made from oyster shells that are burned, and burning the oyster shells removes carbon dioxide from them. When you put a burnt oyster shell in water, it chemically changes into lime.

PROFESSOR EDDIE
More lime putty.

JASON
That chemical change also creates a lot of heat, so you might see a lot of steam when we make lime.

The Red Team is back at the joinery, gathered around the table with Matt.

MATT
So now we're going to talk a little bit about shellac. And shellac is made from this material right here, and this is called lac...

Matt pours lac into Dylan and Amarra's hands so they can examine it.

MATT
... and so what lac is, lac actually comes from little bugs that live in a tree. The bugs suck the sap out of the tree, and then excrete a material onto the branches.

AMARRA
Bug excretions?

DYLAN
Cool.

Matt pours alcohol into a cup with lac.

MATT
The lac is a solute, and the alcohol is the solvent. Now, when we mix the two together, what happens?

DYLAN

Well, it's starting to dissolve.

MATT
That's right. So you have one material that dissolves into another, and that creates a solution, which is shellac...

Matt paints a piece of wood with the newly-made shellac.

MATT
... and so as we apply that, what's happening is you're sealing the surface, and it protects the wood, as well as gives us a really nice finished coat.

The Red Team walks out of the joinery.

AMARRA
Aww man, we should have said that the dissolving shellac was a chemical change.

PROFESSOR EDDIE
Wait! It's not too late! Score one for the Red Team!

Well, the teams are headed back to the coffeehouse now. Looks like we have a winner.

Professor Eddie sits on the coffeehouse steps, looking bored. He sees the two teams returning and jumps up.

PROFESSOR EDDIE
Here they come now! Welcome back, teams!

Teams approach.

AMARRA
Hey guys.

KENNETH, SHANNON AND DYLAN
Hi.

PROFESSOR EDDIE
May I have your digital devices please. Thank you. Well, the final team scores will now be revealed.

Shot of nervous contestants with suspenseful music.

PROFESSOR EDDIE
... Don't you just hate those long, drawn-out buildups to reveal the winners? Let's get right to it. Well, the score is: Red Team eight points, and

Blue Team ten. The Blue Team is the winner of the Amazing Trade Shop Science Race!

Blue Team and Red Team shake hands.

DYLAN
Good job guys.

AMARRA
Nice job.

KENNETH AND SHANNON
Thanks.

PROFESSOR EDDIE
Well done, Amarra and Dylan. You kept it neck and neck through most of the race, well identifying levers, wedges, several chemical changes, and a transfer of energy. Here are your runner-up haversacks, for a game well played.

Professor Eddie gives Amarra and Dylan their haversacks and turns to the Blue Team.

DYLAN AND AMARRA
Thanks.

PROFESSOR EDDIE
Shannon and Kenneth, congratulations on your winning scores. You identified multiple wedges, levers, in addition to pulleys, fulcrums, and a change in state. Here are your first-place haversacks, filled with all kinds of stuff!

Hands haversacks to Blue Team, who excitedly accept.

PROFESSOR EDDIE
And that's our show, from the Charlton Coffeehouse in Colonial Williamsburg's Historic Area. I'm Professor Eddie, and we'll see you next week on... okay, okay, so I'm not really a professor. And we won't really see you next week, but I hope you still enjoyed...

EVERYONE
The Amazing Trade Shop Science Race!