1

00:00:00,000 --> 00:00:09,000

On this episode of Mythbusters, Adam and Jamie have a data with Destiny.

2

00:00:09,000 --> 00:00:12,000

I have totally psyched about numbers.

3

00:00:12,000 --> 00:00:21,000

They're testing the myth that during an underwater explosion, lying prone on the surface will increase your chances of survival.

4

00:00:21,000 --> 00:00:23,000

Whoa, go hide that place!

5

00:00:23,000 --> 00:00:29,000

Then, Carrie Grant and Tori tackle an ancient armor saga.

6

00:00:29,000 --> 00:00:31,000

Oh, I felt that one.

7

00:00:31,000 --> 00:00:34,000

Is the firefetch theory that paper armor...

8

00:00:34,000 --> 00:00:37,000

Well, you couldn't find me a giant pair of scissors to run with.

9

00:00:37,000 --> 00:00:39,000

...protects as well as steel...

10

00:00:39,000 --> 00:00:41,000

Well, that is one dangerous looking machine.

11

00:00:41,000 --> 00:00:44,000

...fact or pulp fiction.

12

00:00:48,000 --> 00:00:51,000

Who are the Mythbusters?

13

00:00:51,000 --> 00:00:52,000

Adam Savage.

14

00:00:52,000 --> 00:00:53,000

Come on, let's go!

15

00:00:53,000 --> 00:00:54,000

Here comes chaos!

16

00:00:54,000 --> 00:00:55,000

And Jamie Heidemann.

17

00:00:55,000 --> 00:00:57,000

Relax. This one hurt a bit.

18

00:00:57,000 --> 00:01:02,000

Between them more than 30 years of special effects experience, joining them...

19

00:01:02,000 --> 00:01:04,000

Carrie Byron.

20

00:01:04,000 --> 00:01:05,000

This should be fun.

21

00:01:05,000 --> 00:01:06,000

Tori Bellachy.

22

00:01:06,000 --> 00:01:08,000

We survived.

23

00:01:08,000 --> 00:01:09,000

And Grant Imahara.

24

00:01:09,000 --> 00:01:10,000

Start the car!

25

00:01:10,000 --> 00:01:13,000

They don't just tell the myth.

26

00:01:13,000 --> 00:01:16,000

They put them to the test.

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00:01:28,000 --> 00:01:30,000

Check this out.

28

00:01:30,000 --> 00:01:35,000

Navy divers who find themselves in the water when an explosion, like a depth charge or something,

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00:01:35,000 --> 00:01:40,000

is supposed to go off underwater, are instructed specifically that the safest position for them to be in,

30

00:01:40,000 --> 00:01:44,000

in the case of an underwater explosion, is flat on their back on the surface.

31

00:01:44,000 --> 00:01:49,000

And that that's significantly safer even than treading water in an upright position.

32

00:01:49,000 --> 00:01:53,000

Hmm, that's interesting. You wouldn't think there'd be any difference at all.

33

00:01:53,000 --> 00:01:56,000

You wouldn't. And that's why I think it's something that we should test.

34

00:01:56,000 --> 00:01:58,000

I'm up for it.

35

00:01:58,000 --> 00:02:03,000

Navy SEALs and Walruses are advised that if in danger of a depth charge disaster,

36

00:02:03,000 --> 00:02:11,000

their best chance of survival is to float on the surface rather than treading water or diving down.

37

00:02:11,000 --> 00:02:13,000

But would it really make a difference?

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00:02:13,000 --> 00:02:18,000

Adam, Jamie and the bomb squad are primed to find out.

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00:02:18,000 --> 00:02:24,000

Ultimately, of course, I foresee a large-scale quarry like big explosions, very cool high-speed shots.

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00:02:24,000 --> 00:02:26,000

But where do we begin?

41

00:02:26,000 --> 00:02:30,000

Well, let's say we start with some underwater shockwave testing here in the shop

42

00:02:30,000 --> 00:02:35,000

and see if we can collect some data, see if there are any problems, see if there's anything to the myth.

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00:02:35,000 --> 00:02:37,000

Sure, that shouldn't be that hard.

44

00:02:37,000 --> 00:02:38,000

Okay.

45

00:02:38,000 --> 00:02:44,000

We're going to need three things. A tank full of water, an explosion, and a means of measuring the

shockwave.

46

00:02:44,000 --> 00:02:53,000

It sounds deceptively simple, but setting off and measuring underwater explosions in the shop is anything but simple.

47

00:02:53,000 --> 00:03:01,000

I'm thinking this requires a brainstorming sequence with an inevitable tense discussion.

48

00:03:01,000 --> 00:03:03,000

It would fail catastrophically.

49

00:03:03,000 --> 00:03:05,000

Obligatory technical jargon.

50

00:03:05,000 --> 00:03:06,000

15 psi.

51

00:03:06,000 --> 00:03:08,000

Equidistant from the sensors.

52

00:03:08,000 --> 00:03:09,000

Blast pressure.

53

00:03:09,000 --> 00:03:10,000

7 psi.

54

00:03:10,000 --> 00:03:11,000

That can work.

55

00:03:11,000 --> 00:03:14,000

And after a final audio crossfader too.

56

00:03:14,000 --> 00:03:16,000

And we create our shockwave guns.

57

00:03:16,000 --> 00:03:18,000

So I just grab a draw.

58

00:03:18,000 --> 00:03:20,000

And we got sensors.

59

00:03:20,000 --> 00:03:23,000

There's a resolute conclusion signaling a solution.

60

00:03:23,000 --> 00:03:25,000

I think that seems like a plan.

61

00:03:25,000 --> 00:03:26,000

I think so.

62

00:03:26,000 --> 00:03:27,000

This here is our tank.

63

00:03:27,000 --> 00:03:30,000

15 feet tall, it's going to hold 1,300 pounds of water.

64

00:03:30,000 --> 00:03:34,000

Inside that tank, we will place four shock sensors.

65

00:03:34,000 --> 00:03:37,000

I will detonate a pistol, dead center in the tank.

66

00:03:37,000 --> 00:03:41,000

That pistol will generate a shockwave that will travel up and down through the tank.

67

00:03:41,000 --> 00:03:46,000

If depth plays no role in the propagation of a shockwave underwater,

68

00:03:46,000 --> 00:03:49,000

we should see an identical reading between sensors B and C,

69

00:03:49,000 --> 00:03:53,000

because they are each the same distance from the source of the shockwave.

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00:03:53,000 --> 00:03:57,000

If depth does play a significant factor in the force of a shockwave underwater,

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00:03:57,000 --> 00:04:02,000

then we should see a difference in the force measured by these two sensors.

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00:04:02,000 --> 00:04:05,000

And that's where this story gets really interesting.

73

00:04:05,000 --> 00:04:07,000

But it gets interesting before that,

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00:04:07,000 --> 00:04:10,000

because Jamie has an ingenious plan of a tank.

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00:04:10,000 --> 00:04:13,000

We're going to need a very tall, narrow tank for this test.

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00:04:13,000 --> 00:04:16,000

We built one of these before for firing bullets into water.

77

00:04:16,000 --> 00:04:20,000

But let's just say there was a serious problem with that one.

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00:04:21,000 --> 00:04:25,000

Water is heavy and keeping it contained is a tricky task.

79

00:04:25,000 --> 00:04:27,000

That was a tank, man!

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00:04:27,000 --> 00:04:29,000

Oh, criminy.

81

00:04:29,000 --> 00:04:33,000

Now, with that in mind, I've come up with an entirely new way of building a tank

82

00:04:33,000 --> 00:04:35,000

that we've never tried before.

83

00:04:35,000 --> 00:04:38,000

It uses very thick vinyl.

84

00:04:39,000 --> 00:04:41,000

Well, that ought to do it.

85

00:04:44,000 --> 00:04:46,000

You're up!

86

00:04:47,000 --> 00:04:48,000

Another six inches.

87

00:04:48,000 --> 00:04:49,000

It's in!

88

00:04:49,000 --> 00:04:54,000

In a few minutes, we're about to fill that tube with 1,300 pounds of water.

89

00:04:54,000 --> 00:04:56,000

Will it hold?

90

00:04:56,000 --> 00:04:58,000

I can't detect any leaks.

91

00:04:58,000 --> 00:05:00,000

I hope so.

92

00:05:00,000 --> 00:05:05,000

So does Jamie, because nothing scares the Heinemann more than a mess in potentia.

93

00:05:05,000 --> 00:05:07,000

It's terrifying. Put yanking on it.

94

00:05:07,000 --> 00:05:13,000

With the tank holding, they're about to tempt fate by introducing the explosive ingredient.

95

00:05:13,000 --> 00:05:17,000

The role of our shock producer in the small-scale test will be played by this,

96

00:05:17,000 --> 00:05:22,000

a .357 magnum pistol to which I'm going to make some modifications

97

00:05:22,000 --> 00:05:25,000

so we can fire it remotely and underwater.

98

00:05:35,000 --> 00:05:36,000

Okay, Kerry, what do you got for us?

99

00:05:36,000 --> 00:05:39,000

I've got historical myth, and I love this one.

100

00:05:39,000 --> 00:05:46,000

Now, in ancient times, even up to the 1800s, some armies in China actually made armor out of paper.

101

00:05:46,000 --> 00:05:50,000

Paper armor? That is cool. I mean, paper's the last thing you would think of to make armor.

102

00:05:50,000 --> 00:05:51,000

I like this one.

103

00:05:51,000 --> 00:05:54,000

And the cool thing is that paper was supposed to perform as well as steel.

104

00:05:54,000 --> 00:05:55,000

Wait a minute.

105

00:05:55,000 --> 00:05:58,000

Paper armor performing as well as steel armor?

106

00:05:58,000 --> 00:05:59,000

I'd like to see that.

107

00:05:59,000 --> 00:06:01,000

That's why I want to test it.

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00:06:01,000 --> 00:06:07,000

Throughout history, material science has been at the cutting edge of advancements in armor.

109

00:06:07,000 --> 00:06:12,000

But is it really possible that the ancient Chinese manufactured paper armor

110

00:06:12,000 --> 00:06:16,000

capable of performing as well as its contemporary steel equivalent?

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00:06:16,000 --> 00:06:23,000

To find out, Kerry, Grant and Tori are arming themselves with the facts, and then the armor.

112

00:06:23,000 --> 00:06:25,000

Well, first up, I'd like to do some research.

113

00:06:25,000 --> 00:06:28,000

Talk to an expert, find out how the paper armor was possibly made

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00:06:28,000 --> 00:06:30,000

and what the steel counterpart would be.

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00:06:30,000 --> 00:06:34,000

Yeah, I mean, when we think of steel armor, we think of medieval armor like this,

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00:06:34,000 --> 00:06:37,000

but Chinese steel armor of the period may not have been like this at all.

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00:06:37,000 --> 00:06:40,000

So it sounds like we're going to need to get some steel armor of the period

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00:06:40,000 --> 00:06:42,000

and make ourselves some paper armor.

119

00:06:42,000 --> 00:06:46,000

Then we'll run them through some tests and see how the paper compares to the steel.

120

00:06:46,000 --> 00:06:47,000

I'm looking forward to this.

121

00:06:47,000 --> 00:06:51,000

For a paper armor myth, I've come up to the Napa Valley so that I can talk to Greg Martin.

122

00:06:51,000 --> 00:06:54,000

Now, he's an antique arms and armor expert.

123

00:06:54,000 --> 00:06:56,000

Hopefully, you'll have a little insight for me.

124

00:06:57,000 --> 00:07:03,000

And his first interesting insight is that the existence of paper armor is no myth at all.

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00:07:03,000 --> 00:07:08,000

Historically, paper armor is traced back to the Tang Dynasty, 600 BC.

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00:07:08,000 --> 00:07:11,000

And of course, the Chinese were very big developers of paper.

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00:07:11,000 --> 00:07:15,000

So it was stand to reason that paper armor would develop there.

128

00:07:15,000 --> 00:07:18,000

So how would paper armor likely have been constructed?

129

00:07:18,000 --> 00:07:25,000

By using what we call laminator paper was laminated together into squares

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00:07:25,000 --> 00:07:30,000

and then attached piece by piece and then would cover the entire body.

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00:07:30,000 --> 00:07:34,000

So, laminar paper armor really was used in ancient China.

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00:07:34,000 --> 00:07:38,000

There are records of multiple manufacturing methods and designs.

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00:07:38,000 --> 00:07:43,000

But the myth is that it was as effective as the steel armor of its day.

134

00:07:43,000 --> 00:07:44,000

An outrageous claim.

135

00:07:44,000 --> 00:07:48,000

And the team is skeptical, but there is some cause for hope.

136

00:07:48,000 --> 00:07:52,000

Now, we know from historical sources that they used a mulberry paper.

137

00:07:52,000 --> 00:07:56,000

Look at this. You can see the fibers. This is strong stuff.

138

00:07:56,000 --> 00:08:01,000

What they would do is they would stack layers of it together and that was enough to stop errors.

139

00:08:01,000 --> 00:08:09,000

Now, one source told us that they would take these layers of paper and laminate it with resin or some kind of shellac or even glue.

140

00:08:09,000 --> 00:08:14,000

Another source says that they would cover it with a cotton cloth and sew around the edges.

141

00:08:14,000 --> 00:08:18,000

What we're going to do is we're going to take all those techniques, find out which works best.

142

00:08:18,000 --> 00:08:23,000

Once we have that, then we'll be able to put that up against steel and see which one does best.

143

00:08:23,000 --> 00:08:27,000

And to test our armor pieces, we're going to use this.

144

00:08:27,000 --> 00:08:28,000

Ow!

145

00:08:28,000 --> 00:08:31,000

This is a sharpened tip on the end of a pneumatic cylinder.

146

00:08:31,000 --> 00:08:34,000

Here we have a chunk of ballistic material.

147

00:08:34,000 --> 00:08:45,000

Put each sample underneath and then fire the cylinder like this and see how each sample performs as a result of the puncture.

148

00:08:45,000 --> 00:08:49,000

And the best one will go on to make our final armor pieces.

149

00:08:49,000 --> 00:08:51,000

This is folded paper with cotton.

150

00:08:51,000 --> 00:08:57,000

So, the goal is to compare the range of historically accurate manufacturing methods.

151

00:08:57,000 --> 00:08:59,000

One. Wow, look at that.

152

00:08:59,000 --> 00:09:00,000

Wow.

153

00:09:00,000 --> 00:09:01,000

It actually stopped it.

154

00:09:01,000 --> 00:09:06,000

And decide which will give the steel the best run for its money.

155

00:09:06,000 --> 00:09:11,000

Each paper piece, regardless of its construction method, is one half inch thick.

156

00:09:11,000 --> 00:09:14,000

A dimension discovered in the research.

157

00:09:14,000 --> 00:09:16,000

Lacker made it more brittle and it actually went all the way through.

158

00:09:16,000 --> 00:09:22,000

And although shellac, an organic resin, may double up as an effective weapon.

159

00:09:22,000 --> 00:09:26,000

That actually stuck.

160

00:09:26,000 --> 00:09:34,000

The result that emerges is that hardened squares like lacquer lack the penetrative protection of the winning sample.

161

00:09:34,000 --> 00:09:37,000

Okay, and folded paper.

162

00:09:37,000 --> 00:09:38,000

Whoa!

163

00:09:38,000 --> 00:09:40,000

Oh my God, look at how well that works.

164

00:09:40,000 --> 00:09:43,000

This absolutely works the best. Simplicity.

165

00:09:44,000 --> 00:09:51,000

Now that we've found our winning paper construction, which is simply folded up paper, it's time to put it up against steel.

166

00:09:51,000 --> 00:09:55,000

So, we're going to be putting both of these materials against common weapons of the time.

167

00:09:55,000 --> 00:10:01,000

We're going to be doing blunt force, some kind of a club or a mace, a sword, and then finally an arrow.

168

00:10:01,000 --> 00:10:04,000

See which one performs the best.

169

00:10:04,000 --> 00:10:07,000

Later in depth charge disaster.

170

00:10:07,000 --> 00:10:08,000

Oh yeah.

171

00:10:08,000 --> 00:10:11,000

Adam and Jamie have a data with destiny.

172

00:10:11,000 --> 00:10:14,000

First, that is one dangerous looking machine.

173

00:10:14,000 --> 00:10:17,000

It's steel paper sword.

174

00:10:22,000 --> 00:10:27,000

Our trio of mythbusters have a martial mystery from Oriental history.

175

00:10:27,000 --> 00:10:33,000

Supposedly as a material for making armor, paper matches steel.

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00:10:33,000 --> 00:10:43,000

So far the team has discovered that of all the historically recorded manufacturing techniques, simple folded squares provide the most protection.

177

00:10:43,000 --> 00:10:46,000

This absolutely works the best.

178

00:10:46,000 --> 00:10:50,000

But they're still skeptical of paper's ability to match steel.

179

00:10:50,000 --> 00:10:59,000

So before they go all out and build a full suit of paper armor, paper will have to prove itself in an authentic setting.

180

00:10:59,000 --> 00:11:01,000

Greetings friends.

181

00:11:01,000 --> 00:11:11,000

Though this looks like an entirely authentic Tang dynasty household, it is in fact the best reproduction we could come up with for under $10. Cue the gong.

182

00:11:11,000 --> 00:11:15,000

And here's how this proof of concept will work.

183

00:11:15,000 --> 00:11:19,000

Paper will go up against steel in a series of weapons tests.

184

00:11:19,000 --> 00:11:29,000

And if the damage to a clay block beneath is reasonably comparable, only then will they move on to a full scale testing with full suits of armor.

185

00:11:29,000 --> 00:11:38,000

Now the way we're choosing our thickness of armor is we've done some research and the Lammelar armor was about 1.32 of an inch steel.

186

00:11:38,000 --> 00:11:42,000

As far as the paper armor goes, we found out that it was about a half inch thick.

187

00:11:42,000 --> 00:11:46,000

And a half inch thick equals about 28 sheets of the paper.

188

00:11:46,000 --> 00:11:51,000

To get things rolling, Grant wheels out a familiar robotic swinger.

189

00:11:52,000 --> 00:11:59,000

Calibrated to human swinging speeds, that's 125 miles per hour for the Data Divas out there.

190

00:11:59,000 --> 00:12:02,000

She's ready for weapon number one.

191

00:12:02,000 --> 00:12:09,000

So for our blunt force trauma test, we're going to use this. This is a reproduction of an ancient Chinese weapon called a chewy.

192

00:12:09,000 --> 00:12:11,000

That's going to do some damage, isn't it?

193

00:12:11,000 --> 00:12:13,000

Hopefully.

194

00:12:13,000 --> 00:12:20,000

First up, for a taste of the mace is the steel control. The material the mythical paper armor has to match.

195

00:12:20,000 --> 00:12:24,000

Trauma test in three, two, one.

196

00:12:24,000 --> 00:12:28,000

Wow, that did really well.

197

00:12:28,000 --> 00:12:35,000

Yep, the clay indentation is slight and shallow, but now for the all important comparison.

198

00:12:35,000 --> 00:12:38,000

Alright, let's see how paper armor can do.

199

00:12:38,000 --> 00:12:40,000

Okay, this is the trauma test.

200

00:12:40,000 --> 00:12:43,000

Oh, that looks good.

201

00:12:43,000 --> 00:12:45,000

That looks like it would hurt.

202

00:12:45,000 --> 00:12:53,000

And a look at the side by side impressions only enforces the impression that this myth belongs in the waste paper bin.

203

00:12:53,000 --> 00:12:55,000

I'd rather be wearing steel at this point.

204

00:12:55,000 --> 00:12:58,000

Alright, I think the steel wins in this situation.

205

00:12:58,000 --> 00:13:04,000

But there are two more chances to find out if paper cuts it as armor.

206

00:13:04,000 --> 00:13:07,000

See, I just cut my eyebrow.

207

00:13:07,000 --> 00:13:09,000

First, the sword.

208

00:13:09,000 --> 00:13:12,000

That is one dangerous looking machine.

209

00:13:12,000 --> 00:13:17,000

Just for reference, let's first see what the sword does to the unprotected clay.

210

00:13:17,000 --> 00:13:18,000

Ouch.

211

00:13:18,000 --> 00:13:19,000

Alright.

212

00:13:19,000 --> 00:13:20,000

Okay.

213

00:13:20,000 --> 00:13:23,000

It looks like it went in about an inch.

214

00:13:23,000 --> 00:13:25,000

Now for the cold hard steel.

215

00:13:25,000 --> 00:13:28,000

Three, two, one.

216

00:13:28,000 --> 00:13:30,000

Oh!

217

00:13:30,000 --> 00:13:38,000

Alright, you see here, the sword hit the steel armor and it put a dent in the clay, but it didn't actually cut through wounding the person.

218

00:13:38,000 --> 00:13:43,000

So now what we're going to do is we're going to switch out the steel armor for the paper armor and see what kind of damage it does on the clay.

219

00:13:43,000 --> 00:13:47,000

Wow.

220

00:13:47,000 --> 00:13:51,000

The result is astonishing. The damage is minimal.

221

00:13:51,000 --> 00:13:58,000

It's similar to the steel at a vast improvement on the inch deep slice experienced by the unprotected clay.

222

00:13:58,000 --> 00:14:01,000

It only cut like maybe two or three layers.

223

00:14:01,000 --> 00:14:03,000

That is crazy.

224

00:14:03,000 --> 00:14:06,000

Paper for armor.

225

00:14:06,000 --> 00:14:07,000

It could work.

226

00:14:07,000 --> 00:14:08,000

I'm impressed.

227

00:14:08,000 --> 00:14:10,000

It's looking great.

228

00:14:10,000 --> 00:14:15,000

Which brings us to the third and final weapons test, the arrow.

229

00:14:15,000 --> 00:14:17,000

Oh, it bounced back.

230

00:14:17,000 --> 00:14:20,000

Let's see how far it went in.

231

00:14:20,000 --> 00:14:21,000

That's it.

232

00:14:21,000 --> 00:14:22,000

That's it.

233

00:14:22,000 --> 00:14:24,000

That is less than a quarter of an inch.

234

00:14:24,000 --> 00:14:29,000

So paper has one final chance to prove it's metal against the metal.

235

00:14:29,000 --> 00:14:32,000

In three, two, one.

236

00:14:32,000 --> 00:14:42,000

And hold on to your skeptics hat because despite the arrow's penetration into the paper, the clay beneath survived better than it did against the steel.

237

00:14:42,000 --> 00:14:44,000

Wow.

238

00:14:44,000 --> 00:14:45,000

Look at that.

239

00:14:45,000 --> 00:14:47,000

I think the arrow went deeper on the steel armor.

240

00:14:47,000 --> 00:14:48,000

Yep.

241

00:14:48,000 --> 00:14:49,000

It's concept proof.

242

00:14:49,000 --> 00:14:57,000

The paper more or less matched the metal and this myth can move on.

243

00:14:57,000 --> 00:15:07,000

To best avoid injury from an underwater depth charge, would it really make a difference lying supine on the surface?

244

00:15:07,000 --> 00:15:14,000

Intent on investigating, Adam and Jamie will set off an underwater shockwave and measure it at various depths.

245

00:15:14,000 --> 00:15:15,000

All right.

246

00:15:15,000 --> 00:15:19,000

This is my finished shockwave producing remote firing pistol.

247

00:15:19,000 --> 00:15:27,000

It will fire only blank rounds because I have put a little shockwave disperser in so that it disperses the shockwave both exactly up and exactly down.

248

00:15:27,000 --> 00:15:35,000

I put a blank round in it, cock it, and then from above the water, I can fire it, generating the shockwave we need for instrumentation.

249

00:15:35,000 --> 00:15:40,000

To measure the shockwave from the handgun blank is the final item on Jamie's list.

250

00:15:40,000 --> 00:15:43,000

Four pressure sensors held in place by magnets.

251

00:15:43,000 --> 00:15:45,000

Here we go.

252

00:15:45,000 --> 00:15:47,000

Hey, it worked.

253

00:15:47,000 --> 00:15:50,000

So what's the water tube going to tell us after this test?

254

00:15:50,000 --> 00:15:53,000

Are we going to get a much higher blast pressure here than here?

255

00:15:53,000 --> 00:15:59,000

It's an interesting question because the pressure here is already at 4.2 pounds per square inch.

256

00:15:59,000 --> 00:16:04,000

Up here, it's only two pounds per square inch and that's just from the weight of the water.

257

00:16:04,000 --> 00:16:05,000

It feels like a bank heist.

258

00:16:05,000 --> 00:16:11,000

So that combined with the explosion, I think it's going to inherently give us a higher blast pressure down there.

259

00:16:11,000 --> 00:16:17,000

But will that equate to death while treading water, while life, while lying flat on your back?

260

00:16:17,000 --> 00:16:18,000

I don't think so.

261

00:16:18,000 --> 00:16:20,000

Okay, we're hot.

262

00:16:20,000 --> 00:16:28,000

The question we're trying to answer here is whether there's some feature to do with depth underwater and the associated pressures,

263

00:16:28,000 --> 00:16:31,000

the greater the depth, the more intense the shockwave.

264

00:16:31,000 --> 00:16:33,000

That is perfect.

265

00:16:33,000 --> 00:16:37,000

The shallower the depth, the less intense the shockwave and the safer you'll be.

266

00:16:37,000 --> 00:16:39,000

What do I think?

267

00:16:40,000 --> 00:16:42,000

I don't think there's going to be much of a difference.

268

00:16:42,000 --> 00:16:47,000

So both mythbusters are skeptical, but science is an evidence-based discipline.

269

00:16:47,000 --> 00:16:52,000

This is depth charge, disaster, small scale test.

270

00:16:52,000 --> 00:16:54,000

Hopefully not making me too wet.

271

00:16:54,000 --> 00:16:57,000

In three, two, one.

272

00:16:58,000 --> 00:16:59,000

Nice.

273

00:16:59,000 --> 00:17:04,000

Well, the sensors did register a result and the tank didn't spring a leak,

274

00:17:04,000 --> 00:17:07,000

but a close look reveals the numbers aren't ideal.

275

00:17:07,000 --> 00:17:08,000

So what did we get?

276

00:17:08,000 --> 00:17:13,000

Well, it's looking awfully noisy, but we're getting some interesting numbers.

277

00:17:13,000 --> 00:17:19,000

Unfortunately, the close proximity of the walls of the tank to the explosion is affecting those pressure waves

278

00:17:19,000 --> 00:17:24,000

and creating noise, which is obscuring the measurements that we're looking for.

279

00:17:25,000 --> 00:17:29,000

That noise, the reflected shockwaves bouncing around in the narrow tank,

280

00:17:29,000 --> 00:17:31,000

Is it still noisy?

281

00:17:31,000 --> 00:17:36,000

Means the peak pressure wave for each individual sensor is difficult to determine.

282

00:17:36,000 --> 00:17:38,000

Let's run it again.

283

00:17:39,000 --> 00:17:44,000

But three man's later and they have enough data points for a pattern to emerge.

284

00:17:44,000 --> 00:17:47,000

Alright kids, put down your juice boxes and pay attention.

285

00:17:47,000 --> 00:17:49,000

It's time for the moment you've been waiting for.

286

00:17:49,000 --> 00:17:51,000

It's time to interpret the numbers.

287

00:17:51,000 --> 00:17:54,000

Remember that if there was anything to this story at all,

288

00:17:54,000 --> 00:17:58,000

if depth, you didn't play a factor in increasing the force of a shockwave,

289

00:17:58,000 --> 00:18:02,000

we should see that the deeper sensors would give us a higher reading

290

00:18:02,000 --> 00:18:05,000

than the shallower sensors at the same distance.

291

00:18:05,000 --> 00:18:06,000

And that is what we're seeing.

292

00:18:06,000 --> 00:18:12,000

In every one of our tests, the sensor 3 readings are higher than the sensor 2 readings.

293

00:18:12,000 --> 00:18:16,000

The sensor 4 readings are higher than the sensor 1 readings.

294

00:18:16,000 --> 00:18:21,000

That tells me at least that in small scale, there might just be something to this story.

295

00:18:21,000 --> 00:18:28,000

So paper armor has potential.

296

00:18:28,000 --> 00:18:30,000

I think it might be time for us to go full scale.

297

00:18:30,000 --> 00:18:34,000

Let's make armor out of paper and put it up against steel in a series of challenges.

298

00:18:34,000 --> 00:18:37,000

I love it. We'll put each of the armor on and then run through a series of tests.

299

00:18:37,000 --> 00:18:40,000

Maybe we'll test speed, agility and endurance.

300

00:18:40,000 --> 00:18:43,000

And we'll have to have some kind of ultimate battle between the two suits.

301

00:18:43,000 --> 00:18:45,000

Not worrying, of course.

302

00:18:45,000 --> 00:18:46,000

Pick a number.

303

00:18:46,000 --> 00:18:50,000

So cue the full scale monumental mission.

304

00:18:50,000 --> 00:18:52,000

You're a dork.

305

00:18:52,000 --> 00:18:55,000

To make a full suit of paper armor.

306

00:18:55,000 --> 00:18:58,000

Only 850 to go.

307

00:18:58,000 --> 00:19:03,000

And the less taxing task of having a real steel one delivered.

308

00:19:03,000 --> 00:19:09,000

So to put our paper armor to the test, we're going to pit it against a metal suit of armor from the same period.

309

00:19:09,000 --> 00:19:15,000

Now, because this is hard to make, we ordered it from a modern armory company in the Ukraine.

310

00:19:15,000 --> 00:19:17,000

And it's battle ready.

311

00:19:17,000 --> 00:19:20,000

Who wants some?

312

00:19:22,000 --> 00:19:24,000

Else, we do parties.

313

00:19:24,000 --> 00:19:28,000

Meanwhile, Tori gets busy pulling the paper armor design together.

314

00:19:28,000 --> 00:19:34,000

A design based on these ancient drawings and Grant's period accurate steel replica.

315

00:19:34,000 --> 00:19:39,000

Now, if you look at the steel armor, the scales have holes drilled into them and they're tied together with leather straps.

316

00:19:39,000 --> 00:19:41,000

Plus, they are overlapping.

317

00:19:41,000 --> 00:19:44,000

Now, there are no gaps in the armor.

318

00:19:44,000 --> 00:19:46,000

I think we need to do the exact same thing.

319

00:19:46,000 --> 00:19:52,000

Take our paper scales, drill some holes into them, overlap them and tie them together with cotton cord.

320

00:19:52,000 --> 00:19:56,000

Producing this season's hot new paper armor is a huge job.

321

00:19:56,000 --> 00:20:00,000

So the Mythbusters sweatshop is open for business.

322

00:20:00,000 --> 00:20:12,000

And after a week's hard work, hundreds of lamellar plates have been sewn together to form a full suit of armor that, after some minor tailoring, will be ready to go into battle.

323

00:20:12,000 --> 00:20:16,000

Oh, Kerry, I just don't know about this paper motif.

324

00:20:16,000 --> 00:20:20,000

I don't know if the judges are really going to like it or not.

325

00:20:20,000 --> 00:20:22,000

Oh well, make it work.

326

00:20:22,000 --> 00:20:25,000

The question is, will it work as well as steel?

327

00:20:25,000 --> 00:20:29,000

To find out, the team is signing up for basic battle training.

328

00:20:29,000 --> 00:20:31,000

Hang up!

329

00:20:31,000 --> 00:20:36,000

Now that we have our full suits of armor made, it's time to put them to the test.

330

00:20:36,000 --> 00:20:40,000

We're going to put our suits head to head in the types of things that you would find in battle.

331

00:20:40,000 --> 00:20:45,000

Namely, speed, agility and endurance.

332

00:20:45,000 --> 00:20:48,000

Oh, my back.

333

00:20:48,000 --> 00:20:54,000

First event in the Armor Olympics is the 50 yard sprint with sword.

334

00:20:54,000 --> 00:20:56,000

Well, you couldn't find me a giant pair of scissors to run with.

335

00:20:56,000 --> 00:21:01,000

Well, you will be wearing a suit of armor. This season's must have safety gear.

336

00:21:01,000 --> 00:21:05,000

Here on Mythbusters, we are making science.

337

00:21:05,000 --> 00:21:07,000

Cool.

338

00:21:08,000 --> 00:21:12,000

So I'm about to take my speed run in the paper armor.

339

00:21:12,000 --> 00:21:16,000

Alright, this is sprinting in paper armor. Are you ready?

340

00:21:16,000 --> 00:21:20,000

And I'd say I do think that the paper armor is going to encumber me a little bit,

341

00:21:20,000 --> 00:21:24,000

just because I've got the armor right down here where my legs are.

342

00:21:24,000 --> 00:21:28,000

Here we go. On your mark, get set.

343

00:21:28,000 --> 00:21:30,000

We'll see how I do.

344

00:21:38,000 --> 00:21:41,000

So eight seconds is the benchmark.

345

00:21:41,000 --> 00:21:46,000

And although the paper is undoubtedly bulkier, the steel is twice as heavy.

346

00:21:46,000 --> 00:21:51,000

Meanwhile, Tori, looking for revenge for past transgressions,

347

00:21:51,000 --> 00:21:54,000

fails to dent Grant's defenses.

348

00:21:56,000 --> 00:21:59,000

Call that a kick. Let's do this.

349

00:21:59,000 --> 00:22:02,000

Now to make sure that Grant is testing these armors fairly,

350

00:22:02,000 --> 00:22:04,000

we're going to let him rest in between tests,

351

00:22:04,000 --> 00:22:07,000

so that way he has full energy for each of the runs.

352

00:22:07,000 --> 00:22:10,000

Kind of reminds me of Raiders of the Lost Ark.

353

00:22:13,000 --> 00:22:15,000

On your marks, get set.

354

00:22:16,000 --> 00:22:20,000

I'm just saying I'm really surprised at how little of a difference there is

355

00:22:20,000 --> 00:22:23,000

between the paper and the steel armor.

356

00:22:23,000 --> 00:22:26,000

I can't believe there's only a second difference.

357

00:22:26,000 --> 00:22:31,000

Yep, the bulkier, more restrictive paper armor performed fractionally better.

358

00:22:31,000 --> 00:22:35,000

But with so little in it, conclusions can't be drawn just yet.

359

00:22:35,000 --> 00:22:37,000

Q-Test 2.

360

00:22:37,000 --> 00:22:41,000

Now for the endurance part of this test, I will be running a mile through these hills

361

00:22:41,000 --> 00:22:43,000

and then ending up on that side of the moat.

362

00:22:43,000 --> 00:22:48,000

At which point I will try to jump up onto the rope and cross over.

363

00:22:48,000 --> 00:22:50,000

So that's the course.

364

00:22:50,000 --> 00:22:51,000

Go!

365

00:22:51,000 --> 00:22:54,000

Now for the time trial in paper.

366

00:22:54,000 --> 00:22:56,000

I don't know if I'm going to have the energy to fight when I get there.

367

00:22:56,000 --> 00:23:00,000

With the armor weighing in at close to 30 pounds, it's tough going.

368

00:23:01,000 --> 00:23:03,000

Now the running wasn't so bad in the paper armor.

369

00:23:03,000 --> 00:23:06,000

I mean it is awkward you have all this bulk on you.

370

00:23:06,000 --> 00:23:08,000

I am tore, part of the paper clamp.

371

00:23:08,000 --> 00:23:11,000

But climbing over the rope, I get too old for this.

372

00:23:11,000 --> 00:23:13,000

I thought I had it.

373

00:23:13,000 --> 00:23:17,000

But about midway there, my legs fell off the rope.

374

00:23:17,000 --> 00:23:19,000

Once I lost my legs.

375

00:23:19,000 --> 00:23:21,000

You pull yourself back up?

376

00:23:21,000 --> 00:23:22,000

Do it!

377

00:23:22,000 --> 00:23:24,000

I knew that was it, I was going in.

378

00:23:25,000 --> 00:23:27,000

It's fresh!

379

00:23:27,000 --> 00:23:28,000

Ah!

380

00:23:28,000 --> 00:23:29,000

F***!

381

00:23:29,000 --> 00:23:31,000

Gleep indeed.

382

00:23:31,000 --> 00:23:34,000

Because paper and water don't necessarily mix.

383

00:23:34,000 --> 00:23:38,000

But luckily it has a chance to dry out overnight.

384

00:23:38,000 --> 00:23:43,000

Whether it will retain its structural integrity for the test to come is another matter.

385

00:23:43,000 --> 00:23:45,000

And speaking of tests to come,

386

00:23:45,000 --> 00:23:51,000

Tori's time to beat tomorrow while wearing steel is just short of 12 minutes.

387

00:23:52,000 --> 00:23:53,000

Boom!

388

00:23:53,000 --> 00:23:58,000

Coming up on Mythbusters, we replace this cardboard boom with the real McCoy.

389

00:24:02,000 --> 00:24:04,000

So where do we stand?

390

00:24:04,000 --> 00:24:10,000

Well, our data is a little noisy, but it does seem to be supporting the central tenant of this myth,

391

00:24:10,000 --> 00:24:15,000

which is that depth does seem to be a factor in increasing shockwave strength.

392

00:24:15,000 --> 00:24:18,000

Yeah, but the data is just too noisy, I don't trust it.

393

00:24:18,000 --> 00:24:20,000

I think we need to go full scale.

394

00:24:20,000 --> 00:24:21,000

To a quarry lake?

395

00:24:21,000 --> 00:24:22,000

Could be.

396

00:24:23,000 --> 00:24:26,000

Oh, look at you, aren't you Mr. Television?

397

00:24:26,000 --> 00:24:28,000

Come on, let's get to work.

398

00:24:28,000 --> 00:24:32,000

To test this story, we're going to set off a series of explosions 15 feet underwater

399

00:24:32,000 --> 00:24:36,000

and measure them with sensors placed at different depths nearby.

400

00:24:39,000 --> 00:24:43,000

I claimed it short in the name of Mythbusters and Science in general.

401

00:24:43,000 --> 00:24:47,000

Now for all this to be accurate, we need to be able to locate the explosives

402

00:24:47,000 --> 00:24:50,000

and the sensors in a precise orientation to each other.

403

00:24:53,000 --> 00:24:55,000

What'd you let it go for?

404

00:24:55,000 --> 00:24:58,000

I didn't realize it would pull so hard.

405

00:24:58,000 --> 00:25:01,000

To pull that off, we're going to use a variety of ropes and anchors.

406

00:25:01,000 --> 00:25:05,000

Alright, that's our sensor array, booey.

407

00:25:05,000 --> 00:25:09,000

The sensor array with its PCB sensors at five different depths

408

00:25:09,000 --> 00:25:13,000

will be positioned at three distances from the site of the explosion

409

00:25:13,000 --> 00:25:18,000

and that spread of 15 data points is designed to answer the question

410

00:25:18,000 --> 00:25:22,000

how best to survive a depth charge disaster?

411

00:25:22,000 --> 00:25:27,000

And with the lake rigged with all the relevant anchors and buoys, the bomb boys arrive.

412

00:25:27,000 --> 00:25:30,000

Now whenever we use explosives, we bring in the professionals.

413

00:25:30,000 --> 00:25:35,000

Retired FBI Special Agent Frank Doyle and the Calaveras County Bomb Squad.

414

00:25:36,000 --> 00:25:41,000

Sporting a look available at www.shadesanduniforms.bomb,

415

00:25:41,000 --> 00:25:47,000

these are the guys that will make sure all three big booms happen safely.

416

00:25:47,000 --> 00:25:52,000

Meanwhile, Adam with his sensitive mast is focusing on data acquisition.

417

00:25:52,000 --> 00:25:54,000

This is my sensor mast.

418

00:25:54,000 --> 00:25:57,000

These five devices are my sensors.

419

00:25:57,000 --> 00:25:59,000

In a few minutes, I'm going to join them all together

420

00:25:59,000 --> 00:26:02,000

and put them in the water to make the largest piece of data gathering scientific equipment

421

00:26:02,000 --> 00:26:06,000

we have yet built and used in the history of the show.

422

00:26:06,000 --> 00:26:08,000

That's no exaggeration.

423

00:26:08,000 --> 00:26:12,000

Attached to a floating rig will be five high-tech pressure transducers

424

00:26:12,000 --> 00:26:17,000

at five different depths, all linked to a central command center.

425

00:26:18,000 --> 00:26:21,000

Let's talk about the constants and variables in this experiment.

426

00:26:21,000 --> 00:26:25,000

As far as the constants go, we're always going to be using TNT.

427

00:26:25,000 --> 00:26:28,000

We're going to be using 10 pounds, which is five of these things,

428

00:26:28,000 --> 00:26:32,000

and they're going to be hanging at 15 feet below the surface of the water

429

00:26:32,000 --> 00:26:34,000

where the explosion will occur.

430

00:26:34,000 --> 00:26:35,000

Boom!

431

00:26:35,000 --> 00:26:37,000

Also a constant are the sensors.

432

00:26:37,000 --> 00:26:41,000

They're going to be placed at five different depths, both above and below water,

433

00:26:41,000 --> 00:26:44,000

and they'll be the same for every blast.

434

00:26:44,000 --> 00:26:46,000

I feel safer already.

435

00:26:46,000 --> 00:26:48,000

As far as variables, there's only one,

436

00:26:48,000 --> 00:26:51,000

and that's the distance of the sensor array from the explosion.

437

00:26:51,000 --> 00:26:54,000

Now we're going to start at 150 feet away

438

00:26:54,000 --> 00:26:59,000

and move progressively closer, recording the readings that we get off the sensors at each stage.

439

00:26:59,000 --> 00:27:02,000

Hey, look at that. It's working beautifully.

440

00:27:02,000 --> 00:27:07,000

All right. How are we going to use our sensors to represent a body lying flat on its back

441

00:27:07,000 --> 00:27:09,000

versus a body treading water?

442

00:27:09,000 --> 00:27:11,000

Here's what we're thinking.

443

00:27:12,000 --> 00:27:16,000

We determined that the torso of a person lying flat on their back on the surface

444

00:27:16,000 --> 00:27:18,000

has an average depth of about six inches.

445

00:27:18,000 --> 00:27:21,000

We also determined that the torso of a person treading water

446

00:27:21,000 --> 00:27:24,000

has an average depth of about two feet.

447

00:27:24,000 --> 00:27:25,000

Why the torso?

448

00:27:25,000 --> 00:27:28,000

No, because that's where the air pockets are.

449

00:27:28,000 --> 00:27:30,000

That's where our sensors are going.

450

00:27:31,000 --> 00:27:34,000

Yep, it's a gruesome but important detail.

451

00:27:34,000 --> 00:27:38,000

Injuries from underwater explosions are primarily caused

452

00:27:38,000 --> 00:27:44,000

when shockwaves pass through internal air cavities, such as the lungs and intestines.

453

00:27:44,000 --> 00:27:47,000

Hence the focus on the depth of the torso.

454

00:27:47,000 --> 00:27:50,000

Ten pounds of underwater fun.

455

00:27:50,000 --> 00:27:52,000

Well, everything's prepped.

456

00:27:52,000 --> 00:27:55,000

Yep, nothing left but an explosion.

457

00:27:55,000 --> 00:27:57,000

Unfortunately, you're going to have to wait for that explosion

458

00:27:57,000 --> 00:28:00,000

for these commercial messages and perhaps some other bitbusters.

459

00:28:01,000 --> 00:28:08,000

Tori is rested, ready and looking not so hot.

460

00:28:08,000 --> 00:28:12,000

You know what, this thing will protect me from arrows and getting dates.

461

00:28:14,000 --> 00:28:16,000

Come on Tori, you can do it!

462

00:28:16,000 --> 00:28:17,000

Go!

463

00:28:17,000 --> 00:28:22,000

The question is, how will Tori's time in steel compare to the 12-minute paper run?

464

00:28:22,000 --> 00:28:24,000

And will he even survive?

465

00:28:24,000 --> 00:28:27,000

No, there's actually a little jeopardy to this test

466

00:28:27,000 --> 00:28:30,000

because first of all, the run is going to be really hard.

467

00:28:30,000 --> 00:28:32,000

It's going to be slow, that thing is heavy.

468

00:28:32,000 --> 00:28:34,000

This sucks big time.

469

00:28:34,000 --> 00:28:40,000

But, climbing this rope over this water, he's wearing 60 pounds of steel.

470

00:28:40,000 --> 00:28:43,000

He goes into the drink that's six feet deep.

471

00:28:43,000 --> 00:28:44,000

How do you extra-

472

00:28:44,000 --> 00:28:45,000

Look at the weight!

473

00:28:45,000 --> 00:28:49,000

There's no way you're making it across that rope.

474

00:28:49,000 --> 00:28:51,000

I don't think I'm going to make it.

475

00:28:52,000 --> 00:28:55,000

Somebody stick a spear in me, I'm done.

476

00:28:55,000 --> 00:28:57,000

The weight of the steel was the killer.

477

00:28:57,000 --> 00:29:03,000

Tori took an additional five minutes to complete the run and then couldn't climb the rope.

478

00:29:03,000 --> 00:29:10,000

So an army traveling any kind of distance on foot would be at a distinct disadvantage in the heavier steel,

479

00:29:10,000 --> 00:29:12,000

which means paper wins that round.

480

00:29:13,000 --> 00:29:19,000

For the final event in the Armour Olympics, agility, courtesy of some time-bending editing,

481

00:29:19,000 --> 00:29:24,000

Kari will simultaneously tackle the Assault Course in steel and paper.

482

00:29:24,000 --> 00:29:29,000

After drying out overnight, the paper doesn't appear to have suffered any damage,

483

00:29:29,000 --> 00:29:31,000

but it's still just as awkward.

484

00:29:32,000 --> 00:29:35,000

It's definitely not as heavy as the steel Armour.

485

00:29:35,000 --> 00:29:36,000

Not a lot of give here.

486

00:29:36,000 --> 00:29:39,000

Okay, here we go. In three, two, one.

487

00:29:41,000 --> 00:29:45,000

Go, go, go, pick up those feet! Pick up those feet!

488

00:29:45,000 --> 00:29:48,000

On the first obstacle, the paper already has an advantage.

489

00:29:51,000 --> 00:29:54,000

The weight difference is clearly the key factor.

490

00:29:54,000 --> 00:29:59,000

Halfway into the course, and paper-clad Kari has already opened up a big lead.

491

00:29:59,000 --> 00:30:02,000

Come on, Byron! Go, go, go, go, go, go!

492

00:30:02,000 --> 00:30:06,000

And while crawling, the paper may well be slowing Kari down.

493

00:30:06,000 --> 00:30:09,000

Uh-oh, she's having a little trouble with the sand pit.

494

00:30:09,000 --> 00:30:12,000

But the steel almost brings her to a halt.

495

00:30:15,000 --> 00:30:16,000

The paper's in the way!

496

00:30:16,000 --> 00:30:19,000

Which pretty much sums it up for the rest of the Agility Course.

497

00:30:19,000 --> 00:30:24,000

The paper may be awkward, but the weight of the steel seals the deal.

498

00:30:25,000 --> 00:30:26,000

Good work.

499

00:30:26,000 --> 00:30:31,000

So with the first three events in the Armour Olympics complete, the conclusion is clear.

500

00:30:31,000 --> 00:30:34,000

Paper is outperforming steel.

501

00:30:34,000 --> 00:30:37,000

But now is the real test, the battle test.

502

00:30:37,000 --> 00:30:42,000

We're going to use weapons from the period and see if it can still stand up to metal.

503

00:30:46,000 --> 00:30:50,000

Welcome back. Let me walk you through our setup.

504

00:30:50,000 --> 00:30:57,000

Out there in the middle of the lake, tied to a buoy, we've got ten pounds of explosives floating 15 feet below the surface.

505

00:30:57,000 --> 00:31:00,000

Oh, it does nicely. Great.

506

00:31:00,000 --> 00:31:07,000

150 feet away from our explosives, we have our sensor mask with five sensors that detect shock waves mounted to it.

507

00:31:07,000 --> 00:31:10,000

One above the water and four below at the following depths.

508

00:31:10,000 --> 00:31:15,000

One at six inches below the water. This simulates someone lying flat on their back at the surface of the water.

509

00:31:15,000 --> 00:31:19,000

One two feet under the water. This simulates our person who is treading water.

510

00:31:19,000 --> 00:31:23,000

One 15 feet below the surface at the exact level of the explosives.

511

00:31:23,000 --> 00:31:29,000

And one deeper than the explosives mounted all the way down 25 feet below the water surface.

512

00:31:29,000 --> 00:31:36,000

Each explosion will cause movement in the sensors, which will be translated into electrical energy, which will be sent as data through these wires.

513

00:31:36,000 --> 00:31:42,000

That data will find its final resting place here in the equipment man by David Harding, who will crunch our numbers.

514

00:31:42,000 --> 00:31:47,000

After three blasts, we'll end up with 15 data points and hopefully the answer to our question.

515

00:31:47,000 --> 00:31:54,000

Now, normally we would do something like set off a blast, look at the data, set up another blast, look at the data, etc.

516

00:31:54,000 --> 00:31:56,000

I think we're good to go, huh?

517

00:31:56,000 --> 00:32:01,000

In this case, we're not going to do that. We're going to set up all three of our blasts in as short a period of time as possible.

518

00:32:01,000 --> 00:32:03,000

I don't know!

519

00:32:03,000 --> 00:32:08,000

We're doing this for two reasons. One, so that the condition the explosions happen under is really, really similar.

520

00:32:08,000 --> 00:32:10,000

That makes our data much more consistent.

521

00:32:10,000 --> 00:32:12,000

I don't know!

522

00:32:12,000 --> 00:32:18,000

Second reason is the numbers we're going to be looking at might be quite subtle and only by correlating across all three blasts.

523

00:32:18,000 --> 00:32:21,000

Are we going to be sure that we're telling a proper story?

524

00:32:21,000 --> 00:32:24,000

Here we go for data acquisition stage one.

525

00:32:24,000 --> 00:32:27,000

Or the first big boom of the day.

526

00:32:27,000 --> 00:32:31,000

150 feet in three, two, one.

527

00:32:33,000 --> 00:32:34,000

Yeah!

528

00:32:34,000 --> 00:32:36,000

Wow!

529

00:32:36,000 --> 00:32:38,000

That was a hell of a thud!

530

00:32:38,000 --> 00:32:47,000

That blast was really unexpectedly cool. It had three distinct kind of whumps to it, like a boom, boom, boom.

531

00:32:47,000 --> 00:32:49,000

Very cool.

532

00:32:49,000 --> 00:32:51,000

Oh, look at that.

533

00:32:51,000 --> 00:32:53,000

That is just lovely.

534

00:32:53,000 --> 00:32:56,000

I'm always astonished by how fast the shock wave maps.

535

00:32:56,000 --> 00:32:59,000

Yeah, it's done and gone before you actually see anything happen.

536

00:32:59,000 --> 00:33:04,000

You think that this is all the explosion and actually that's way after that's the aftermath.

537

00:33:04,000 --> 00:33:09,000

The blast one went off perfectly and David says we got good data from all the sensors.

538

00:33:09,000 --> 00:33:14,000

We are going to withhold looking at them for now. We're going to go right into blast two from 70 feet.

539

00:33:14,000 --> 00:33:16,000

Okay, that ought to do it.

540

00:33:16,000 --> 00:33:21,000

Firing in three, two, one.

541

00:33:21,000 --> 00:33:23,000

Whoa!

542

00:33:23,000 --> 00:33:25,000

Whoa, look how high that went!

543

00:33:25,000 --> 00:33:27,000

Wow!

544

00:33:27,000 --> 00:33:29,000

Alright, well let's go look at the high speed.

545

00:33:29,000 --> 00:33:32,000

So what actually happens during an underwater explosion?

546

00:33:32,000 --> 00:33:40,000

Well, the explosion creates a rapidly expanding gas bubble that pushes water in front of it and that creates a pressure wave.

547

00:33:40,000 --> 00:33:45,000

It's that pressure wave that we're looking at because that is what could potentially hurt a human.

548

00:33:45,000 --> 00:33:53,000

But the question is, does that hurt potential and your very survival depend on a difference in depth?

549

00:33:53,000 --> 00:33:54,000

That's truly awesome.

550

00:33:54,000 --> 00:33:56,000

It's pretty.

551

00:33:56,000 --> 00:34:02,000

To answer that, the race is on for numbers and the third and final data point.

552

00:34:02,000 --> 00:34:06,000

But David says we got good data from the first two blasts. Shall we prep for the last one?

553

00:34:06,000 --> 00:34:07,000

Great, I'll set it up.

554

00:34:07,000 --> 00:34:08,000

Alright.

555

00:34:08,000 --> 00:34:13,000

Want to know why we did what we did and didn't do what we didn't do? Check out the after show.

556

00:34:13,000 --> 00:34:17,000

Log on to Discovery.com slash MythBusters after show.

557

00:34:18,000 --> 00:34:29,000

As incredible as it sounds, paper armor is holding up against its contemporary steel equivalent.

558

00:34:29,000 --> 00:34:33,000

But the team has yet to put paper in front of the firing squad.

559

00:34:33,000 --> 00:34:34,000

Good work.

560

00:34:34,000 --> 00:34:43,000

So now that both steel and paper armor have passed through the agility tests, it is time to see how well they protect under a full-scale attack.

561

00:34:43,000 --> 00:34:45,000

What we are going to do is set up some mannequins.

562

00:34:46,000 --> 00:34:48,000

Grim up is going to get dangerous.

563

00:34:48,000 --> 00:34:57,000

Cover those mannequins with both armors and then attack them on a full-scale with swords, arrows and even an ancient gun.

564

00:34:57,000 --> 00:35:02,000

Then we'll be able to find out once and for all, is paper armor as good as steel armor?

565

00:35:02,000 --> 00:35:09,000

But perhaps paper's biggest test will come not from our trio of weapon-wielding barbarians, but a second soaking.

566

00:35:09,000 --> 00:35:11,000

This time from the heavens.

567

00:35:11,000 --> 00:35:15,000

Or more accurately, the condensation of atmospheric water vapor.

568

00:35:17,000 --> 00:35:22,000

The rain may indeed weaken the paper and favor the steel, but it's a real-world problem.

569

00:35:22,000 --> 00:35:28,000

If paper is to prove itself as protective armor, it'll have to cope with a light shower.

570

00:35:28,000 --> 00:35:29,000

We're all set.

571

00:35:29,000 --> 00:35:33,000

Now we're going to start with the arrow test and just throw a barrage of arrows at them.

572

00:35:33,000 --> 00:35:34,000

Remember the watcha?

573

00:35:34,000 --> 00:35:36,000

Watcha!

574

00:35:37,000 --> 00:35:38,000

I'm going to watcha them.

575

00:35:38,000 --> 00:35:39,000

So watcha this.

576

00:35:39,000 --> 00:35:41,000

And so the barrage begins.

577

00:35:41,000 --> 00:35:46,000

Carry Torian Grand Lett loose from 20 feet at both sets of armor.

578

00:35:46,000 --> 00:35:54,000

And despite being soaked, softened and sodden, the paper protects our male model mannequins as well as the steel does.

579

00:35:57,000 --> 00:35:58,000

Holy work!

580

00:35:59,000 --> 00:36:01,000

That is phenomenal!

581

00:36:01,000 --> 00:36:02,000

That's the worst!

582

00:36:02,000 --> 00:36:04,000

The paper armor is stopping the arrows.

583

00:36:04,000 --> 00:36:07,000

We have not got one arrow to penetrate through.

584

00:36:07,000 --> 00:36:12,000

I mean, it doesn't look as good as the steel armor, but the important thing is, it's working.

585

00:36:13,000 --> 00:36:15,000

Next up, the sword test.

586

00:36:15,000 --> 00:36:17,000

Slicing, dicing, jabbing, stabbing.

587

00:36:17,000 --> 00:36:21,000

I'm just going to go and try to maim those guys.

588

00:36:21,000 --> 00:36:22,000

Alright, carry.

589

00:36:22,000 --> 00:36:24,000

Just swing wildly.

590

00:36:24,000 --> 00:36:29,000

Using both an edge slicing stroke and a stabbing action.

591

00:36:31,000 --> 00:36:32,000

Oh, I felt that one.

592

00:36:32,000 --> 00:36:37,000

Carry finds the dial marked crazy and turns it up to 11.

593

00:36:37,000 --> 00:36:38,000

I'll tell you one thing.

594

00:36:38,000 --> 00:36:41,000

It's interesting the sound you make when you're attacking.

595

00:36:41,000 --> 00:36:43,000

I didn't actually mean to verbalize all the eh.

596

00:36:47,000 --> 00:36:48,000

Working out some issues there?

597

00:36:48,000 --> 00:36:54,000

I'm going to get myself a stabbing mannequin for home, because it's a really good way to work out aggression.

598

00:36:54,000 --> 00:36:59,000

And speaking of aggression, where does that leave the mannequins and the myth?

599

00:36:59,000 --> 00:37:03,000

It looks like it's separating through, but it's stopping before it even gets halfway through the tile.

600

00:37:03,000 --> 00:37:05,000

That's great.

601

00:37:05,000 --> 00:37:08,000

Yes, the paper armor is working.

602

00:37:08,000 --> 00:37:16,000

On any individual stab, slice, or arrow shot, a previously undamaged scale clearly matches the metal.

603

00:37:16,000 --> 00:37:21,000

But Tori sees a key armor attribute where steel trumps paper.

604

00:37:21,000 --> 00:37:25,000

Now, right now the paper armor is stopping the sword attacks, just like the steel armor.

605

00:37:25,000 --> 00:37:29,000

However, after multiple attacks, the paper armor starts to break down.

606

00:37:29,000 --> 00:37:32,000

It's looking like the steel armor is a lot more durable.

607

00:37:32,000 --> 00:37:33,000

Next weapon.

608

00:37:33,000 --> 00:37:40,000

And this is where we surely draw the line on paper, because gunpowder has just been invented.

609

00:37:40,000 --> 00:37:46,000

Okay, Greg, so for our experiment, we need a firearm that would have been of the era of the paper armor.

610

00:37:46,000 --> 00:37:47,000

What do you have?

611

00:37:47,000 --> 00:37:51,000

Well, a paper armor was used up to the 19th century.

612

00:37:51,000 --> 00:37:58,000

Let's try something from the 18th century, which is this French flintlock pistol from about 1750.

613

00:37:58,000 --> 00:38:00,000

Okay, let's do it.

614

00:38:01,000 --> 00:38:05,000

And first up, facing the flintlock is the metal.

615

00:38:05,000 --> 00:38:07,000

Nice shot.

616

00:38:07,000 --> 00:38:10,000

Followed by its fibrous franning.

617

00:38:12,000 --> 00:38:14,000

Now to assess the results.

618

00:38:14,000 --> 00:38:15,000

Ouch, did it go through?

619

00:38:15,000 --> 00:38:17,000

It didn't go through.

620

00:38:17,000 --> 00:38:19,000

The paper armor stopped.

621

00:38:19,000 --> 00:38:21,000

The paper armor stopped the bullet.

622

00:38:21,000 --> 00:38:23,000

And it looks like the steel stopped the bullet as well.

623

00:38:23,000 --> 00:38:26,000

Both these armors are effective against this weapon.

624

00:38:26,000 --> 00:38:33,000

With paper once again in the same league of steel, this myth requires a further fast forward in time.

625

00:38:33,000 --> 00:38:38,000

So now we're going to try our 19th century gun, the Colt 45, 1200 foot pounds of muzzle energy.

626

00:38:38,000 --> 00:38:41,000

This should put our paper armor to the test.

627

00:38:41,000 --> 00:38:46,000

This is 19th century gun versus steel and paper armor.

628

00:38:46,000 --> 00:38:50,000

Here we go. In three, two, one.

629

00:38:53,000 --> 00:38:55,000

And neither stood a chance.

630

00:38:55,000 --> 00:38:59,000

Well, it's obvious it punctured the steel and it looks like it went through the paper as well.

631

00:38:59,000 --> 00:39:07,000

With both sets of armor succumbing to the souped up firepower, it's time to conclude this ancient Chinese conundrum.

632

00:39:07,000 --> 00:39:13,000

Okay, paper armor performed the same as steel with every test we've done and it failed in the same place as well.

633

00:39:13,000 --> 00:39:17,000

Yeah, it just seems that the guns got too powerful for the armor.

634

00:39:17,000 --> 00:39:21,000

I've really been wanting to do this story for a long time because it seems so outlandish.

635

00:39:21,000 --> 00:39:27,000

But it's super impressive. Paper armor is actually a viable option in warfare.

636

00:39:27,000 --> 00:39:30,000

Viable, but there is one notable drawback.

637

00:39:30,000 --> 00:39:36,000

As you can see, it doesn't have the same durability as the steel, but it still works.

638

00:39:36,000 --> 00:39:38,000

So this one is plausible.

639

00:39:38,000 --> 00:39:39,000

Plausible?

640

00:39:39,000 --> 00:39:42,000

Plausible it is. Unbelievable.

641

00:39:44,000 --> 00:39:49,000

Welcome back.

642

00:39:49,000 --> 00:39:54,000

Jamie and I have been spending this episode exploring the idea that if you're in the water during an underwater explosion,

643

00:39:54,000 --> 00:39:59,000

you are far safer lying flat on your back at the surface than you are even treading water.

644

00:39:59,000 --> 00:40:01,000

We've done some small scale experiments.

645

00:40:01,000 --> 00:40:04,000

We've done some large scale blasts in this here quarry lake.

646

00:40:04,000 --> 00:40:06,000

Not yet. Looked at our data.

647

00:40:06,000 --> 00:40:09,000

We have one more data point to get. One more blast.

648

00:40:09,000 --> 00:40:15,000

And then we're going to look and see if it actually correlates to what the Smith purports to say.

649

00:40:15,000 --> 00:40:17,000

Okay, 30 feet. Are you good to go?

650

00:40:17,000 --> 00:40:18,000

I'm good to go. Let's do it.

651

00:40:18,000 --> 00:40:21,000

In three, two, one.

652

00:40:28,000 --> 00:40:32,000

Those of you keeping score, 10 pounds of explosives, 15 feet under the water,

653

00:40:32,000 --> 00:40:37,000

130 feet from where you're standing on land feels exactly like an earthquake.

654

00:40:39,000 --> 00:40:43,000

Well, it all comes down to this. David's crunching our last set of numbers,

655

00:40:43,000 --> 00:40:47,000

and that's the final piece of the puzzle that we need to answer our question.

656

00:40:47,000 --> 00:40:56,000

Remember, the question is, during an underwater explosion, does it really make a difference lying on your back compared to treading water?

657

00:40:58,000 --> 00:41:02,000

And the threshold number to keep in mind is...

658

00:41:02,000 --> 00:41:10,000

What our research has uncovered is that people exposed to a pressure of 87 PSI or higher have a greater than 50% chance of dying.

659

00:41:10,000 --> 00:41:16,000

That's our threshold then. Anything below 87 PSI milliseconds is alive. Anything above it equals dead.

660

00:41:16,000 --> 00:41:21,000

And hot off the portable printer, the figures make for a pair of happy mythbusters.

661

00:41:21,000 --> 00:41:25,000

Remember, Jamie smiles on the inside.

662

00:41:25,000 --> 00:41:27,000

Dude!

663

00:41:27,000 --> 00:41:29,000

Check that out!

664

00:41:30,000 --> 00:41:32,000

Nicely done!

665

00:41:32,000 --> 00:41:34,000

It doesn't get any clearer than that.

666

00:41:34,000 --> 00:41:35,000

It totally does not.

667

00:41:35,000 --> 00:41:39,000

I have to admit we have rarely gotten data this lovely.

668

00:41:39,000 --> 00:41:45,000

We had five sensors, three blasts for 15 separate data points, and this whole story comes down to two data points.

669

00:41:45,000 --> 00:41:51,000

The sensor we had at six inches versus the sensor we had at two feet for the blast from 30 feet away.

670

00:41:51,000 --> 00:41:58,000

That blast would have killed you if you were treading water and you would have lived through it if you were lying flat on your back.

671

00:41:58,000 --> 00:42:03,000

That's the story we came to tell, and that's the story the data tells. It's lovely.

672

00:42:03,000 --> 00:42:10,000

It's a definitive set of data, all right, but to really put this myth to bed, Jamie reads it a story called Why.

673

00:42:10,000 --> 00:42:14,000

All this data is great, but what it doesn't tell us is why.

674

00:42:14,000 --> 00:42:17,000

Now, I did a bunch of digging around, and this is what I found.

675

00:42:17,000 --> 00:42:22,000

Energy doesn't like to transition from one material to another if they're different.

676

00:42:22,000 --> 00:42:25,000

The more different they are, the more it doesn't like it.

677

00:42:25,000 --> 00:42:32,000

So in the case of an explosion underwater, as that pressure wave travels towards the surface, it bounces off because it can't pass through it.

678

00:42:32,000 --> 00:42:42,000

And what it does is it transitions from a pressure wave to a tensile wave, and therefore it's able to neutralize a lot of the energy, especially in that surface zone.

679

00:42:42,000 --> 00:42:44,000

And that's why it's safer there.

680

00:42:44,000 --> 00:42:51,000

So soldiers in the military are told that in the case of an underwater explosion, they are far safer if they are lying on the surface of the water flat on their back.

681

00:42:51,000 --> 00:42:54,000

Then if they're treading water, what is our answer to that?

682

00:42:54,000 --> 00:42:57,000

That's exactly what we found. They got it right. It's confirmed.

683

00:42:57,000 --> 00:42:59,000

Totally confirmed. Let's go.

684

00:42:59,000 --> 00:43:05,000

I'll tell you, even though that last blast would have been survivable if I was lying on the surface, I wouldn't want to try it.

685

00:43:05,000 --> 00:43:08,000

Yeah, that was like being in an earthquake.