CD319

DECEMBER 2017

DICKSON insights

A UNIVERSAL LANGUAGE

Using Mathematical Principles to Understand Biological Entities

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TWP Touchscreen • PAGE 9

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LETTER FROM THE EDITOR

A SIMPLE EQUATION

Healthcare + Math = Innovation

Creating something new is never easy. It often takes thought provoking ideas and months, if not years, of research, sometimes to never even see an idea come to fruition. By bringing in experts from several disciplines, however, something beautiful can be made.

That's happening in the world of healthcare. Experts in the discipline of mathematics are partnering with leading researchers in health to innovate in ways like never before. When viral research is combined with geometry, we can learn not only what something looks like, but how it's built. By understanding how something is built, we can learn how to disassemble it and even stop it from developing.

In the pages that follow, you'll learn more about how math and healthcare could lead to new forms of treatment and prevention in the future, as well as other articles relating to keeping your assets safe and your auditors happy.

Thanks for reading, and I hope you enjoy the December issue of Dickson Insights.

JEFF RENOE
INSIGHTS EDITOR-IN-CHIEF

Dickson is now offering more robust validation packages. See page 14 to learn more about validation or visit **DicksonData.com/validation** to see what's new.

INSIGHTS

FEATURE

ALSO IN THIS ISSUE

Want to know your facility better? **Leave it to us.**

TEMPERATURE MAPPING EXPERTS

LET DICKSON'S SKILLED PROFESSIONALS GET YOU UP TO DATE.

Temperature mapping your facility, warehouse, or equipment is a daunting task. We know, we've done it a lot. Dickson can help keep your business fully compliant, streamline your business operations, and protect sensitive products with our temperature mapping services.

PLAN OF ATTACK

We evaluate and decide where to place devices for a successful mapping.

MEET AUDIT REQUIREMENTS

Rely on our expertise to create reports that are defendable in an audit.

DICKSON CALIBRATED DEVICES

No 3rd party vendors here saving you time and headaches.

WATCH WHILE WE WORK

We'll handle the process from start to finish so you don't lose time.

ENVIRONMENTAL INVESTIGATION

We're here to digest, analyze, and help you understand your facility and its data.

LET'S GET STARTED.

Once the mapping has ascertained where the points of temperature variation lie within a temperature controlled environment, then permanent monitoring can be installed so that owners and users can prove their adherence to the related health and safety standards.

CONTACT A SPECIALIST TODAY.

Intense temperature can put your audit at risk. Book your winter mapping study now to keep your assets from freezing.

630-563-4215

HEALTHCARE IN ZERO G

By Rachel Kellett

WHEN MOST OF US think of space missions, we picture the scenes and images portrayed in thrilling Hollywood movies such as *The Martian*, *Interstellar*, or *Life*. It all seems so exciting, scary, and incredibly fascinating. But have you ever stopped to think about what life is really like while up in space? Better yet, have you ever stopped to think about what happens when an astronaut gets sick or hurt in orbit?

Throughout decades of space travel, luckily, no astronaut has ever had a major injury or needed surgery in space. However, if humans ever venture past low Earth orbit and outward toward deeper space, chances are someone is going to get hurt. Matthieu Komorowski, an aspiring astronaut and current anesthesiologist, wrote in the Journal of Cardiothoracic and Vascular Anesthesia, "For a crew of six on a 900-day mission to Mars, that's pretty much one major emergency all but guaranteed."

AS YOU ENTER SPACE and spend some time there, your body starts to change. Your blood vessels don't constrict and dilate as well, your red cell mass goes down, your total blood circulation decreases, and your immune system weakens making you more susceptible to bacteria. Aside from those changes, the other most common dangers that come with space travel are radiation, muscle atrophy, decreased bone density, and psychiatric decompensation.

So what equipment is aboard the International Space Station to combat these dangers? The crew has access to a small pharmacy, an automated emergency defibrillator, IV fluids, dental equipment and other diagnostic equipment like blood pressure cuffs. For internal injuries such as internal bleeding or fluid levels, the space station crew also carries an ultrasound device.

Vaccines, specifically flu shots, may also be added to the list. Astronaut Scott Kelly was the first to receive a flu shot aboard the ISS on his year-long journey in 2016. In order to compare how the body reacts to the vaccine in space, Kelly's twin brother, Mark, received the same flu shot on earth. Research on the vaccination is still ongoing, but NASA journalist Rachel Hobson says, "Understanding exactly which parts of the immune system are altered during spaceflight will help scientists know how to ensure that crew members maintain a healthy immune system during long flights, and stay protected against infections from Earth when visitors arrive at the space station."

GREAT, SO THEY'RE EQUIPPED, but who knows how to use all of this stuff? Is there a doctor at the space station? The answer is no. It's the astronauts themselves that learn the basic medical procedures as part of their pre-expedition training. Examples of what they learn include inserting a chest tube and administering fluids. Some even spend time assisting in emergency rooms to get some firsthand experience. In spite of this training, nothing compares to the actual challenge of medical care in space. Among other challenging factors, blood can splatter and pool even more than usual due to the lack of gravity and IV's require a pump to keep bubbles from floating to the top of the solution.

Although there usually isn't a doctor on board, there is an on call surgeon on the ground. Engineer and retired NASA astronaut, Steve Swanson, recalls, "There's a few things we train to handle right away. Anything besides that, we were going to be calling the ground." The surgeon can help guide the crew through a procedure, or help determine if he or she needs to come home via a Soyuz for immediate medical attention.

THE DECISION TO COME HOME is a big deal. That kind of decision goes all the way to the flight director and head of NASA. It's because there could potentially be a lot of complications concerning the Soyuz and the patient's injury. Swanson explains, "If someone breaks a leg, how would you get them in a pressure suit?" The Soyuz capsule is a cramped fit. "They're really bent up in there. If the patient is intubated, on a ventilator with oxygen tanks, they won't fit into the Soyuz at all, much less into a pressure suit."

NASA is currently sponsoring research to discover a way to solve these complications. For now, it is at least comforting to know that astronauts are prepared and trained to handle medical emergencies to keep each other safe.

*Have something personal you'd like to add to the conversation? Send us your thoughts to **jeff@dicksondata.com** for a chance to be featured in a future blog or magazine.*

WELCOME TO THE CLOUD

DATA AT YOUR FINGERTIPS. ANYTIME. ANYWHERE.

DicksonOne

TAKE

POWER

OVER YOUR ENVIRONMENT

with **DicksonOne**

We've re-thought temperature and humidity monitoring making it easier, scalable, and cost effective.

Your data. How you want it. When you want it.

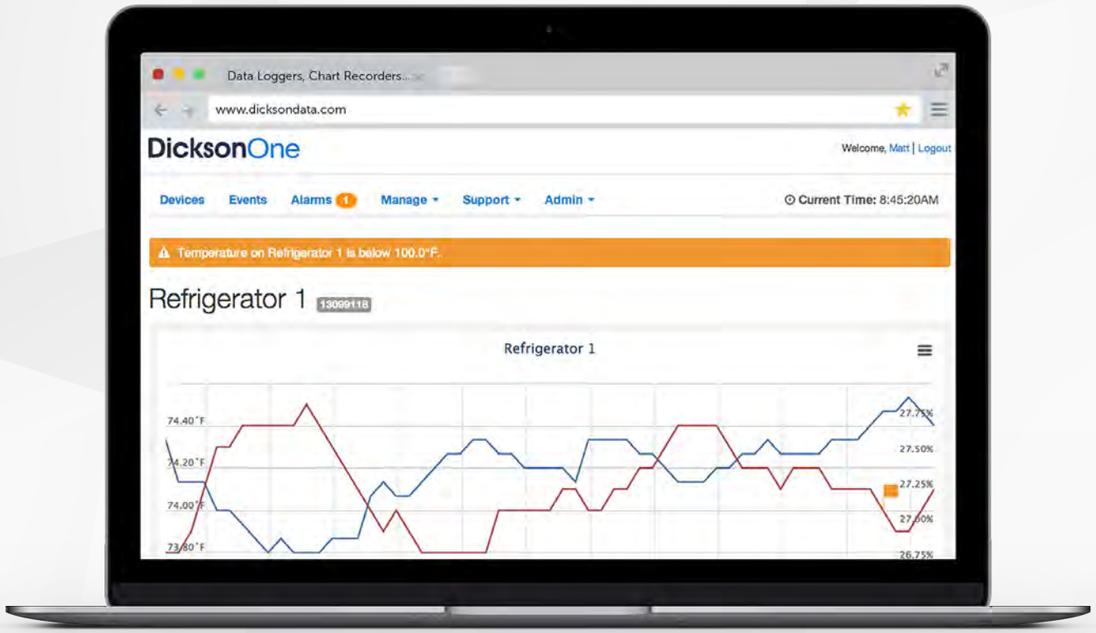
FocusFeature

LEGACY UPLOADER

Have you been a Dickson customer for a while? Have a lot of our legacy data loggers laying around? Breathe some new life into those devices by enabling the Legacy Uploader functionality in **DicksonWare Secure**. It allows you to automate the download process, share, and add context to your data. Plus it's now included in **DicksonWare Secure** at no extra cost.

*For more details, visit **DicksonData.com/Uploader**.*

DICKSONONE • **OVERVIEW**



Secure

We utilize bank-grade security and Amazon Web Services for unparalleled reliability.

Anywhere

Wherever you are, access your data anywhere, anytime, 24/7.

Infinite

Securely store all your data in the cloud, whether you're recording for days, months, or years.

Automated

Devices send all collected data to the DicksonOne servers automatically, so you don't have to.

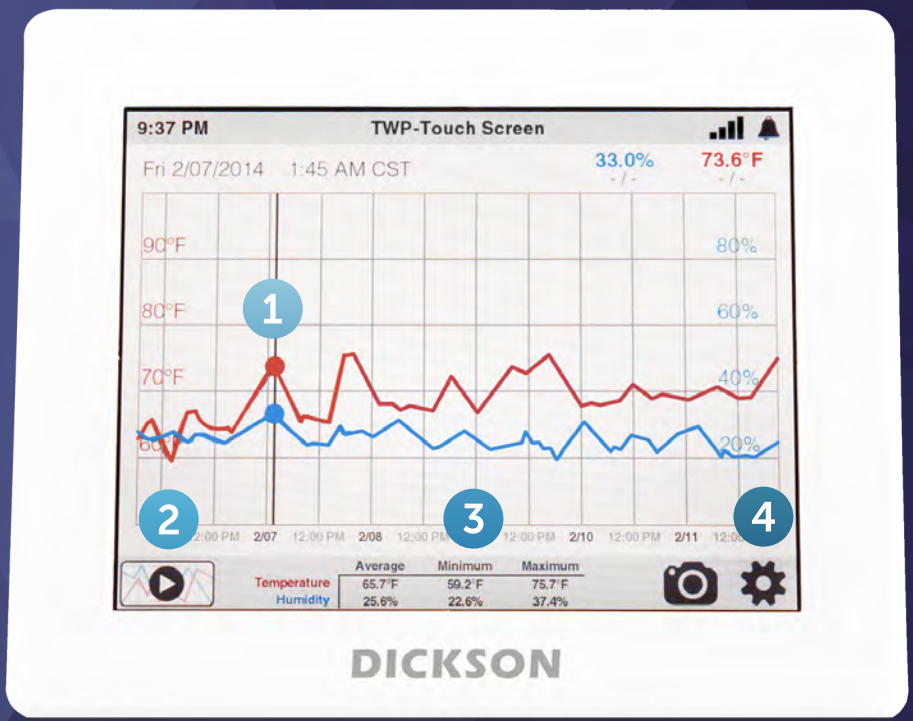
On Your Time

Create customizable reports delivered exactly when you want them.

Immediate

Receive real-time email, text, or phone call alarms when excursions occur.

Your data.
Only a Touch Away.



1 The Graph

We updated the user-interface, and made it easy to view and manage your data.

2 Monitoring

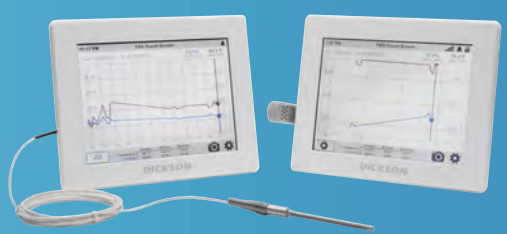
Pushing the play button brings you back to the most recent readings, updating the view in real-time.

3 Your Channels

The touchscreen automatically calculates and updates summary data for the selected time range.

4 Settings

Easily adjust sample rates, set alarms, and connect to **Dickson**One.



DicksonOne Enabled • Capacitive LCD Touchscreen
Replaceable Sensors • WiFi, Ethernet, and USB Connectivity

The Touchscreen

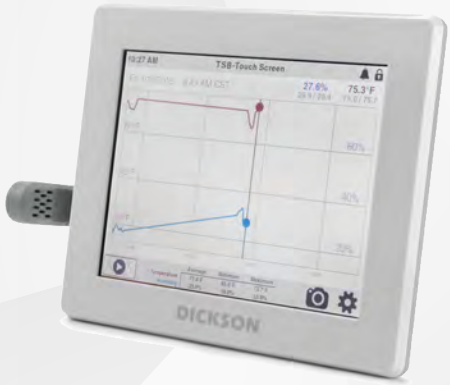
The Touchscreen gives you the option to connect directly to **Dickson**One. You get all of your data at your fingertips, and now you can access it anywhere too. Just connect your device to your local WiFi network or plug it into an Ethernet port, log into **Dickson**One, and boom, complete data control.

Email us at support@dicksonone.com • Talk to a specialist at 630.563.4215

DicksonOne

Touchscreen

MODEL	REMOTE PROBE	PRICE
TSB	USB Download	$424
TWE	**Dickson**One Wifi/Ethernet Connection and Download	$524
TWP	**Dickson**One Download and Power over Ethernet	$599



DicksonOne

Display Logger

MODEL	REMOTE PROBE	PRICE
DWE	**Dickson**One Wifi/Ethernet Connection and Download	Starting at $350

DicksonOne

Software

One of the most common pain points when discussing monitoring is the retrieval of data. **Dickson**One loggers send data to the cloud automatically, freeing up resources to do what they do best.

Per device billing now available!
$3
per device, per month
(requires a credit card)

BASIC	STARTER	REGULAR	PLUS	ENTERPRISE
$0	$300	$725	$1,400	Call for Quote
Unlimited Devices Data stored for 30 days 1 hour sample interval	1-10 Devices Data stored for life of account Multiple sample rates Email, Phone, & Text Alerts API Access	11-25 Devices Data stored for life of account Multiple sample rates Email, Phone, & Text Alerts API Access	26-50 Devices Data stored for life of account Multiple sample rates Email, Phone, & Text Alerts API Access	51+ Devices Data stored for life of account Multiple sample rates Email, Phone, & Text Alerts API Access

REMOVING THE HAZE

Features and Security Set the Cloud Apart

By Matt McNamara

Part 2

The Cloud and its Advantages

As we started discussing last month, the cloud offers its users a variety of benefits that sometimes go unseen or unrecognized. We've already shared thoughts on the costs associated with the Cloud and differences between paid services and "free" services. Today we're going to talk about how the cloud benefits customers from a performance and security standpoint.

Features, Function, + Performance

Last month we used Adobe's Creative Cloud as a prime case study of cloud based offerings, and the comparison will continue here. While every user of Adobe may not have updated their software every year in the past, there were always new features to be had that made it run faster, allowed users to do more than before, or helped them complete work faster.

In traditional software models, users had to pay for a new version of the software in order to obtain the benefits of the updated release. In SaaS models, you generally receive the new features automatically as a function of being a paying customer on a month-to-month or year-to-year basis. This is important because as technology advances, the ability to do more with software and hardware advances as well.

On the software side, you might have something like a new feature in a web browser that enables faster performance or even new capabilities that weren't available before. On the hardware side, products like the iPad have extended the reach and capabilities of software platforms that would've been locked to a single location or machine in the past. Rarely, if ever, do you have to pay for the use of a service's mobile app on top of their webapp, resulting in added functionality and freedom built right into the service's subscription.

Using Adobe again as an example, their Lightroom mobile app is a great example of this. Included with your monthly subscription is a syncing feature that lets you seamlessly transfer images between a desktop and your mobile device. While the apps aren't as full-featured as the computer version, they offer a surprising amount of functionality considering they work on a computer that fits in your pocket or small bag.

The ability to add features on the fly without needing to upgrade servers, apply patches or updates, or deal with downtime not only saves time and money, but also adds functionality to your existing product. If done correctly, it can also help improve the security of the system as well.

Security and Compliance

If done responsibly and correctly, the ability to release updates to software on the fly is a major advantage for the users of SaaS. While there is risk of new bugs in any update to software, a company that performs the appropriate testing on their system is likely to minimize those risks.

Controlling a SaaS application's infrastructure and running a single version of code allows the creators of software to maintain stability for more users much more efficiently. Additionally, they can release a patch for any security vulnerabilities or bug fixes as they happen with tools that are often proactively reporting on these areas of concern. This results in quicker fixes and ultimately a more secure environment.

In the compliance world, releases can often mean more work for those who use equipment or software in validated environments. Admittedly, regulations have not kept up with the changes in how modern software is created and deployed and this only complicates the process. But, I want to make the case that SaaS software is better for two reasons:

1. As regulations change, your existing system can adapt to your changing needs quickly
2. If there's an issue (security or functionality), the developer can release a remedy very quickly and eliminate downtime in critical environments

While the end user's work following an update may be a hindrance, the benefits they offer can often make any setback a worthwhile one. Ultimately, however, whether or not the benefits outweigh the cost is a decision that each customer must decide for themselves. D

If you are a customer who is in a compliance heavy environment and have questions regarding the benefits of the cloud in your environment and how our customers handle some of the challenges, we're here to guide you. Learn more on our website or call ***630.563.4215.***

Have something personal you'd like to add to the conversation? Send us your thoughts to ***jeff@dicksondata.com*** *for a chance to be featured in a future blog or magazine.*

There's No Reason to Improve on the Best.
We Did it Anyway.

DSB

The newest member to the Dickson family.

Dickson's Display Loggers, one of our top annual sellers, have been fully redesigned to incorporate features from our best selling devices into non-connected units.

The logger will be able to collect all of the temperature and humidity data you've become accustomed to from Dickson's replaceable sensors. You can learn more about Replaceable Sensors on page 20.

Starting at $199, the DSB is now available to order! Visit **DicksonData.com/DSB** for more info.

TEMPERATURE SENSORS STARTING AT $110

- Single/Dual K-Theromocouple Temperature Sensor
- Single/Dual Temperature Thermistor Sensor
- Ambient Temperature & Humidity Sensor
- Platinum RTD Temperature Sensor
- Ambient Temperature Sensor

REPLACEABLE SENSORS

UPDATED DICKSONWARE

UP TO 2X THE BATTERY LIFE

MORE COMPACT DESIGN

Introducing **Legacy Uploader.**

View, analyze and export your data in a 21CFR11 compliant environment. Want to share your data with others throughout the company? Then manually upload all of your downloaded data to the **Dickson**One Cloud thanks to our new Legacy Uploader tool.

*For more details, visit **DicksonData.com/Uploader**.*

Get more out of **DicksonWare.**

Why go digital? **That's easy.**

DicksonWare now allows you to store and share data easily with others in your organization by uploading it to our cloud-based environmental monitoring system, **Dickson**One.

For more information visit DicksonData.com/DicksonWare.

ANALYZE YOUR DATA

View your temperature monitoring data historically, graphed in detail to allow you to pull insights and recognize any excursions as they occurred.

SIMPLIFY SHARING

Not only can you view temperature and humidity data on your phone, tablet, or computer, you can also grant data access to key employees through individual user logins.

VIEW YOUR DATA

Take your data with you wherever it's been uploaded. And, thanks to our new Legacy Uploader, you can save your data to the cloud to view on any connected device.

VALIDATION SERVICES

SOLUTIONS TO SUIT YOU

Why Dickson?

If you're in the quality assurance business like us, validation is a term you hear every day. "Validation" falls under the umbrella of terms businesses use to discuss the quality of their product, facility, or service. For those not well-versed in the world of quality assurance, hearing "validation" can send you running to hide under your desk. Luckily, Dickson offers validation services for our **Dickson**One and **DicksonWare** software customers, also including temperature controlled equipment such as refrigerators, stability chambers, freezers, walk-in chambers, and much more.

IQ
INSTALLATION QUALIFICATION

TESTS
VERIFICATION OF CORRECT EQUIPMENT INSTALLATION

ENSURES
CORRECT INSTALLATION OF SYSTEM PER SPECS

ESTABLISHES
A BASELINE FOR EQUIPMENT

OQ
OPERATIONAL QUALIFICATION

TESTS
VERIFICATION OF CORRECT EQUIPMENT OPERATION

ENSURES
CORRECT OPERATION OF SYSTEM PER SPECS

VERIFIES
SYSTEM MEETS CLAIMS FROM PARAMETER

PQ
PERFORMANCE QUALIFICATION

TESTS
VERIFICATION OF CORRECT EQUIPMENT PERFORMANCE

ENSURES
CORRECT PERFORMANCE OF SYSTEM PER SPECS

VERIFIES
SYSTEM MEETS CUSTOMER'S INTENDED PURPOSE

Is your company ready for a quotation or need more information?
Contact a specialist today at 630.563.4215

SETTING THE STANDARD

Calibration Services

Calibrations are essential to all devices that measure a variable. However, we often get the questions, "Why isn't it accurate already?" and "Isn't it made to be accurate?" The answers are: it is, and yes. However, while our devices are accurate without calibrations, we can't be positive they are accurate to a specific measurable degree (and thus can't prove their accuracy) unless we perform a calibration.

HOW CALIBRATION **WORKS**

STEP ONE

We compare your sensor with a standard sensor in a stable environment across a range of temperature readings.

STEP TWO

If there are any differences between the sensor and the standard, we adjust the sensor to align with the standard.

STEP THREE

We run through this process multiple times, adjusting the device as it is compared at multiple temperatures.

STEP FOUR

We perform a final check of one or more points, depending on the order, and create the necessary calibration certificate.

CALIBRATION OPTIONS

What works for my company?

1-POINT **NIST**

- One specific temperature point (middle) calibration
- Good if your temperature varies little
- Choice to specify the temperature point to best reflect your application

3-POINT **NIST**

- Three-point (high, middle, and low) temperature point calibration
- Grants a larger proof of accuracy
- Choice to specify the temperature points to best reflect your application

Need help? **Let us be your calibration expert.** | 630.563.4215 | support@dicksondata.com

INSTALLATION & IMPLEMENTATION

SAVE TIME ON YOUR TIME.

Let's face it. Time is one of our most valuable resources, and you don't have enough of it. It's why we offer installation. We want to help you get some of it back. That means if time really does equal money, then working with Dickson is like putting money in the bank. It doesn't take a venture capitalist to recognize that as a smart investment.

DICKSON'S FOUR-POINT PLAN

INSTALL
Easy just got easier. Let us give you your time back by installing your loggers wherever, whenever.

CONFIGURE
We'll take the time to connect your devices to the cloud and manage any alarms that you request.

TEST
Once everything is up and running we will test the devices to ensure they're working as intended.

TRAIN
Your system is ready to go, but we'll be there to answer any questions you may still have.

OUR INSTALLATION OPTIONS

SELF
Easily install DicksonOne units on your own.

By following along with our installation guide, it should take just a few minutes for each device in your system to be in "set it and forget it" mode.

TURNKEY
Sit back and we'll take care of everything.

We'll install the devices and set up the software on your behalf, and you'll have the peace of mind in knowing it's all been done right.

HYBRID
Let us help you with some of the heavy lifting.

Your team installs the units and we help manage the software's implementation, including user-invitations, alarms, location setup, permissions and more.

TRAINING

Want the most out of your **Dickson**One system? We offer training courses to ensure that your team is getting the most from your company's investment.

LET'S TALK.

Is your company ready for a quotation or need more information?

Contact a specialist today at 630.563.4215

CHART RECORDERS

Want a physical readout right where you are monitoring? Our Chart Recorders have you covered. For ninety years we've built the best chart recorders in the business. Check out our models below.

8 and 6 Inch Models

MODEL	FEATURES	STARTING PRICE
KT6	6 Inch Temperature	$384
KT8	8 Inch Temperature	$436
TH6	6 Inch Temperature and Humidity	$509
TH8	8 Inch Temperature and Humidity	$509

4 and 3 Inch Models

MODEL	FEATURES	STARTING PRICE
SL4350	4 Inch Temperature	$249
SL4100	4 Inch Temperature	$249
SC367	3 Inch Temperature	$249

Pressure Recorders

MODEL	FEATURES	STARTING PRICE
PW4	4 Inch Chart Recorder < 1000 PSI	$469
PW86	8 Inch Chart Recorder < 1000 PSI	$654
PW87	8 Inch Chart Recorder ≥ 1000 PSI	$779

Visit **DicksonData.com/products/find/pressure** for a full list of available pressure loggers.

DATA LOGGERS

For data loggers, information (temperature/humidity measurement and date and time) is stored as information. That data is stored in the device for later download (via software) onto a computer, or sent to a cloud application or server for remote access.

Indicators

TC700 Touchscreen Handheld Indicator — $299
Instant temperature data.
No-slip silicone cover. Battery powered.
Temperature Range: -200 to 1999°F, (-128 to 1093°C)

TH700 Touchscreen Handheld Indicator — $299
Instant temperature/humidity data.
No-slip silicone cover. Battery powered.
Temperature Range: -40 to 185°F, (-40 to 85°C)
Humidity Range: 0 to 95% RH (non-condensing)

High Temperature

HT300 Waterproof, High Temperature Data Logger — $349
HACCP and FDA Compliant. USB Download. IP68 Rating.
Temperature Range: -40°F to 257°F, -40°C to 125°C
1 & 3 Point Calibration options available.

HT350 High Temperature Process Logger — $349
HACCP Compliant. K-Thermocouple Probe, USB Download, and a large temperature range.
Temperature Range: -40 to 257°F (-40 to 125°C)
1 & 3 Point Calibration options available.

Compact

SP125 — $119
Temperature Logger
Accuracy: ±1.2°F, ±.7°C
Range: -10°F to 176°F, -23°C to 80°C

TP125 — $199
Temperature & Humidity Logger
Accuracy: ±0.8°F, ±.44°C
Range: -10°F to 176°F, -23°C to 80°C
Humidity: +/-2% RH from 0 to 60%; +/-3% RH from 60 to 95%

SK550 — $699
Temperature Logger Pack of 12
Accuracy: ±1.8°F, ±1°C
Range: -4°F to 158°F, -20°C to 70°C

TK550 — $999
Temperature & Humidity Logger Pack of 12
Accuracy: ±1.8°F, ±1°C
Range: -4°F to 158°F, -20°C to 70°C
Humidity: ±2% RH from 0 to 60%; ±3% RH from 60 to 95%

Display

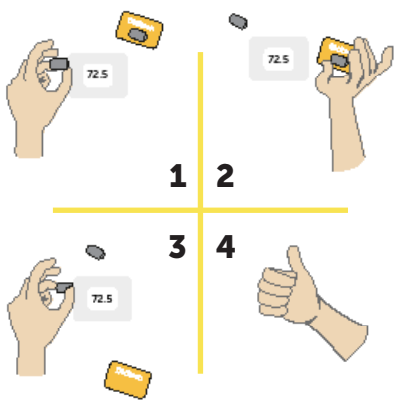
SP425 — $159
Data Logger with Large Display
Accuracy: ±1.2°F, ±.7°C
Range: -4°F to 158°F, -20°C to 70°C

TP425 — $249
Temperature & Humidity
Accuracy: ±0.8°F, ±.44°C
Range: -4°F to 158°F, -20°C to 70°C
Humidity: ±2% RH from 0 to 60%; ±3% RH from 60 to 95%

CONVENIENCE IS KEY

ALL YOUR CALIBRATION DATA RIGHT ON THE SENSOR.

Now, you have the option to calibrate the sensor as opposed to the unit. Think of it like this: the Replaceable Sensor takes an environmental reading, and the data logger or chart recorder records that environmental reading. By splitting up the sensor from the data logger and chart recorder, we've created a plug and play device that will keep you in compliance and save you time and resources.



ZERO DOWN TIME

All Dickson sensors come pre-calibrated with upgrade and certificate options.

FAST & EFFICIENT

Pull the old sensor off. Put the new sensor on. It's that simple.

COST-EFFECTIVE

Back up units are no longer needed. Pay for a sensor, not an extra device.

FORMUL(a)IC APPROACH

By Jeff Renoe

How Mathematics Is Impacting Healthcare In More Ways Than You Realize

IN THE WORLD, THERE IS ONE LANGUAGE that is universal to every culture. It doesn't change regardless of where you are or what you believe. It's hidden in plain sight and you use it every day whether you like it or not. It's mathematics.

The fact that mathematics is a language that all can understand isn't an altogether novel idea. Carl Sagan, an American astronomer, cosmologist, astrophysicist, and astrobiologist, used the idea as the basis for his book, turned movie, *Contact*. In his book, the main character states that, "Mathematics is the only true universal language." For the purpose of his novel, he justifies the thought and this was also showcased in the film adaptation of the book.

When a strange signal is intercepted by a listening station in the desert, Dr. Ellie Arroway quickly discerns that it is providing a list of prime numbers--the first 100 of them to be exact. In case you don't remember prime numbers from school, and you wouldn't be the only one, a prime number is a whole number greater than 1, whose only two whole-number factors are one and itself. This means the first 10 prime numbers are 2,3,5,7,11,13,17,19, 23 and 29, because they cannot be divided evenly by any whole number. So, why would an alien race choose math, let alone prime numbers, to be what they use to make their initial contact with Earth? *Plus*, the internet magazine devoted to math, shared the reasoning.

"The indivisibility of prime numbers by any number other than themselves and one is a universal truth. We know it, and so should any other creatures of comparable or greater intelligence."

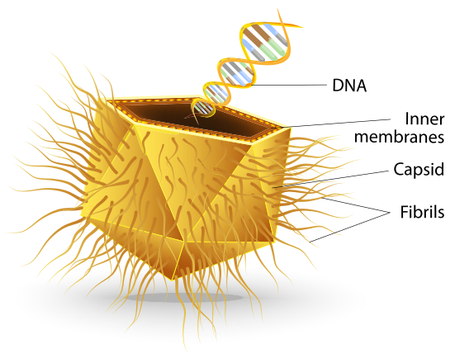
Sensationalized as the idea may have been made in the movie, the fact of the matter remains true. Math is constant. 1+1 will always equal two. 2+2 will never equal five. A new equation, however, may one day equal better vaccines.

THE BELIEF IS THAT mathematical principles can be applied to better understand biological entities. Should that happen, many have theorized that it could drastically transform the way we look at preventing and treating viral diseases with a potentially safer way to develop vaccines and medicines.

The research on this started more than a half century ago by James Watson and Francis Crick. The two came up with a possible explanation for what's always been a complex problem. Here's an excerpt from an article in *Wired* that discusses the complexity of the task.

> *"Viruses consist of a short string of DNA or RNA packaged in a protein shell called a capsid, which protects the genomic material and facilitates its insertion into a host cell. Of course, the genomic material has to encode for the formation of such a capsid, and longer strands of DNA or RNA require larger capsids to shield them. It didn't seem possible that strands as short as those found in viruses could achieve this."*

MIMIVIRUS



An illustration of a virion that is a causative agent of pneumonia. Here you can see how it is polygonal in shape.

To understand that, let's look at everything that makes up a virus. Britannica gives a strong definition that's a little bit easier to understand. When considering an entire virus particle, or a virion, you must look at the outer protein shell, this is the capsid as previously discussed, and the nucleic acid that rests within it.

If you looked at a virion under extreme magnification you might confuse it with a twenty sided die. That's because the capsid surrounding the virus would be a twenty-sided icosahedron. Remember those from geometry?

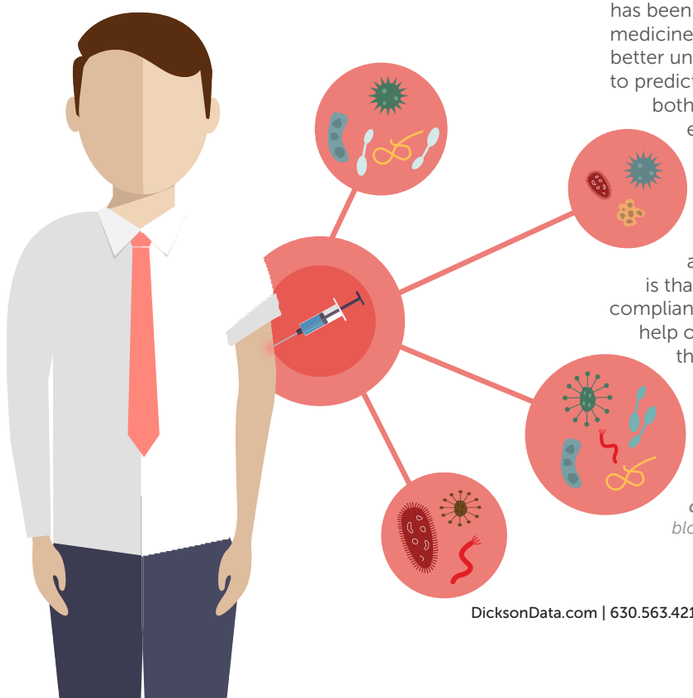
This is great information to have, but the complexity of an icosahedron (pronounced: ahy-koh-suh-hee-druh n) made it difficult to fully understand and recognize when you were looking at the virion from different angles under a microscope. Using a variety of additional recent mathematical equations and discoveries, which you can find links to learn more about on our blog, helped inform researchers of how the protein subunits of capsids were oriented. This, ultimately, also provided a framework for how the subunits interacted with each other and with the genomic material inside. This was a key breakthrough in the research.

"I think this is where we made a very big contribution," said Reidun Twarock, a mathematician at the University of York in England. "By knowing about the symmetry of the container, you can understand better determinants of the asymmetric organization of the genomic material [and] constraints on how it must be organized. We were the first to actually float the idea that there should be order, or remnants of that order, in the genome."

MATHEMATICS, RATHER THAN SCIENCE, helped researchers better understand the way that viruses were constructed. It becomes much easier to tear something down if you know how, and why, it's formed. While curing disease would be an obvious application for using such data, the research team is more focused on preventative medicine rather than curative. Today, the number of vaccines that exist is minute in comparison to the number of severe illnesses and infections that one can fall ill from. This research could help scientists vaccinate against hundreds of viruses, whereas, today, available vaccines only number in the dozens.

Traditionally, vaccines are based on one of two different methods. The first involves viruses that have been killed off and injected that the body is still able to recognize. The second involves using weakened viruses that the immune system should be able to easily stave off. One version only offers a short lived immunity, while the latter poses the risk of becoming a serious risk if it becomes virulent and the body can't fight it off. Thanks to this mathematical research we may soon have a third option. Rather than approach these breakthroughs as a way to destroy a virus, why not use it to learn how to build a synthetic virus that scientists could control and the body could easily fight off? *Quanta Magazine*, a publication focused on developments in mathematics, theoretical physics, theoretical computer science and the basic life sciences, explains just what this could mean for the global population.

"By understanding capsid formation, it may be possible to engineer virus-like particles (VLPs) with synthetic RNA. These particles would not be able to replicate, but they would allow the immune system to recognize viral protein structures. Theoretically, VLPs could be safer than attenuated live viruses and might provide greater protection for longer periods than do chemically inactivated viruses."



RATHER THAN APPROACH THESE BREAKTHROUGHS AS A WAY TO DESTROY A VIRUS, WHY NOT USE IT TO LEARN HOW TO BUILD A SYNTHETIC VIRUS THAT SCIENTISTS COULD CONTROL AND THE BODY COULD EASILY FIGHT OFF?

AT THIS POINT, IT'S UNCLEAR whether or not these types of manufactured viruses would be impacted by temperature differently than a standard vaccine. As we've talked about in the past, a number of vaccines are unable to be freeze dried and need to be kept as close to 40°F as possible. Vaccines like this have been the topic of in-depth testing to determine the potency of the medicine after freezing. The results haven't been promising.

"A freeze-thaw test on four batches of tetanus showed a 14.5% regression in potency following a single freeze-thaw and a 61.5% regression after two rounds of freezing. Similar tests have shown comparable results across a variety of different inoculations."

WHAT MAY BE UNSURPRISING TO YOU after reading this far, is that math plays a major role in a vaccine's degradation. That's because of what is known as the Arrhenius equation. In 1889 Swedish scientist Svante Arrhenius proved a mathematical equation that suggested a reaction rate was dependent on environmental conditions. Here's an excerpt from a piece we published last year on the topic.

"A reaction can involve any number of criteria, like the oxidation of iron or the combustion of cellulose in a fire, but has been extremely important in industries like food and medicine. That's because it has helped the food industry better understand spoilage and the world of pharmaceuticals to predict the shelf life of their reagents and medications. In both cases, the shelf life decreases as the temperature elevates. According to an article in the 2014 issue of Biologicals, this makes it imperative to monitor the environment in the world of healthcare whenever a vaccine is involved."

While mathematics may be a universal language, a language that is universal within many industries is that of compliance. The risks to society are real when compliance initiatives aren't met. It's why we work so hard to help our customers measure their environment and meet their regulations, and why we've worked to simplify the process. It's why your company plus Dickson equals compliance. That's a universal equation we can all understand.

Have something personal you'd like to add to the conversation? Send us your thoughts to ***jeff@dicksondata.com*** *for a chance to be featured in a future blog or magazine.*

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Points **that Matter**

INTERPHEX

We'll be traveling to NYC in April to attend INTERPHEX, the premier pharmaceutical, biotechnology, and medical device development and manufacturing event where you can "Experience Science through Commercialization," at **BOOTH 1935** on the show floor.

If you'll be in New York for the show, stop by and say hello. We love meeting with as many of you as we can to learn more about your businesses and the work you do to help positively impact society. Send us a message to **jeff@DicksonData.com** to schedule a time to chat during the show from April 17-19.

We can't wait to see you all there!

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