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Chapter 1 — Introductions

Learning Objectives

1. Get to know the speakers
2. Who we work for, and
3. Why we came here to talk today

Part 1 — Technology in Publishing, Digital and Mobile Development

First off, "Hello". We are Mike O'Hanlon, Vice President at Imagineeringart.com and Darryl Lehmann, Lead Developer. As the heading suggests we are the technology leads at Imagineeringart.com, where we deal exclusively in book publishing. Mike has been working in the industry now for 20 years, and Darryl has been in the field for the relatively short time of 6 years. In the past five years, we've seen tremendous change. In fact, during this period we've been a part of a steady progression of technologies:

- Unix publishing systems,
- Quark and InDesign,
- mass database and SGML/XML systems,
- XSLT and XSL-FO,
- Digital books through the Inkling Habitat platform,
- iBooks Author books,
- Adobe DPS Book apps to both Apple® and Android™ markets,
- ePub2 and ePub3 books,
- and many formats in between

During this time, we've noticed the gravitation towards formats that help reduce or eliminate costly conversion processes. The "Holy Grail" as it were, being a single-source workflow able to generate multiple output streams with as little intervention as possible.

Summary

- Get to know the speakers
- Who we work for, and
- Why we came here to talk today

Part 2 — Our Perspective

Here at Imagineeringart.com we specialize in textbook content creation. Some of you may know us from our work in digital art surrounding the life sciences, geography, skill trades to name a few. We have teams of Illustrators, Animators, 3D specialists on hand.
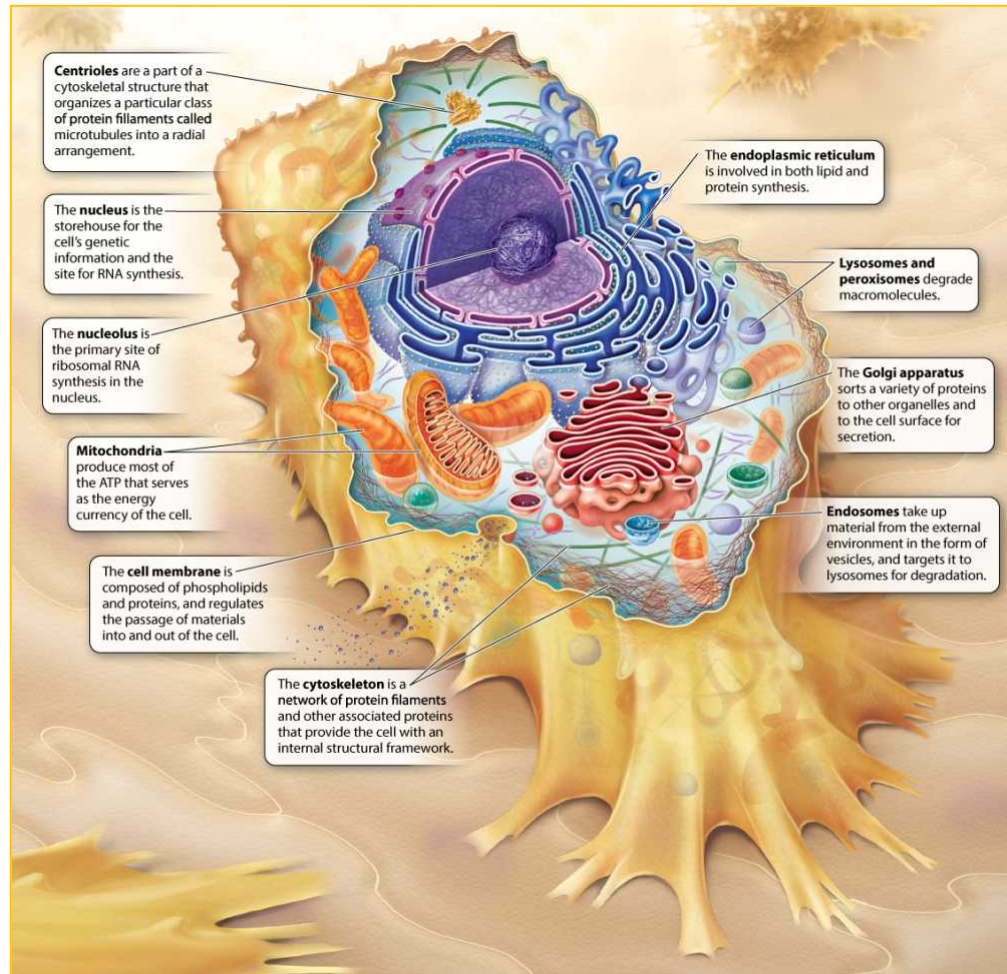

Centrioles are a part of a cytoskeletal structure that organizes a particular class of protein filaments called microtubules into a radial arrangement.

The **nucleus** is the storehouse for the cell's genetic information and the site for RNA synthesis.

The **nucleolus** is the primary site of ribosomal RNA synthesis in the nucleus.

Mitochondria produce most of the ATP that serves as the energy currency of the cell.

The **cell membrane** is composed of phospholipids and proteins, and regulates the passage of materials into and out of the cell.

The **endoplasmic reticulum** is involved in both lipid and protein synthesis.

Lysosomes and peroxisomes degrade macromolecules.

The **Golgi apparatus** sorts a variety of proteins to other organelles and to the cell surface for secretion.

Endosomes take up material from the external environment in the form of vesicles, and targets it to lysosomes for degradation.

The **cytoskeleton** is a network of protein filaments and other associated proteins that provide the cell with an internal structural framework.

Figure 1.1: A 3D depiction of an Animal cell.

We take content very seriously and to that end have developers (like myself) to expand upon that core, building truly interactive learning objects.

For our part, we've taken the approach that publishers and authors alike are looking to rely on us for quality content that will work in whatever platform they choose to work in. This is why our focus has been a Web-centric and Open standards approach.

" Open standards approach

The idea being, that while we have experience with a multitude of book publishing platforms, we recognize that everyone has differing needs. This allows us to help guide our partners, while providing highly engaging, yet highly flexible interactive content.

Summary
- Content specialists
- Pioneers in Digital content and enhancements
- Open standards for a broad reach

Part 3 — Interactive Learning

In <u>Part 1</u> we saw a list of technology paths moving forward. When looking at the later half of this list, there is one consistent theme — book content is evolving, and we think it's no surprise that eReaders and Apps are moving to meet that challenge.

❝ Book content is evolving

When we consider textbook material this statement is even more true. At first, it was supplementary content on CD/DVD or even access to a learning content management system. Now, with the rise of tablet readers, the digital book **is becoming** the platform.
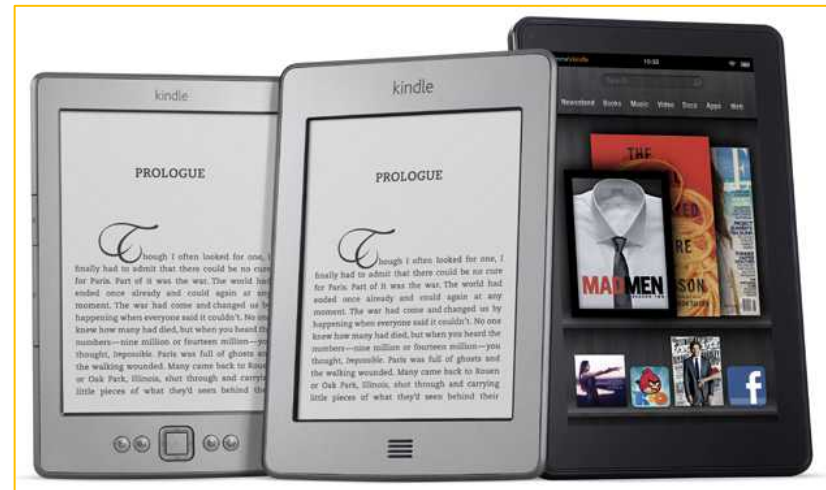

Figure 1.2: eReaders are evolving to meet the challenge.

The ebook evolution

For an insightful look at this concept, have a look at <u>"the ebook evolution" by Jenn Webb</u>, a great read to be sure, and just like our topic an immersive reading website complete with compatibility features and interactive content supplements.

Digital Enhancements

Now, when we talk about interactive learning we are of course talking about extending or enhancing book material to reach a wider array of learning styles, to add a richer depiction of our subject, or to provide real time testing and feedback on a given subject matter.

ePub3 being married to the HTML5 specification, allows for a wide range of interactivity. Right now, it's understanding what exactly that means for us a content providers.

To help illustrate this, let's have a look at a few examples that can already be found amongst key digital book platforms like:

- **Apple® iBook® Author Widgets** — including Keynote presentations, Interactive Images, Interactive Galleries, Scrolling Sidebars, Pop-Over, Media, Chapter Reviews, **3D Images**, and **HTML Modules**
- **Inkling® Enhancements** — including Poptips, Links, Inline Audio, Show/Hide Answers, Slideshows, Slidelines, Guided Tours, Hotspots, Test Yourself Images, Videos, Assessment cards, **3D Models, 3D Molecules**, and **HTML Widgets**
- **Adobe® Digital Publishing Suite Overlays** — including Panoramas, Audio & Video, Hyperlink and button, Pan and Zoom, Slideshow, Scrollable Frame, **Image Sequence**, and **Web Content overlays**

Interesting among these lists of enhancements is both the *3D aspect* and the *Web or HTML content* types. Now, why do we mention these platforms in reference to ePub3? Well quite simply to illustrate the interoperability of ePub3 content. **ePub3** being built around Web content standards affords the content provider to build once and deploy to many, as we will soon see.

" Build once and deploy to many

This is why we are here today, to discuss a new way of learning and how ePub3 makes this a reality.

Summary
- Content is evolving
- Web technology is broad reaching
- 3D Learning a natural progression

Chapter 2 — A Web of Learning

Learning Objectives

1. Brief look at 3D learning
2. HTML interactivity as a cross-platform option
3. Interoperable back-end

Part 1 — The Nature in 3D Learning

So what is 3D learning? Well, we can start by describing a 3D object. Objects in a 3D scene have tangible width, height, and depth and are often a representation of a real world object. We can manipulate these objects similarly to how we would in the real world. 3D learning is the natural evolution of how we learn, it brings us back to learning by doing.

It's the realisation of learning in a boundless form, by seeing, doing, and engaging with our environment. Be it real or virtual, we become immersed in the subject matter, and this drives us to explore and investigate.

Does the content have to be real world objects? No, sometimes expressing an idea in 3D can be a culmination of form and design, as we can see in Figure 2.1.
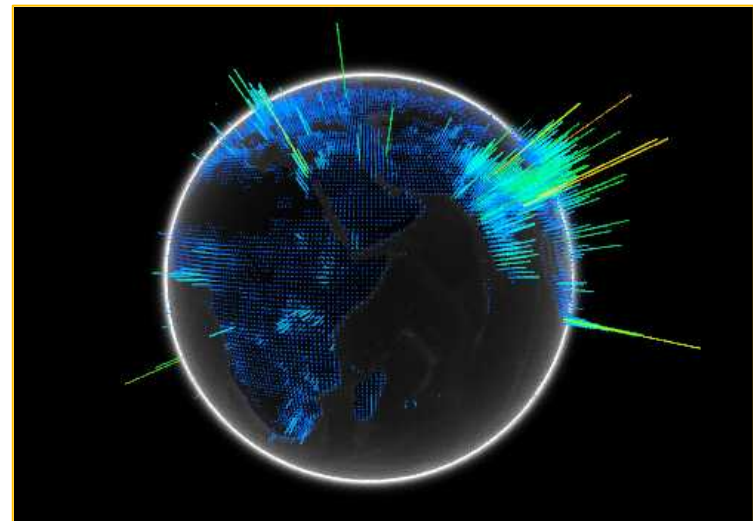
" Expressing an idea in 3D

Figure 2.1: Global population visualized in 3D.

3D Learners

For an informative white paper on the subject of 3D learning, we invite you to check out, "The 3D in Education White Paper" by Professor Dr Anne Bamford. Talking about children today being "digital native" learners.

An important facet regarding 3D learning is that by seeing the whole of an object we can better understand it's parts.

Now traditionally we are met with visual aids coupled with auditory lecture, and this covers a fair range of learners. Now imagine if we coupled this with a kinesthetic learning approach we can extend that reach even further.

Let's look at it from another perspective, modern media is so tantalizing that maintaining student engagement has never been harder. That's where adapting our teaching techniques and building more engaging tools can help to close the gap.

Figure 2.2: The three basic learning types.

Summary
- 3D learning is the future
- Learning types merged
- Taking learning to the students

Part 2 — The Short Road

We've touched on what is special about 3D learning but where do we go from here. This is a good question, and one that needs careful consideration of the latest, and existing technologies in use today.

But, before we get too far ahead, let's consider our subject matter first — textbook material. Generally speaking, textbook material is fairly complex, often including a multitude of figures, tables, sidebars, and question and answer bridges to name a few. Not exactly a front runner for the ePub2 books and the eInk devices that support them. So let's consider the more modern Tablet style devices, or even tablets sporting eReader style Apps, well this seems to have narrowed down our focus.

ePub3 has brought with it not only a new interactive standard, but focused our set of delivery devices, effectively raising the bar. These devices, whether pure breed readers or tablet based Apps all share common lineage. They must read HTML5, CSS2.1+, and Javascript, making them far closer to browsers than ever before. Eureka, we have coalescence!

Web meets Books

Now, we have a place to display our interactive content. But what a broad term that is, what exactly will we do with it. Well if you recall our list from Chapter 1 talking about; enhanced figure types, assessment type content, galleries, html content, and 3D content!

Let's begin with Web interactivity first, seen from a textbook perspective.

" Imagine you're studying entomology,
  you're keen on butterflies.

" You scroll through a science textbook
  to land upon...

Figure 2.3: **The Monarch Butterfly** — large migratory American butterfly having deep orange wings with black and white markings. *The "Interactive Butterfly" is a copyrighted work © Imagineeringart.com, Inc. 2013*

Isn't that refreshing, a figure comes to life. Dances in front of you and provides direct linked information to the subject matter. It's not 3D, at least not fully realised, but it's interactive and engaging! Plus, on devices where 3D isn't perhaps available just yet, you could still enjoy the experience.

But wait, all too often we've seen it. We want to take the interactivity realised in ePub3 and deploy it to another platform or place it within an LMS? Well, because we've taken up an Open standards approach that won't be a problem.
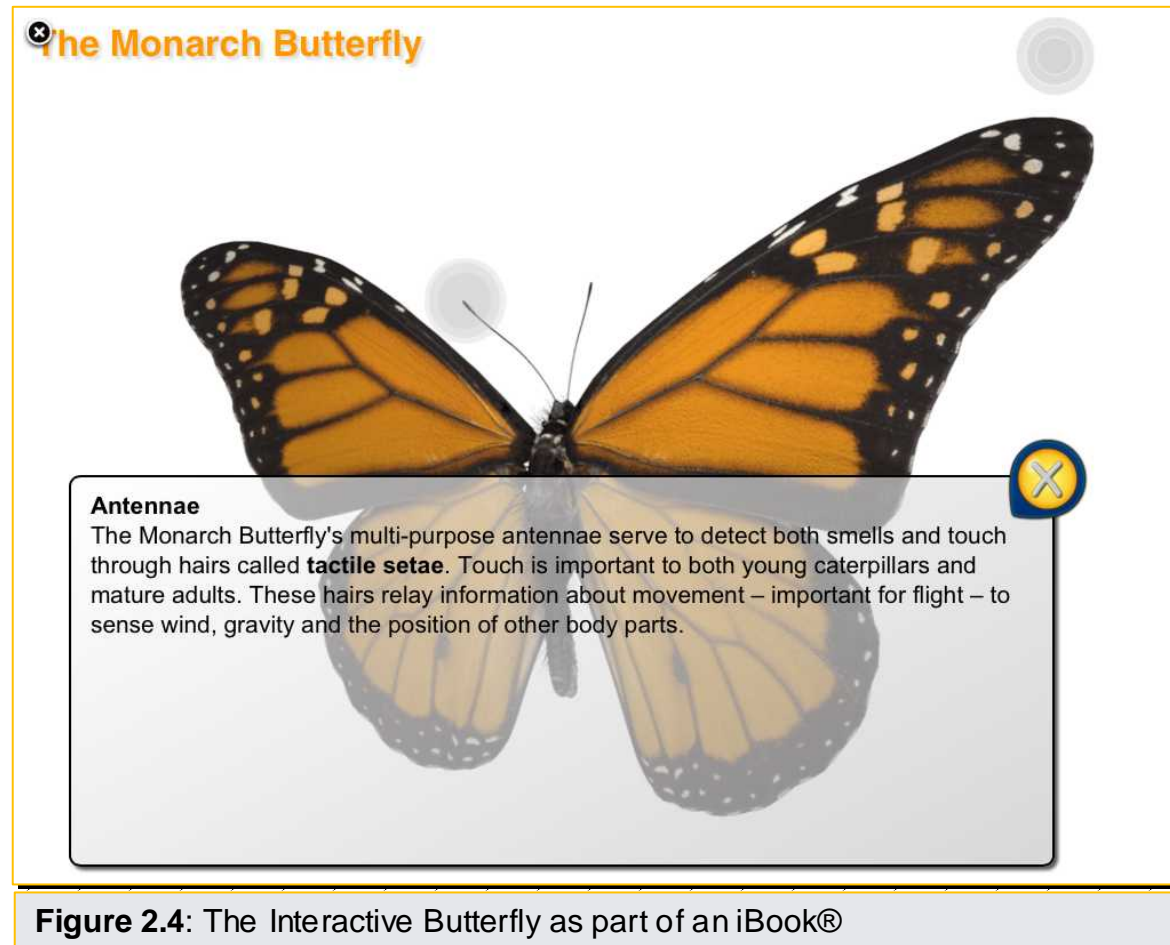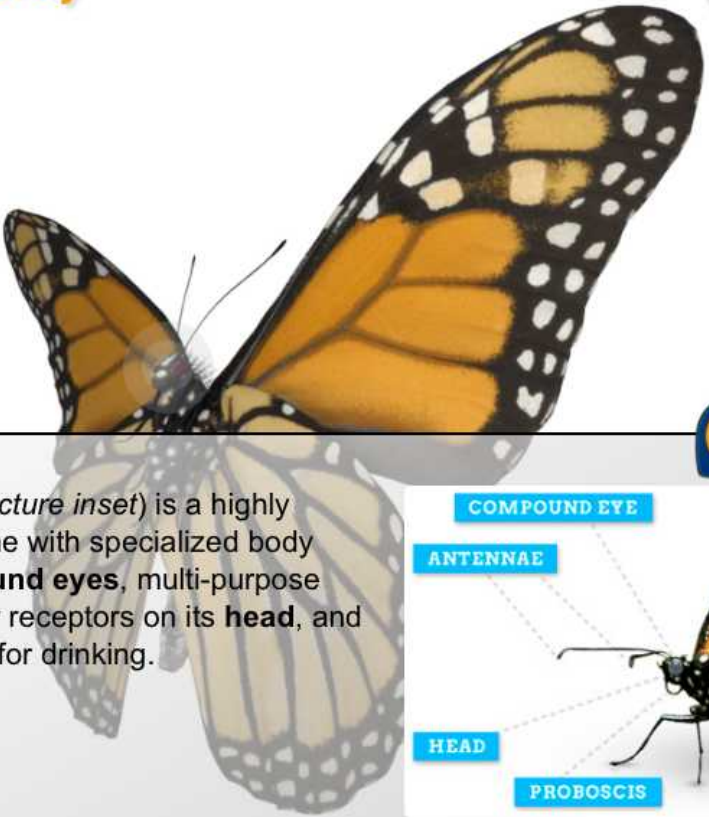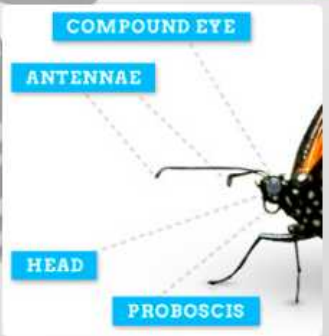

Figure 2.4: The Interactive Butterfly as part of an iBook®

Figure 2.5: The Interactive Butterfly seen in this Inkling reader card

The Monarch Butterfly

Discal Cell

The Discal Cell (*picture inset*) like all cell's of the Monarch Butterflies wing is a portion of each wing that is relatively devoid of veins, although entirely surrounded by veins. The large cell located from the wing's base to near the center of the wing is called the **discal cell**.

DISCAL CELL

Figure 2.6: The Interactive Butterfly as part of an iBook®

Here we can see the interoperability of Web standards, this is what makes ePub3 so special. Interestingly, while all these interactive book platforms stand strong on their own, they also share another commonality. That being, they all support ePub3 content generation/support in one way or another.

Summary

- Textbook content has taken up the reins
- Interoperability through Open Web Standards

Part 3 — Building for the Future

Now, we've had a look at a specific Web application moving between different platforms. But, let's take a minute to discuss how we approach the data behind all of this. It's all well and good to build a unique experience, but just like ePub has evolved to meet Textbook content, so to will the future of interactivity. This leads me to a powerful method of maintaining data usability to better future proof our content — XML. XML is a widely used, flexible, and robust data markup language that allows us to capture our important object data and be sure that it is ready to meet the next challenge.

Learning Objects in XML

Having utilized XML and XSLT for pipeline integration and conversion in the past our thoughts were to find a standard approach to Learning Objects. The search quickly lead to a well adopted specification already used by Education technology companies today. Namely the XML specifications developed by the IMS Global® Learning Consortium.

More specifically the XML schema's for:

- IMS v1.3 (IEEE LOM 1484.12.1 equivalent) XML for developing learning object metadata,
- IMS Common Cartridge for extending learning objects semantically for a multitude of interactive purposes, and
- The IMS LTI (Learning Tools Interoperability™) initiative which establishes a uniform method for learning object communication between content providers, LMS suites, and Educational systems alike.

Together they are light and flexible and catered specifically to capturing education learning objects and delivering them in a manner befitting to the web we live in.

Figure 2.7: XML, like this Lego tower, are the building blocks for future proof content. Original article can be found here

Summary

- XML as a future proof option
- Learning Object XML and Interoperability

Chapter 3 — ePub3D

Learning Objectives

1. Explore 3D in ePub3
2. Accessibility and Interoperability
3. WebGL Standards
4. How do we get there

Part 1 — Getting to the Heart of 3D

We've touched on the progression of learning tools, the use of interactivity, and seen some engaging content material that can be used today. But if we reach just a little bit further, we can see a new frontier is emerging. True 3D in an ePub3 book, is very real and perhaps not as far away as we thought.

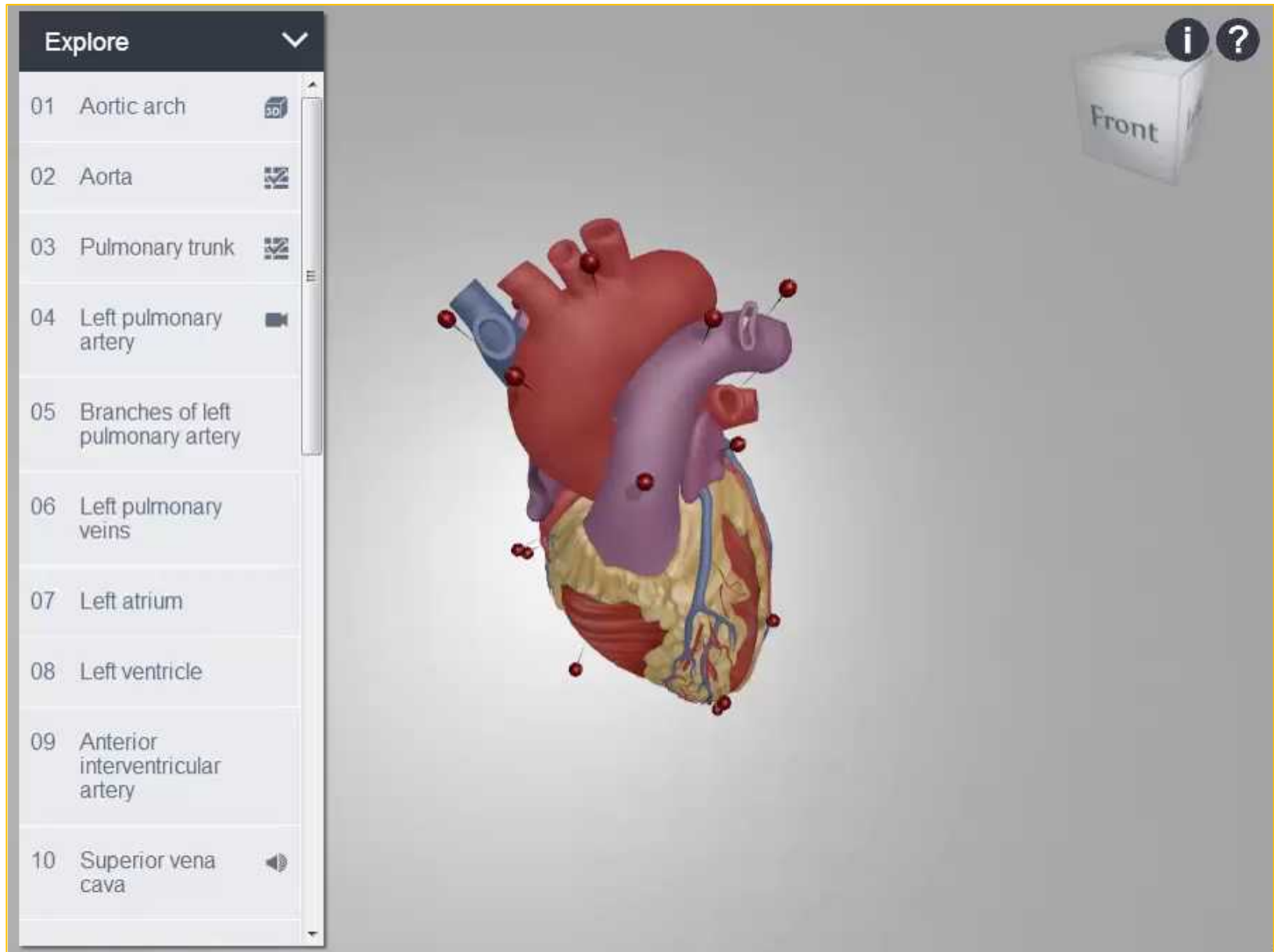Let's have a look at what Imagineeringart.com has been working on.

Figure 3.1: **Human Heart** — The human heart is the organ providing a continuous blood circulation through the body. *Model of the "Human Heart" is a copyrighted work © Imagineeringart.com, Inc. 2013*

Here we can see a three dimensional heart model, fully annotated and interactive. You can explore the shape, depth, important features visually. You are presented with annotation material like that seen in a textbook, but with some very powerful benefits at the ready:

- real-time positioning of the object in 3D for best view of a feature,
- "Explore" bar to enumerate the objects features in a meaningful way,
- embedded video,
- audio,
- question and answer material,
- social feeds,
- nested 3D,
- really anything HTML5 can offer

This is an example of what we can do to re-engage students and teachers, and fuel a burning interest in making ePub3 and digital textbooks a reality.

Let's present the fallback images for comparison, just to illustrate how much information we can encapsulate in a **Interactive 3D Viewer** of this type, and really how powerful the presentation is for associated learning.
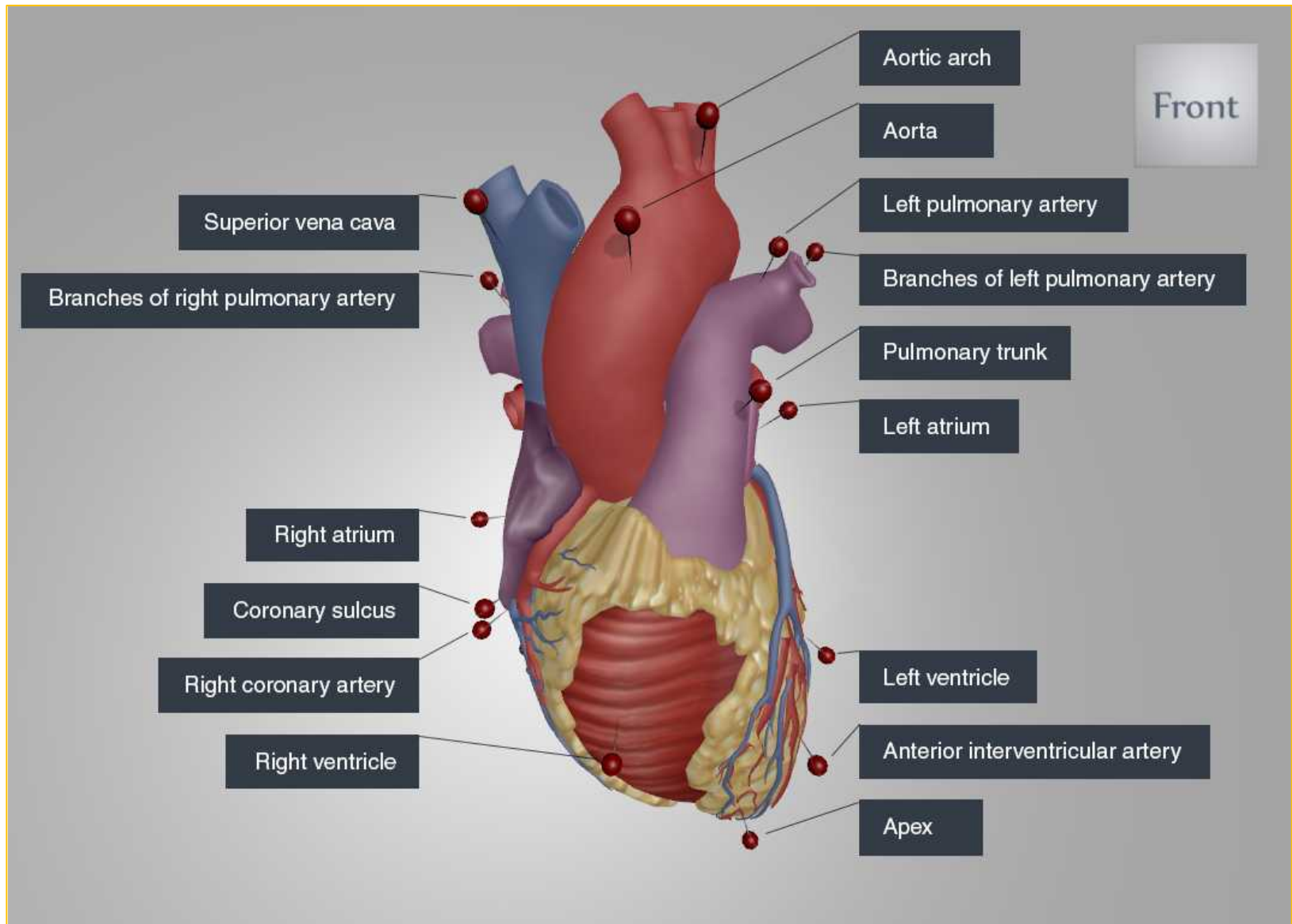
Figure 3.2: **Features of the Heart (Front detail)** — The human heart is the organ providing a continuous blood circulation through the body.

Features of the Heart (Front detail)

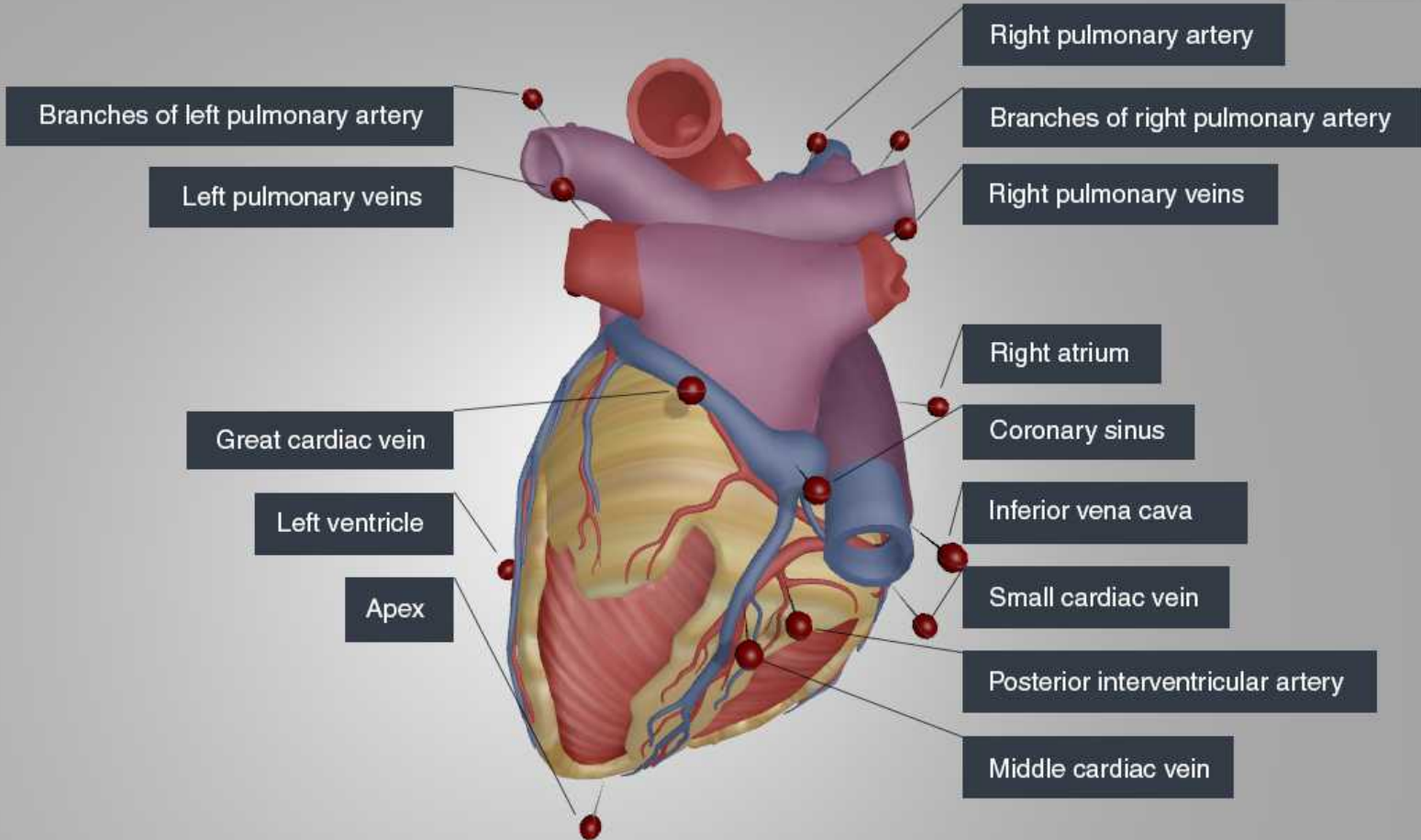| Feature	Description
Superior vena cava	The superior vena cava carries blood from the body to the right atrium.
Branches of right pulmonary artery	The branches of right pulmonary artery carry blood to the lungs.
Right atrium	The right atrium receives blood from veins.
Coronary sulcus	Coronary sulcus separates the atria from the ventricles.
Right coronary artery	The right coronary artery supplies blood to the wall of the right ventricle.
Right ventricle	The right ventricle pumps blood into the pulmonary trunk.
Aortic arch	The aortic arch arises from the left ventricle, carrying blood to the rest of the body.
Aorta	The aorta carries blood to the rest of the body.
Left pulmonary artery	The left pulmonary artery carries blood to the lungs.
Branches of left pulmonary artery	The branches of left pulmonary artery carry blood to the lungs.
Pulmonary trunk	The pulmonary trunk arises from the right ventricle and splits into the pulmonary arteries.
Left atrium	The left atrium receives blood from veins.
Left ventricle	The left ventricle pumps blood into the aorta.
Anterior interventricular artery	The anterior interventricular artery (in the anterior interventricular sulcus) supplies blood to the anterior wall of the heart and the left ventricle.
Apex	the lowest superficial part of the heart

Right pulmonary artery

Branches of left pulmonary artery

Branches of right pulmonary artery

Left pulmonary veins

Right pulmonary veins

Right atrium

Great cardiac vein

Coronary sinus

Left ventricle

Inferior vena cava

Apex

Small cardiac vein

Posterior interventricular artery

Middle cardiac vein

Back

Figure 3.3: **Features of the Heart (Back detail)** — *Continued…*

Features of the Heart (Back detail)

Feature	Description
Branches of left pulmonary artery	The branches of left pulmonary artery carry blood to the lungs.
Left pulmonary veins	The left pulmonary veins carry blood from the lungs to the left atrium.
Great cardiac vein	The great cardiac vein (in the anterior interventricular sulcus) drains blood into the coronary sinus.
Left ventricle	The left ventricle pumps blood into the aorta.
Apex	the lowest superficial part of the heart
Right pulmonary artery	The right pulmonary artery carries blood to the lungs.
Branches of right pulmonary artery	The branches of right pulmonary artery carry blood to the lungs.
Right pulmonary veins	The right pulmonary veins carry blood from the lungs to the left atrium.
Right atrium	The right atrium receives blood from veins.
Coronary sinus	The coronary sinus is a large vein that brings blood into the right atrium.
Inferior vena cava	The inferior vena cava carries blood from the body to the right atrium.
Small cardiac vein	The small cardiac vein drains blood from cardiac muscle.
Posterior interventricular artery	The posterior interventricular artery (in the posterior interventricular sulcus) supplies blood to the wall of the right ventricle.
Middle cardiac vein	The middle cardiac vein (in the posterior interventricular sulcus) drains blood into the coronary sinus.
Branches of left pulmonary artery	The branches of left pulmonary artery carry blood to the lungs.

Summary

- 3D realised
- Object exploration
- Associated learning

Part 2 — Canvas accessibility and interoperability

An important consideration for ePub3 is accessibility. How do we leverage 3D from within an HTML5 Canvas context while maintaining this primary usability feature.
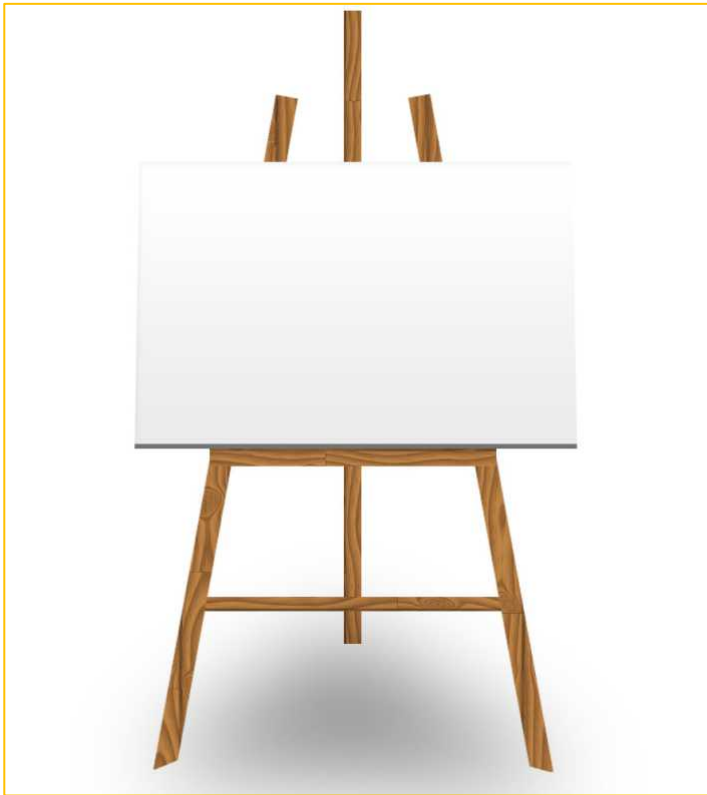

Figure 3.4: A blank canvas, an analogy to the HTML5 Canvas potential

Well, by carefully designing our 3D content to utilize Canvas for 3D and marrying it to a native HTML5 element stack for information transport. All the content is built in pure HTML5 to allow for ARIA described elements. As you'd expect from a compliant ePub3 interactive book. Plus we maintain a fallback position of either a scripted image sequences as seen in Chapter 2, or traditional images with leaders and associated table data as we saw with our heart figures earlier.

What we are left with is a Interactive 3D "Figure" with screen reader capable content and ample room for expansion.

On the side of interoperability, we maintain a method of XML delivery that is both flexible and maintainable across platforms as we've previously discussed.

Summary

- Keeping content accessible
- Content that moves with us

Part 3 — WebGL Standards

Now you may be wondering, is this really a possibility? Well, if you consider the emerging nature of ePub3, the rapid expansion of WebGL, and the ever shrinking costs of tablet hardware, then yes! But let's have a look at what's involved, and where we need to take the next steps.

On the Desktop

You'll note that this presentation is given from within the Chrome™ Desktop browser utilizing the IDPF's own Readium Chrome Extension. At this time, this compliant ePub3 document renders 3D from within these confines, but it isn't the only desktop reader to do so.

Now, stand-alone versions of this Interactive 3D Viewer run seamlessly across all HTML5 compliant desktop browsers including, but not necessarily limited to:

- Google™ Chrome™
- Mozilla® Firefox®
- Apple® Safari®
- Microsoft® Internet Explorer® 11

The performance and list of features being added is staggering, WebGL is a well liked standard, and has potential to revolutionize the way the web works.

On Mobile

Now, is this the case on mobile devices? The answer is not yet! What we can tell you is that in the last month WebGL has been enabled in the Chrome browser for Android on supported devices. In fact the stand-alone version, runs just fine on a Nexus 7 tablet in both Chrome and Firefox. Interestingly, iOS has supported WebGL for their iAds for sometime, but this hasn't yet translated to the Safari Mobile browser.

This leads us to the next question...

What is WebGL?

At it's core [WebGL™](#) is essentially the OpenGL ES 2.0 specification, purpose built for the Web. It expands upon the HTML5 Canvas object to extend a 3D context for use in rendering low-level 3D graphics. This standard is championed by the [Khronos Group](#) with a healthy community and driven contributor's.

Now to anyone familiar with 3D Mobile programming, the two specifications for OpenGL ES 1.1 and 2.0 will sound very familiar. Essentially, WebGL is poised to land on mobile. It's simple a matter of time.

Summary
- Desktop support is broad
- Mobile support is near

Part 4 — The not so Long Road

As we've touched upon, cross-platform/cross-browser 3D development is moving to meet the modern Web. The next steps really revolve around, building awareness, fostering communication, and getting like minded individuals interested. I think we can all agree, now is the time to start building in the area's of 2D and 3D Interactive objects.

To that end, we at Imagineeringart.com would be keen to participate in an "IDPF Working Group for the ePub3 modular extension of WebGL and WebGL frameworks". Collaboratively we could work towards building best practice standards for interactivity, build a basis for ePub3 enhancement work, and address usability concerns. We can look at how we want to approach our interactive data, allowing us to capture what information is pertinent, outside of implementation.

" ePub3 as a future ready interactive standard

Together we can help drive ePub3 as a future ready interactive standard. Changing how we learn, changing how digital books are perceived, by taking the next step into a broader book experience.

Summary
- ePub3 the future of textbook learning