cK-12 Vision Document

September 2012

CK-12 is committed to providing free access to content and technology tools that empower students as well as teachers to enhance and experiment with different learning styles, resources, levels of competence, and circumstances.

cK-12

CK-12 will provide content and technology tools to help teachers provide learning for students in a global world. Free access to high-quality, customizable educational content in **multiple modalities** suited to multiple student learning styles, levels, resources and use content acceptance will allow teachers, students and others to innovate and experiment with new models and modalities of learning. CK-12 help students and teachers alike by enabling **rapid customization** and experimentation of teaching and learning styles.

We need to go from today's "fixed time, variable learning" to a "**variable time, fixed learning**" model or even better, "**maximum capability learning**" within a teachers constraints of standards compliance and other administrative rules in their region. This new model adapts to each student level, style, circumstances leveraging new digital tools to answer the more fundamental questions: "**What can digitization do for the textbook?**" and "**What can digitization do for learning**" instead of the more mundane "How can the textbook become digital?". Leveraging these new tools to multiply and enhance learning resources (such as video, simulations, and peer learning) is a key to CK-12's mission. CK-12's goal is to provide tools that can help increase **student learning** through engagement, and to provide more **universal access** to learning and learning content, irrespective of educational resources available for a student or region. Additionally, CK-12 aims to reduce the impact of educational resources needed (by teachers or by classrooms) by leveraging good teachers, and when teachers are poor, burned out or not available, CK-12 will provide direct access to students for their own learning.

Maximum capability learning

What can digitization do for the textbook?

What can digitization do for learning?

CK-12 Tactics

Students are unique – each has a different pace of learning, different interests, and different goals. Education today is resource-limited and focused on traditional textbooks or a limited number of new modalities, while primarily catering to one level of student learning despite the significant efforts of many teachers. Learning is a very personal process and requires individualization of style and level of learning as well as customization of teaching content in a world that has increasing administrative rules and limitations on teachers and declining resources. To mitigate these issues and to maximize every student's learning potential, CK-12 will provide free access to multi-modal content, and a personalized learning system for their direct use or for use by the student's teacher. CK12 will focus on continuous content enhancement through user-generated content as well as partner tools and content. The CK12 content will have domain expert or teacher certified educational content as well as unverified or user rated user generated content. The CK-12 process will also allow for flexibility within the sequence of learning. There is an additional, possibly greater, need to cater to students who do not have good teachers available to them in many parts of the world. CK-12 hopes to leverage good teachers and their ideas globally through user/teacher-generated content by making it accessible to these students and other under-resourced teachers.

We believe that continuous improvement and iterations are the key to any long-term successful endeavor, which is what learning is.

More specifically, we believe that we can enhance the way learning objects and content are presented by creating supports with the following characteristics:

1. Tools and Content for Customization

Tools and content for customization in the classroom, state, country or for the individual – for states, districts, schools, or teachers to create their own content which can then be iterated.

2. Concept-Based Learning

Educational content as a basis for learning in the STEM subjects for high school is categorized by CK-12 into roughly 5000 concepts (example concepts "Two digit multiplication" or "Photosynthesis" or "Newton's law") that can form the basis of learning. CK-12 believes that these "Byte-Sized" units of content and modalities of learning (as well as varied styles of learning) are more important tools for facilitating learning than traditional educational materials like textbooks. With greater granularity the number of concepts can be increased (to include sub-concepts), and with reduced granularity the number of concepts can be decreased (to only encompass super-concepts), but that is mostly semantics. These "Byte-Sized" units of learning will increase the digestibility and flexibility (and hopefully quality) of content available for teachers and students by increasing the number of modalities available for each concept. Moreover, increased learning will also occur through an increased use of user-generated content, some part of which will be curated and verified by domain experts, while other parts that will be user-rated, or unrated.

3. Concept Maps or Learning Paths

Concepts can be related to other concepts in flexible ways we call a "Concept Map". These concepts are presented in a "**Learning Path**" or sequence through the concept map – and this path can be re-ordered. Each node in the map should be discoverable, like a library book, by its CK-12 "Dewey like" number (its EID number), by "search-based navigation" through keywords or "navigation through the concept map". Each node should have related concepts around it. Navigation by exploring each node creates understanding and provides context for related content and supports modalities, differentiated learning levels, etc.

Often it is a suggested "learning path" that can be re-ordered or customized based on needs.
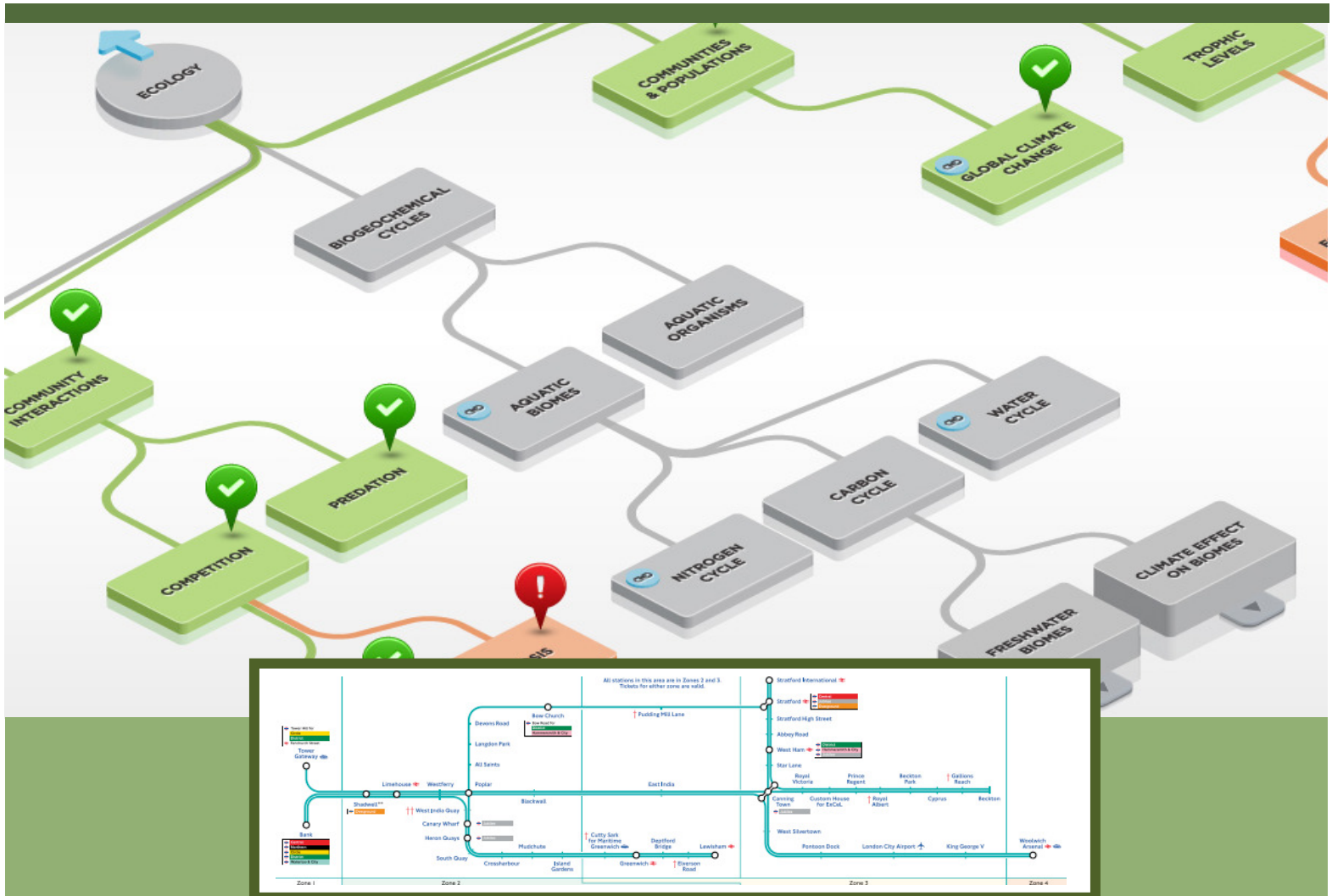
4. Multimodal Content

New technologies bring new ways to present content that enhance learning. CK-12 leverages the idea that concepts can be learned by various "modalities of the concept" with each modality being defined as "**a different way to learn** or explore" a specific concept and its relationship to other concepts. Examples include, but are not limited to:

1. Textual descriptions
2. Video lectures
3. Supplementary videos
4. Multimedia simulations
5. Interactive exploration models
6. Quizzes/exams and question banks
7. Examples of the concept in real-life use
8. Maps of related concepts
9. Web resources related to the concept
10. Galleries of photographs
11. Peer learning
12. Labs or other experiments
13. Flash cards
14. Lesson plans (mostly for teachers)
15. Scaffolding that creates a bridge between the current educational level of a student and the concept in question (for instance language scaffolding, or "dictionary or simplicity bridge" for bi-lingual students or remedial students respectively).

Each modality may or may not apply to every concept. Most modalities can be presented in various languages and at various levels such as "remedial", "at grade", or "advanced". We hope to enrich and diversify many modalities for every concept to these levels eventually, especially with the help of user generated content.

CK-12 leverages the idea that concepts can be learned by various "modalities of the concept"

## 5. Guided Learning through sequences of concepts.

K-12 education and learning required for college can be taught through a few thousand concepts. Multiple sequences are possible through these concepts, and additional skills (e.g. critical thinking) can be taught via the teaching/learning of these concepts. Paths through these "concept maps" should be customizable based on the needs of a teacher, student or region. This becomes especially feasible once assessment of the level of understanding of each concept is part of the system and data mining enables statistical data on best paths through the content.

6. User-Generated and Other Content

contributed by third parties will be a principal mode of content enhancement. CK-12 has developed its own library of basic STEM quality assured and US curriculum-aligned content to serve as a base. This base provides enough utility to teachers and students such that it can serve as a seed crystal on which other user-generated content can flourish, thus allowing for constant updating, localizing, and enrichment of the content. It is the goal of CK-12 to integrate content from any and all external sites (subject to license compatibility).

7. Assessments and Context - both formative as well as summative feedback. CK-12 will use assessments (and self-assessments) of these concepts, and of the strengths and weaknesses of the student to determine what comes next in guided learning. Knowing who the user is and what their learning patterns and needs are is an important aspect of making the technology both seamless and smart. Prediction of what might a student need next, or what they are missing, makes for more relevant feedback/suggestions of what follows. For example, once known, the system will always remember that a specific teacher is a 9th grade biology teacher, and will thus be able to help them more efficiently. Similarly, with a student, the system will remember what the specific student's needs are, and offer assistance based on their performance: identifying what kinds of mistakes the student is making, and whether the student is doing as well as when they were in the same subject in the concept map the last time they visited.
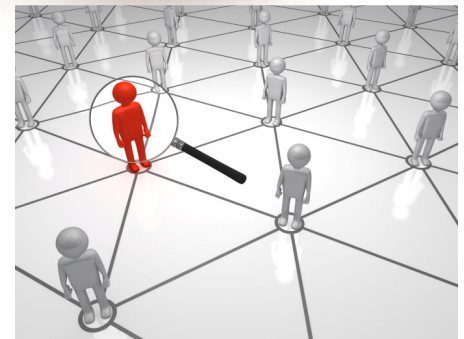
8. Sharing and Collaboration through tools such as "Annotations" and "Highlights", as well as communication with peer groups online, can help meet the above objectives.

9. Engagement is important and can be achieved through: (1) **Gaming mechanisms** (2) **Engaging content** (3) **Focus on real-life applications of the concepts.**

9. Content should be provided in **device-independent formats** when possible.

10. Learning is more than content and can be captured by CK-12 or by others into "**courses**" using frameworks like EdX, Udacity, and Coursera.

The initial focus will be on grades 9-12 (high school), with some extension towards grades 6-8, because we believe learning is continuous and not solely grade-based. Eventually we expect to cover k-12.

CK12's historical path:

Being an educational resource, as well as being customizable, CK-12 allows teachers to decide what concepts to teach, in what order, and how. CK-12 affords students the same flexibility. This is done in V2.0 by adding modalities, defined as "all the ways a concept can be learned". In addition, teachers can also decide to add content or modalities to the CK-12 concept-based content library in any missing or unique topics or modalities they find lacking. The hope is that over time this will develop a rich library that allows for various teaching and learning methods, and will allow for **iterative experimentation** in styles of teaching and learning.

Version 1.0

CK-12's version 1.0 included textbooks and content for teachers – FlexBooks and chapters aligned to curriculum requirements (e.g. state standards, Common Cores); and content which is free and customizable into textbooks or into smaller chapters. It included basic embedding of different modalities – videos, hyperlinks, some interactivity, and simulations – into the appropriate place in the text/textbook. We called it "**Textbooks 2.0**".

Version 2.0

Version 2.0 is about learning and students. In "Learning 2.0" a student learns at his/her own pace and pursues the modalities that best fit their style or preference. One of the most basic educational tenets is that there are relationships between learned concepts – you cannot understand addition unless you understand concept of place value, just as you cannot understand photosynthesis without knowing the many concepts it builds off of, from structural components like chloroplasts to functional components like carbon fixation and the Calvin cycle. A student cannot be expected to know these sequences (which can be flexible) and has to be guided through them for successful learning. Therefore, a system in which the student learns by navigating through a set of concepts arranged in a concept map becomes a key aspect of "**Learning 2.0**". We will provide for the students a defined but changeable and flexible path

thought the Concept Map. In addition, we will also determine the importance of a concept as it is critical for the user to know what s/he can/cannot afford to not understand.

We believe that active student learning can take them many different paths. To mitigate the impact of fixed learning pathways, we provide for flexible and customizable pathways through the system. A teacher or school district may arrange the concepts in their preferred concept map (in fact they may even add or subtract concepts, changing the concept library and the concept map itself though CK-12 will provide a default concept map).

V.2 will be completed when it is guided by feedback loops and adaptive assessment as the student navigates the concept map. The hope is to make the teacher's job easier by allowing them to teach based on individual assessments, and by understanding the strengths and weaknesses of each student.   This will allow teachers to spend time more meaningfully and efficiently by focusing on mentorship and individualized attention.

Although we are targeting teacher-guided concept map navigation, nothing prevents a student from self-guiding through the content, as well as doing self-assessments.

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Addendum document:

Definitions:

1. Concepts

a. Educational content in the STEM subjects in high school is categorized by CK12 into roughly 5000 concepts (example concepts include "Two digit multiplication" or "Photosynthesis" or "Newton's law") that can form the basis of learning. With greater specificity the number of concepts can be increased (to include sub-concepts) and with reduced specificity the number is decreased (to include only super-concepts.

b. Concepts can be related to other concepts in flexible ways. These concepts are presented in a "Learning Path or Sequence" map that be "re-ordered". We call these "concept maps"

c. One or more concepts can be part of "lesson plans" (usually the most relevant level of specificity for a teacher) or aggregated into chapters or textbooks. Or one can go from concepts to lessons to chapters to textbooks.

d. Beyond teaching content there are broader learning skills that can be taught within the context of teaching these specific concepts -- for example, deductive reasoning or the scientific method.

2. Modalities

a. Modalities: Concepts can be learned by various modalities with each modality being defined as "a different way to learn" a concept. Examples include but are not limited to: (1) textual descriptions (2) video lectures (3) supplementary videos (4) multimedia simulations (5) interactive exploration models (6) quizzes/exams (7) examples of the concept in real life use (8) maps of related concepts (9) web resources related to that concept (9) galleries of photographs (10) peer learning (11) labs or other experiments. Each modality may or may not be relevant to every concept. Each modality is a way of learning/teaching the concept and there can be multiple instances of the modality!

b. Each modality can be presented at various levels: "at grade", "remedial", or "advanced" for example, and in various languages. Different students at the same age or grade level are at different levels of competency or understanding of each concept and the content should adapt to their level.

c. Multiple modalities are attached to every concept – an atomic unit of learning.

3. Content

Content is the basic backbone of the project as it enables learning and teaching. It is our charter to provide quality and useful content for fundamental learning needs. The content is provided in standard formats – chapters, concepts, questions and answers, testing and assessment, lesson plans, introduction to the lesson, vocabulary, study guides, etc. But all these instantiations of the concept derive from the basic concept, modalities for each concept (e.g. a quiz is a modality as is a video lecture) or concept map and the hierarchy that can be derived from this structure (e.g. lesson plans, chapters, textbooks can be derived form the concepts). CK-12 acquires it content by 3 different processes:

- **Harvesting** – where content is acquired and reused from other open sites (subject to license compatibility).
- **Seeding** – through a quality assured internal CK12 process or a partnership (e.g. with NASA) that is curriculum based in HS Science, Math, and Engineering.
- **Donated** or User Generated Content– material that teachers, students or others have created such as lesson plans, teacher-created problem sets, original supplemental lesson material, questions from a question bank, tests and assessments, work books, etc.

CK-12 will over provide many different ways of content presentation. In the initial phase (V1.0), CK-12 provided content for MS and HS in STEM conventional courses.

This included:

1. Teachers' editions – primarily containing content that aided teaching and helped in differentiating students.

2. All standards-aligned material.

3. Content that could stand alone, as well as being placed in a sequence based on learning knowledge (for instance, motion has to be learned before you can learn about rate of change in motion i.e. velocity, followed by acceleration i.e. rate of change in velocity).

4. Although a path is provided both in FlexBook form as well as in the concept pathways, choice is also provided such that the user can change it to their particular needs.

5. The phases will evolve as technology changes – we will in the coming phase also offer online courses – for unique platforms like MITx, Coursera, Udacity

6. CK-12's mission is to provide meaningful content that can be customized, as well as providing open access to students free of cost.

4. Assessment

CK-12 will over time provide extensive detailed data for assessment of students and use it to provide guidance for learning strategies for each student. Both real-time data as well as global collective data will be available and analyzed, either by CK12 or by its partners. It will be usable by teachers, students or for automated guidance. This follows the belief that digitization can transform learning from a static state into a more interactive and meaningful venture.

5. Prediction for User Experience

Knowing who the user is and what the user's patterns and needs are is an important aspect of making technology evolve for text-based learning. Prediction of what a student might encounter next, or what the student is missing becomes instant feedback. For example, after asking a person who they are, the system will always remember that they are a 9th grade biology teacher and will be able to help them with their specific needs. Similarly, a student system will remember what the student's needs are and offer assistance based on their performance, including what kinds of mistakes they are making, and what they are doing well. This approach will be used to increase the quality of the sure experience for teachers and students. The navigation has to have the least painful (e.g. least number of clicks) way to get to where the users want to go, to for both beginning users and regular users.

3. Knowledge Pathways as represented by a concept map

a. Navigation by exploration – The concept map looks and feels like a map of the "London Underground" with an overall map of how to navigate the "city of knowledge" that is required for K-12 education. Each node on the map represents the concepts or "stations" in the map. Each node understands and provides context for related content, preceding and upcoming concept or branches in the direction of learning "travel". One may want to go through the "integer multiplication" concept station before getting to the decimal multiplication "station".

b. Each node on the path (think of it as beads on a necklace) represents a concept which is on a particular route that depends either on the "teacher or administratively provided path" or on a path that can be self-determined by the student or teacher for her class or individual student. One should be able to traverse different paths through the concept map either self-defined by a student or defined by a guide (i.e. the teacher).

c. Each node should be discoverable like a library book by its CK12-Dewey number or by "keyword search based navigation" or by walking though a hierarchy or clicking through the space of adjacent concepts much like the London Underground map showing "what station comes before or after a concept/station". Each node should represent:

i. All the modalities associated with the concept, including multiple items per modality (example: multiple videos of different teachers teaching the concept, or multiple examples of how the the concept can be applied in real life applications, or multiple simulation exercises, or….). Each modality is a way of learning/teaching the concept and there can be multiple instances of the modality!

ii. Assessment mechanisms for the student related to the concept and other concepts in the adjacent space

iii. Educational materials provided for teachers (e.g. lesson plan or experimental lab materials list)

d. Once a student has started using the path, the system should remember the path traversed by the user and should bring them back or navigate to the last place they were. A student should be able to see the part of the knowledge city they have travelled and see all the concepts they have learned and their relationships. In fact these relationships between concepts in the curriculum and other "extra-curriculum" relationships could be a valuable modality in itself, helping students and teachers with perspective on what they have learned and how it relates to other concepts/content.

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