Session 5 — Generating Dynamic Questions

Connecting to Real APIs 🌐

You're about to connect your trivia game to the real internet! This guide walks you through fetching live trivia questions from external APIs, transforming API data into game-ready format, and experiencing the power of asynchronous programming. Ready to make your zones come alive with real questions? Let's go!

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☁️ Accessing Your Codespace

Visit github.com/codespaces to relaunch your Codespace from Session 4.

🌐 Understanding APIs and External Data

Before we start coding, let's understand what **APIs** are and why they're everywhere in modern web development.

API stands for **Application Programming Interface** — it's like a menu at a restaurant. The menu tells you what dishes are available, what ingredients they contain, and how much they cost, but it's not the actual food. Similarly, an API tells you what data is available, how to request it, and what format you'll receive, but it's not the data itself.

APIs are the backbone of modern web applications. Your trivia game will use the **OpenTrivia Database API** to fetch real questions from the internet, making your game dynamic and engaging with fresh content.

🏆 Bonus Challenge

Think of three apps you use daily — can you identify what external data they might be fetching through APIs?

🔍 Exploring the OpenTrivia Database

Let's explore the **API** that will power your trivia questions and see what real **API** data looks like.

1. **Visit** the API endpoint by opening https://opentdb.com/api.php?amount=3&category=18&type=multiple&difficulty=easy&encode=url3986 in your browser
2. **Examine** the raw JSON response where you'll see something like this


```
{
  "response_code": 0,
  "results": [
    {
      "type": "multiple",
      "difficulty": "easy",
      "category": "Science%3A%20Computers",
      "question": "What%20does%20GHz%20stand%20for%3F",
      "correct_answer": "Gigahertz",
      "incorrect_answers": [
        "Gigahotz",
        "Gigahetz",
        "Gigahatz"
      ]
    }
  ]
}
```


3. **Notice** the encoding with those `%20` and `%3A` symbols which represent **URL encoding** — a way to safely transmit text over the internet

4. **Understand** the structure where each question has a `question`, `correct_answer`, and `incorrect_answers` array

JSON (JavaScript Object Notation) is the universal language of **APIs**. It's how different applications share structured data over the internet. Your job as a developer is to transform this raw data into the format your game needs.

📚 **API Documentation:** For complete details about OpenTrivia Database parameters, response codes, and features, visit: https://opentdb.com/api_config.php

API Data Transformation Journey

```
Raw API Data → Your Transform Function → Game-Ready Data
```

Before (API Response):

```
{
  "question": "What%20does%20GHz%20stand%20for%3F",
  "correct_answer": "Gigahertz",
  "incorrect_answers": ["Gigahotz", "Gigahetz", "Gigahatz"]
}
```

After (Your Game Format):

```
{
  "question": "What does GHz stand for?",
  "answers": ["Gigahotz", "Gigahertz", "Gigahetz", "Gigahatz"],
  "correct": 1
}
```

⏰ Understanding Asynchronous Programming

Now let's understand **asynchronous programming** — the key to working with **APIs** and external data.

Synchronous code runs line by line, waiting for each operation to complete before moving to the next. **Asynchronous** code can start a task (like fetching data from the internet) and continue with other work while waiting for the result.

Real-World Analogy

Synchronous is like ordering at a fast-food counter where you wait for your entire order before the next person can order. Asynchronous is like a coffee shop where you order, get a number, and sit down while they prepare your drink — other customers can order while you wait.

Fetch requests to **APIs** are asynchronous because network requests take time. Your app needs to stay responsive while waiting for data from the internet. **Async/await** syntax makes asynchronous code easier to read and debug.

⚠️ Hot Module Reloading (HMR) Note

When you make changes to `trivia.js`, you may see these behaviors:

- Game returns to splash screen (normal)
- "useGame must be used within a GameProvider" error (also normal)

How to fix and continue:

1. **Refresh** the browser page manually (Ctrl+R or Cmd+R)
2. **Navigate** back to the game (**click** "Start Game")
3. **Click** a zone to test your updated code

Pro tip: Make several changes to your code, then refresh once to test them all together!

🔗 Building the Fetch Foundation

Time to connect your game to the real internet! Let's implement the core **fetch** logic.

1. **Open** `src/services/trivia.js`
2. **Replace** the alert with basic fetch logic

```
try {
  console.log("Fetching from:", url);
  const response = await fetch(url);
  const data = await response.json();
  console.log("Raw API data:", data);
} catch (error) {
  console.log("Failed to fetch questions:", error);
  return [];
}
```

3. **Test** to verify the API integration
    - **Open** DevTools by pressing F12 or right-clicking → Inspect
    - **Navigate** back to the game by clicking “Start Game”
    - **Click** a zone to test your updated code
    - **Check** the Console tab to see your fetch in action
    - **Check** the Network tab to see the actual HTTP request
4. **Add** data validation immediately after getting the data

```
if (!data.results || data.results.length === 0) {
  console.log("No questions received from API");
  return [];
}
```

Error handling and **data validation** are crucial when working with external **APIs**. Networks can fail, APIs can be down, or responses might be empty. Developers always plan for these scenarios to create robust applications.

🔄 Transforming API Data

Now let’s transform the **API** data into game-ready format. This is where the real magic happens!

1. **Add** transformation testing after the validation check

```
const firstQuestion = data.results[0];
console.log("Before transform:", firstQuestion);

const transformed = transformQuestion(firstQuestion);
console.log("After transform:", transformed);
```

Test by starting Game → clicking zone → seeing `undefined` in console → "We need to implement transformQuestion"

2. **Extract** object properties in the `transformQuestion` function

```
function transformQuestion(apiQuestion) {
  const question = apiQuestion.question;
  const incorrectAnswers = apiQuestion.incorrect_answers;
  const correctAnswer = apiQuestion.correct_answer;

  console.log("Extracted properties:", { question, incorrectAnswers, correctAnsw
}
```

Test by starting Game → clicking zone → seeing extracted properties in console

3. **Add** helper functions for decoding

```
function transformQuestion(apiQuestion) {
  const question = decodeText(apiQuestion.question);
  const incorrectAnswers = apiQuestion.incorrect_answers.map(answer => decodeTex
  const correctAnswer = decodeText(apiQuestion.correct_answer);

  console.log("Decoded data:", { question, incorrectAnswers, correctAnswer });
}
```

Test by starting Game → clicking zone → seeing decoded, formatted data

You should now see formatted game data like:

```
{
  "question": "What does GHz stand for?",
  "incorrectAnswers": ["Gigahotz", "Gigahetz", "Gigahatz"],
  "correctAnswer": "Gigahertz"
}
```

4. **Add** shuffling and index finding

```
function transformQuestion(apiQuestion) {
  const question = decodeText(apiQuestion.question);
  const incorrectAnswers = apiQuestion.incorrect_answers.map(answer => decodeTex
  const correctAnswer = decodeText(apiQuestion.correct_answer);
  const shuffledAnswers = shuffleAnswers(correctAnswer, incorrectAnswers);
  const correctIndex = shuffledAnswers.indexOf(correctAnswer);

  console.log("Shuffled answers:", shuffledAnswers);
  console.log("Correct answer is at index:", correctIndex);
}
```

Test by starting Game → clicking zone → seeing shuffled answers

5. **Return** the final game object

```
function transformQuestion(apiQuestion) {
  const question = decodeText(apiQuestion.question);
  const incorrectAnswers = apiQuestion.incorrect_answers.map(answer => decodeTex
  const correctAnswer = decodeText(apiQuestion.correct_answer);
  const shuffledAnswers = shuffleAnswers(correctAnswer, incorrectAnswers);
  const correctIndex = shuffledAnswers.indexOf(correctAnswer);

  return {
    question: question,
    answers: shuffledAnswers,
    correct: correctIndex
  };
}
```

Test by starting Game → clicking zone → seeing complete transformed object!

You should now see complete game data like:

```
{
  "question": "What does CPU stand for?",
  "answers": [
    "Central Process Unit",
    "Computer Personal Unit",
    "Central Processing Unit",
    "Central Processor Unit"
  ],
  "correct": 2
}
```

6. **Complete** the fetchQuestions integration by replacing the test logging

```
// Transform API response into game-ready format
const questions = data.results.map(apiQuestion => transformQuestion(apiQuestion)
console.log("All transformed questions:", questions);
return questions;
```

   Test by clicking zone → see array of properly formatted questions!

Data transformation is a core skill in web development. APIs rarely return data in exactly the format your application needs. The `map()` method is perfect for transforming arrays of data, and helper functions keep your code clean and reusable.

🧪 Testing Your API Integration

Let's test your complete **API** integration and clean up the debugging code.

1. **Remove** console logs from your functions to clean up the code

```
export async function fetchQuestions(zoneId, count = null) {
  const zone = getZoneById(zoneId);
  if (!zone) return [];

  const questionCount = count || zone.questionCount;
  const url = buildApiUrl(zone, questionCount);

  try {
    const response = await fetch(url);
    const data = await response.json();

    if (!data.results || data.results.length === 0) {
      return [];
    }

    const questions = data.results.map(apiQuestion => transformQuestion(apiQuest
    return questions;

  } catch (error) {
    console.log("Failed to fetch questions:", error);
    return [];
  }
}
```

2. **Test** to verify the complete data flow
    - Game resets to splash screen
    - **Navigate** to the game by clicking “Start Game”
    - **Click** different zones to test various categories and difficulties
    - **Verify** the data flow using React DevTools
        - **Open** DevTools → Components tab
        - **Find** GameProvider and examine `currentQuestions` state
        - **Click** zones and watch the state populate with your transformed questions

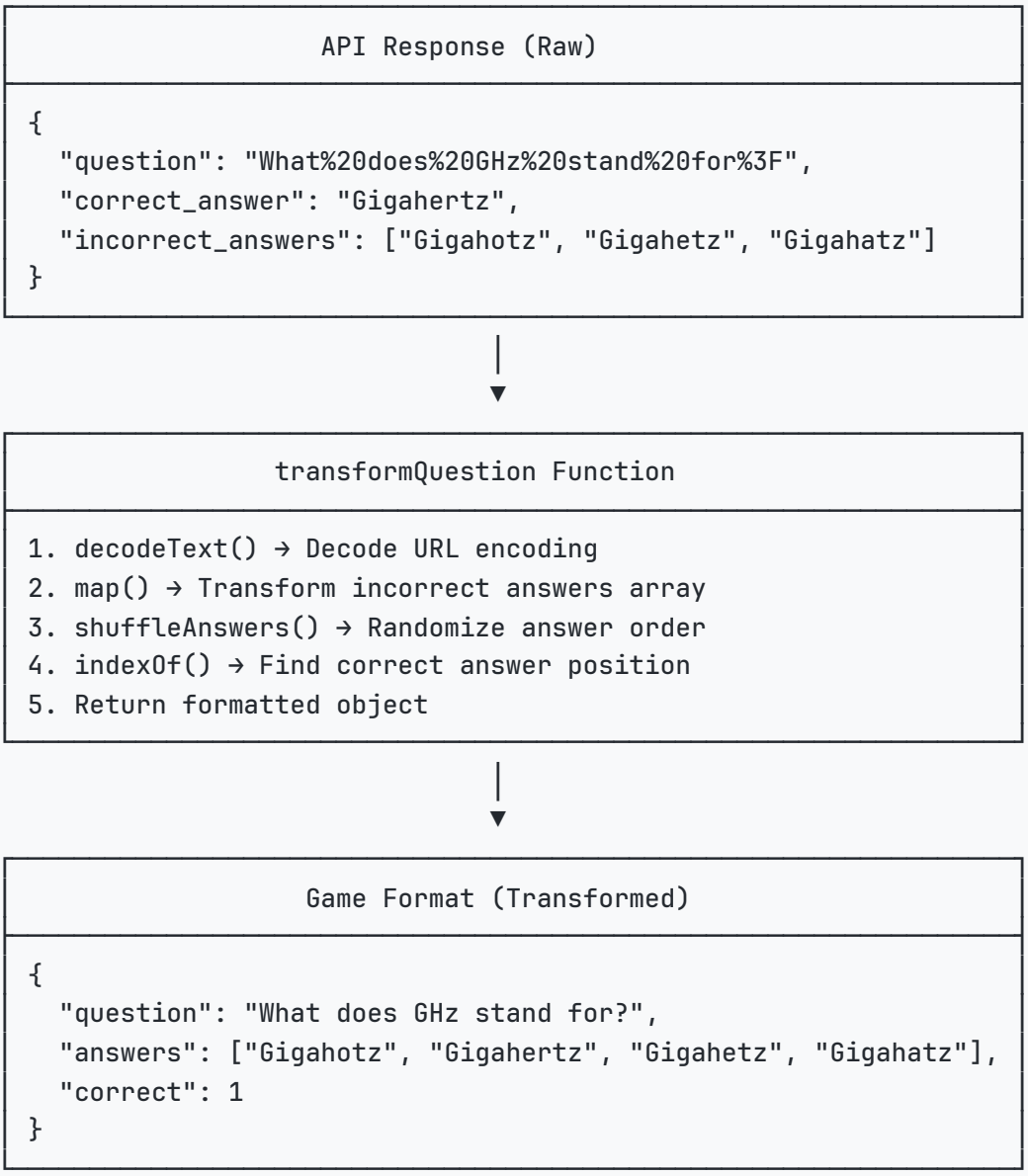
Testing is crucial in web development. You’ve just built a complete API integration that fetches real data from the internet, transforms it, and feeds it into your game’s state management system. This is the foundation that will power your quiz functionality in future sessions.

🔄 Understanding the Complete Data Flow

Let's trace the complete journey from zone click to loaded questions:

```
graph TD
    A[User clicks zone] --> B[GameMap handleZoneClick]
    B --> C[GameContext loadQuestionsForZone]
    C --> D[trivia.js fetchQuestions]
    D --> E[buildApiUrl helper]
    E --> F[fetch from OpenTrivia DB]
    F --> G[response.json parsing]
    G --> H[data.results.map transformation]
    H --> I[transformQuestion for each item]
    I --> J[decodeText + shuffleAnswers helpers]
    J --> K[Formatted game objects returned]
    K --> L[GameContext updates currentQuestions state]
    L --> M[React re-renders with new data]
```

Data Transformation Flow



Understanding the complete data flow helps you debug issues and build more complex features. You've created a robust pipeline that handles API requests, data transformation, and state management — the same patterns used in modern web applications.

📚 Essential Terms

Quick reference for all the API and asynchronous programming concepts you just learned:

Term	Definition	Why it matters
🌐 Application Programming Interface (API)	A set of rules and protocols that allows different software applications to communicate with each other.	Your trivia game uses the OpenTrivia Database API to fetch real questions, transforming static zones into dynamic content.
📋 JSON	JavaScript Object Notation — a text format for exchanging structured data between applications.	OpenTrivia Database returns question data in JSON format, which your `transformQuestion` function converts to game format.
📨 HTTP request	A message sent from your application to a server asking for specific data or resources.	Each zone click triggers an HTTP request to OpenTrivia Database with your zone's specific parameters.
📡 Fetch API	A modern JavaScript interface for making HTTP requests to servers and APIs.	Your `fetchQuestions` function uses `fetch` to request trivia data based on each zone's category and difficulty settings.
🔗 Uniform Resource Identifier (URI)	A string that uniquely identifies a resource on the internet, which can be the same as or part of a URL.	Your `buildApiUrl` function creates URIs that uniquely identify the OpenTrivia API endpoint with specific parameters for each zone.
🔐 URL encoding	A method of converting characters into a format safe for transmission over the internet.	Question text comes URL-encoded from the API — your `decodeText` function converts it to readable game text.

⏰ asynchronous programming	Code execution that doesn't block while waiting for operations to complete, allowing other code to run.	Your game stays responsive while fetching questions — users can still interact with the UI during network requests.
🔄 async/await	JavaScript syntax that makes asynchronous code look and behave like synchronous code.	Your `fetchQuestions` function uses `async/await` to handle API requests in a readable, step-by-step manner.
🤝 promise	A JavaScript object representing the eventual completion or failure of an asynchronous operation.	Every `fetch` call returns a promise — your game will eventually get questions or handle the error gracefully.

🤖 Ask the AI — Generating Dynamic Questions

You just built a complete API integration with data fetching, transformation, and error handling — excellent work!

Now let's deepen your understanding of APIs, asynchronous programming, and data transformation patterns. Here are the most impactful questions to ask your AI assistant about today's session:

- **What makes APIs so important in modern web development?**
- **Why do APIs often return data in formats that need transformation?**
- **What are the benefits of separating data fetching from data transformation?**
- **How does the Fetch API handle network errors and what should developers do about them?**
- **How do helper functions like `decodeText` and `shuffleAnswers` improve code quality?**
- **How does the return keyword work in JavaScript functions, and can you explain it with a non-tech example?**
- **What is functional programming?**